### Part 1 – Submitter Information

<table>
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<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted:</th>
<th>10/17/2019</th>
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</thead>
<tbody>
<tr>
<td>Name: DentalCodeology Consortium</td>
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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

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<tbody>
<tr>
<td>If Yes, Name: The Oral Cancer Foundation</td>
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### Part 2 – Submission Details

1. **Action** (Mark one only)
   - New ☒
   - Revise ☐
   - Delete ☐
   - Affected Code (Revise or Delete only) ☐

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – **blue underline**; deleted text – **red strike-through**; unchanged text – **black**)

   **Nomenclature Required for all “New”**
   - An enhanced oral cancer examination to include a comprehensive risk assessment, visual and tactile, intra/extra oral and oropharyngeal screening to identify abnormalities

   **Descriptor Optional for “New”; enter “None” if no descriptor**
   - This procedure involves a detailed risk assessment to include a verbal inquiry, and/or an updated or new written health history, with a visual inspection using operatory lighting/loupes, and palpation, which are the necessary techniques used in oral and oropharyngeal cancer evaluations.

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**NOTICE TO PREPARER AND SUBMITTER:**

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### 3. Rationale for this request; your persuasive argument for CMC acceptance

*(Required for any type of requested action – New; Revise; Delete)*

**From ADA News October 1, 2019:** Resolution 65H-2019 amended the American Dental Association policy on early detection and prevention of oral cancer to include oropharyngeal cancer and **cover all patients**, not just those previously thought to be at an increased risk because of tobacco and alcohol use. This revised policy aligns with the Center for Disease Control and Prevention guidelines. According to the ADA “**Every patient should be screened by their dentist and dental hygienist for possible early signs and symptoms of oral cancer, including HPV-associated oropharyngeal ones.**”


In 2019 approximately 53,000 Americans will be diagnosed with oral/oropharyngeal cancer. Breaking down to 145.2 Americans diagnosed every day, and **6 Americans diagnosed every hour**. [https://oralcancerfoundation.org/facts/](https://oralcancerfoundation.org/facts/)

**Video on ADA website:** [https://www.youtube.com/watch?v=_CSwFT42xCo#action=share](https://www.youtube.com/watch?v=_CSwFT42xCo#action=share) In this video on the ADA website, an oropharyngeal cancer survivor explains how her new dentist performed an extensive oral exam and external exam, and discovered a swollen lymph node. She was referred, and subsequently diagnosed with oropharyngeal cancer.

“...early diagnosis is associated with the best outcomes. Regular dental check-ups that include an examination of the entire head and neck can be vital in detecting cancer early.”


**Oral and Oropharyngeal cancer will cause more than 9,750 deaths this year.** Of those diagnosed, approximately 57%, will be alive in 5 years. Early detection gives an 83% chance of survival after five years. This statistic has not improved in decades. This increase has changed due to the rising of HPV16 causing cancers. [https://oralcancerfoundation.org/facts/](https://oralcancerfoundation.org/facts/)

Head and neck cancers are of particular interest to health care providers, their patients, and those paying for health care services, because they have a high morbidity, they are extremely expensive to treat, and of the survivors only 48% return to work. Earlier identification of cancers by patients and providers may potentially decrease health care costs, morbidity and mortality. The overall cost burden of OC/OP/SG cancer is significant and is experienced by all payers, Medicare, Medicaid, the employer, and the individual. [https://headandneckoncology.biomedcentral.com/articles/10.1186/1758-3284-4-15](https://headandneckoncology.biomedcentral.com/articles/10.1186/1758-3284-4-15)

Squamous cell carcinoma of the mobile tongue appears to be progressively increasing in incidence, particularly in young adults and especially in females. No specific etiology has been identified. [https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6036956/](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6036956/)

Screening is looking for cancer before a person has any symptoms. This can help find cancer at an early stage. When **abnormal tissue** or cancer is found early, it may be easier to treat. By the time symptoms appear, cancer may have begun to spread. [https://seer.cancer.gov/statfacts/html/oralcav.html](https://seer.cancer.gov/statfacts/html/oralcav.html)

A formalized oral/oropharyngeal cancer screening is beneficial for all individuals. **Incentivizing dental professionals for their vigilance in this regard is aligned with good preventive dental care and recognizes the patient-clinician partnership in achieving improved overall health.** Furthermore, formal procedure coding and reimbursement of this process acknowledges the clinical team’s added effort **and** their liability as they try to achieve the best possible clinical outcomes for every patient.

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6. Additional Comment or Explanation:

CDT Procedure Codes D0120 and D0150 both state “an evaluation for oral cancer where indicated” allowing this evaluation to be optional. Code D0180 states, “this evaluation, may include oral cancer evaluation”, also allowing this evaluation to be optional. An enhanced oral cancer examination should not be optional.

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A. Contact Information (Action Requestor)          Date Submitted: 10/17/2019

| Name:          | DentalCodeology Consortium |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: | The Oral Cancer Foundation |
| No > ☐ |

Part 2 – Submission Details

1. Action (Mark one only)          New ☐ Revise ☒ Delete ☐

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<th>D0120</th>
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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature Required for all “New”</th>
<th>periodic oral evaluation – established patient</th>
</tr>
</thead>
</table>

| Descriptor Optional for “New”; enter “None” if no descriptor | An evaluation performed on a patient of record to determine any changes in the patient’s dental and medical health status since a previous comprehensive or periodic evaluation. This includes a an oral cancer evaluation and periodontal screening, where indicated and may require interpretation of information acquired through additional diagnostic procedures. Report additional diagnostic procedures separately. |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Rationale for this request is pursuant to the request for a new procedure code for an enhanced oral cancer examination to include a comprehensive risk assessment, visual and tactile, intra/extra oral and oropharyngeal screening to identify abnormalities. Supporting evidence for the requested new code applies to the rationale for amending the verbiage in this code.

4. Complete a) – c) only if Action Request is for a New CDT Code

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<tr>
<td>b) Procedure technical description</td>
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6. Additional Comment or Explanation:

None
CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: 10/17/2019
---|---
Name: DentalCodeology Consortium

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☒ | If Yes, Name: The Oral Cancer Foundation |
| No | ☐ |

Part 2 – Submission Details

1. Action (Mark one only) | New | ☐ | Revise | ☒ | Delete | ☐ | Affected Code (Revise or Delete only) | D0150

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature Required for all “New” | comprehensive oral evaluation – new or established patient |
| Descriptor Optional for “New”; enter “None” if no descriptor | Used by a general dentist and/or a specialist when evaluating a patient comprehensively. This applies to new patients; established patients who have had a significant change in health conditions or other unusual circumstances, by report, or established patients who have been absent from active treatment for three or more years. It is a thorough evaluation and recording of the extraoral and intraoral hard and soft tissues. It may require interpretation of information acquired through additional diagnostic procedures. Additional diagnostic procedures should be reported separately. This includes an evaluation for oral cancer where indicated, the evaluation and recording of the patient’s dental and medical history and a general health assessment. It may include the evaluation and recording of dental caries, missing or unerupted teeth, restorations, existing prostheses, occlusal relationships, periodontal conditions (including periodontal screening and/or charting), hard and soft tissue anomalies, etc. |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Rationale for this request is pursuant to the request for a new procedure code for an enhanced oral cancer examination to include a comprehensive risk assessment, visual and tactile, intra/extra oral and oropharyngeal screening to identify abnormalities. Supporting evidence for the requested new code applies to the rationale for amending the verbiage in this code.

4. Complete a) – c) only if Action Request is for a New CDT Code | Mark if Revise or Delete [“a) - c)” are not applicable] | ☒ |

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**CDT CODE ACTION REQUEST**

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6. Additional Comment or Explanation: None

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: The Oral Cancer Foundation |
| No > ☐   |                                           |

Part 2 – Submission Details

1. **Action** (Mark one only)
   - New [ ]
   - Revise ☒
   - Delete [ ]
   - Affected Code (Revise or Delete only) D0180

2. **Nomenclature**
   - Required for all "New"

   - **comprehensive periodontal evaluation – new or established patient**

   **Descriptor**
   - Optional for "New"; enter "None" if no descriptor

   - This procedure is indicated for patients showing signs and symptoms of periodontal disease and for patients with risk factors such as smoking or diabetes. It includes evaluation of periodontal conditions, probing and charting, evaluation and recording of the patient’s dental and medical history and general health assessment. It may include the evaluation and recording of dental caries, missing or unerupted teeth, restorations, and occlusal relationships. and oral-cancer-evaluation.

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)

   Rationale for this request is pursuant to the request for a new procedure code for an enhanced oral cancer examination to include a comprehensive risk assessment, visual and tactile, intra/oral and oropharyngeal screening to identify abnormalities. Supporting evidence for the requested new code applies to the rationale for amending the verbiage in this code.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - Mark if Revise or Delete [“a) - c)” are not applicable] ☒
   - a) CDT Code currently used to report the procedure

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6. Additional Comment or Explanation:

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 11/1/2019

| Name:          | Jean L Creasey DDS |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☒ | If Yes, Name: The CAMBRA Coalition |

Part 2 – Submission Details

1. Action (Mark one only) New ☐  Revise ☒  Delete ☐  Affected Code (Revise or Delete only) D0150

Nomenclature Required for all "New"

| comprehensive oral evaluation new or established patient |

Used by a general dentist and/or a specialist when evaluating a patient comprehensively. This applies to new patients; established patients who have had a significant change in health conditions or other unusual circumstances, by report, or established patients who have been absent from active treatment for three or more years. It is a thorough evaluation and recording of the extraoral and intraoral hard and soft tissues. It may require interpretation of information acquired through additional diagnostic procedures. Additional diagnostic procedures should be reported separately.

This includes an evaluation for oral cancer where indicated, the evaluation and recording of the patient’s dental and medical history and a general health assessment. It may include the evaluation and recording of dental caries (including screening for caries risk), missing or unerupted teeth, restorations, existing prostheses, occlusal relationships, periodontal conditions (including periodontal screening and/or charting), hard and soft tissue anomalies, etc.

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(Required for any type of requested action – New; Revise; Delete)

An addition of the words “screening for caries risk” to the existing code where recording of dental caries is already mentioned.

Dentists determine best treatment plans and successful prevention strategies when they understand the underlying factors that led to the disease state of the patient. Screening is the first step in a systematic analysis of a patient’s caries risk status. Identifying and addressing risk factors are key to lowering a patient’s caries disease rate. Evidence-based decision making validates this approach. Caries disease is multifactorial and like periodontal disease, should include similar wording for risk factor screening in the ADA CDT code. Screening for (identifying) disease risk factors informs prevention interventions. This is distinct from detecting caries disease, which informs restorative options. Dentistry has a proud history of being prevention-focused and our CDT codes should reflect this approach.

### 4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
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<th>CDT Code currently used to report the procedure</th>
<th>Mark if Revise or Delete</th>
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<tr>
<td>D0150</td>
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**a) CDT Code currently used to report the procedure**

D0150

**b) Procedure technical description**

**Clinical example**

A new patient presents for dental examination and services. Included in the oral evaluation are procedures used to screen for caries risk status. Identifying risk factors such as frequent snacking, acid reflux, xerostomia and poor oral hygiene will determine appropriate prevention and treatment protocols. For example, because of a likely poor prognosis, patients with high risk or extreme high risk (xerostomic) would not be good candidates for either orthodontic treatment or complex fixed prosthetic treatments.

### Part 3 – Additional Information

**5. Supporting documentation or literature:**

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Screening is a critical means to identify patients who require further evaluation and intervention. More detailed and comprehensive caries risk assessment can lead to targeted interventions with expected reduction in caries experience. (see codes: DO601-DO603). This is especially important for high and extreme risk individuals. The current code language for O150 mentions identifying the existence of caries disease but not for identifying risk factors that if left unaddressed, will lead to disease manifestations.


Fontana M, Zero D.T., J Am Dent Assoc. 2006 Sep;137(9):1231-9

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# CDT Code Action Request

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| Yes > ☐ | If Yes, Name: The Oral Cancer Foundation |
| No > ☒   |                                           |

## Part 2 – Submission Details

1. **Action** (Mark one only)
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   - Revise ☒
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2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature Required for all “New”</th>
<th>screening of a patient</th>
</tr>
</thead>
</table>

| Descriptor Optional for “New”; enter “None” if no descriptor | A screening, including state or federally mandated screenings, to determine an individual’s need to be seen by a dentist or qualified healthcare provider as determined by their state practice acts for diagnosis. |

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)

   *Per the Code Maintenance Committee (p. iv in CDT 2019) other individuals may report any of the listed CDT Codes as long as they are delivering procedures and services within the scope of their state law." Adding this intent on p. iv directly to the D0190 code descriptor will make it less restrictive and allow those qualified individuals to provide this service. Across the country, this service is being provided by school nurses, dental public health hygienists, direct access hygienists, dental therapists, and others but they are restricted from using this Procedure Code since it states individuals “need to be seen by a dentist”.**

**AT END OF THIS SECTION, PLEASE READ LETTERS FROM 2 QUALIFIED HEALTHCARE PROFESSIONALS WHO ARE IMPACTED BY THE RESTRICTIONS IN D0190**

**ADDITIONAL REFERENCES SUPPORT THIS SUBMISSION, INCLUDING THE ADA:**

- The purpose of the CDT Code is to achieve uniformity, consistency and specificity in accurately documenting dental treatment. One use of the CDT Code is to provide for the efficient processing of dental claims, and another is to populate an Electronic Health Record. [https://www.ada.org/en/publications/cdt](https://www.ada.org/en/publications/cdt)
- ICD-10-CM Official Guidelines for Coding and Reporting FY 2019 (October 1, 2018 - September 30, 2019) In the context of these guidelines, the term provider is used throughout the guidelines to mean physician or any qualified health care practitioner who is legally accountable for establishing the patient’s diagnosis. Only this

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- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click.”
- Completed Request **must** be submitted in unprotected MSWord® format via email to [dentalcode@ada.org](mailto:dentalcode@ada.org).
- A submission will be returned for correction if it is: a) **not** an unprotected MS Word document; b) **not** on the current Action Request format; or c) **it** is missing “Required” information.
Children should receive priority preference; therefore, the most effective and economical utilization of dental therapists will be as **salaried employees in school-based programs**, beginning in underserved rural areas and inner cities. Children suffer disproportionately and most severely from dental diseases. Many countries have school-based dental therapist programs to meet children’s primary oral health care needs. 


(Sec. 2) This bill amends the Public Health Service Act to authorize the Department of Health and Human Services to award grants for oral health initiatives conducted by state, local, and tribal entities, including initiatives aimed at preventing dental disease and reducing barriers to dental services.

(Sec. 3) The bill also reauthorizes through FY2023 and revises the grant program regarding dental health professional shortage areas, which is administered by the Health Resources and Services Administration. The bill authorizes states to use grant funds for: (1) dental homes for children and adults, and (2) **initiatives that reduce emergency department visits for certain dental services**.

Supporting Facts- This bipartisan legislation, introduced by Congresswoman Robin Kelly (D-IL) and Congressman Mike Simpson, DMD (R-ID), to provide **essential oral and dental health services to underserved communities**.

**The Action for Dental Health Act** targets federal funding to provide **vulnerable populations**, especially children, seniors and those living in rural and urban communities with dental care. 

Emergency rooms throughout the country have seen a dramatic increase in the number of patients seeking treatment for dental pain, from 1.1 million in 2000 to 2.1 million in 2010 costing the healthcare system 1.6 billion annually. 1.65 million ER visits can be referred to dental clinics. 

**ADH comprises eight initiatives** designed to address specific barriers to care, and getting people out of the emergency room and into the dental chair is one of its primary goals. 

**Dentists also have a long history of increasing their efficiency by delegating tasks to dental assistants, expanded function dental assistants, dental hygienists, and laboratory technicians.**

**http://www.jdentaled.org/content/76/8/1061**

There is a growing body of research supporting the contribution of poor oral health to the development and severity of multiple medical conditions and diseases. For example: bacterial endocarditis, low birth rate and premature birth, heart disease, and even Alzheimer's disease. 

More than 63 million people in the United States live in areas with dentist shortages, and 60 percent of children on Medicaid did not see a dentist in 2016. 

**The healthcare institutions and systems can produce measurably beneficial impacts on individual and community health, and by so doing, lower preventable demand on the healthcare system.** To increase their power to influence health, health professionals must ask themselves, "How do we more effectively intervene ‘upstream’ to impact the forces that contribute to high rates of chronic and other diseases?**

In 2016, Institute for Healthcare Improvement (IHI) released a white paper called **Achieving Health Equity: A Guide for Health Care Organizations** that presents a framework. It takes a **systematic look at how health care organizations affect health equity**:
CDT CODE ACTION REQUEST

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WITTEN TESTIMONY #1

Dear Committee Members,

My name is Christy Jo Fogarty and I am a licensed dental professional and President of the Minnesota Board of Dentistry. I also serve as a member of the Dental Coding Consortium (DCC) work group.

As you consider changes to the CDT for 2020, I would like you to consider making the language in the code book to reflect changes to how the practice of dentistry is moving forward. In several areas of the CDT guide references are made that a dentist must perform the procedure, although other licensed dental care providers actually may be completing the procedure as allowed by dental practice acts throughout the country. In many cases supportive members of the dental team provide direct patient care yet cannot bill directly. Often dental hygienists cannot bill directly because the code specifically says that only a dentist can perform the service.

A stark example of this is code 0190-screening of a patient. Most often these are dental screening done for Head Start programs to fulfill federal requirements and, in many states, like the state of Minnesota, these can be done by not only dentists but are allowed to be completed by a licensed dental hygienist or a licensed dental therapist. If billing is not allowed for providers other than the named dentist in this code it limits the number of children who will receive this service. In this example, children most in need and at the highest risk for dental caries, are the ones who will go without a much-needed screening.

As dentistry continues to evolve and create new practitioners and collaboration within the field of dentistry, we need to change and adapt as well. Much like the American Medical Association (AMA) does not limit the flexibility of its team with language limiting services to only doctors, dentists should not be limited by the language of their codes.

It is very important to move dentistry forward to remove title specific language to allow for the further expansion of the dental teams and the scope of practice that continues to expand for dental professionals. A simple change to add dental provider can make coding much simpler as dentistry continues to evolve and adapt both in scope of practice and multidiscipline integrated practice.

Please feel free to contact me with any question or concerns.

Respectfully,
Christy Jo Fogarty, LDH, ADT, BSDH, MSOHP
President, MN Board of Dentistry
(612) 867-8875

WITTEN TESTIMONY #2

September 16th, 2019
Tommie Kell, EPDH
Compassionate Dental Wellness
PO Box 816
Jacksonville, OR 97530
(541) 817-6453

To: All individuals with a role that could initiate change in the field

First, I would like to thank you for taking time to read this letter, as it affects thousands of dental hygienists in the country, and therefore hundreds of thousands of citizens in need of dental care.

I have been in the dental industry for almost 16 years, and a hygienist approximately 9 years. After working in private practice for about 8 of those years, I made the decision to open my own independent practice to bring access to care to those that were in need. My focus is comprehensive, personalized care. I am the only practicing Expanded Practice Dental Hygienist in my part of the state. This also means that the need in my area is very substantial.

Working as an independent hygienist has been the most rewarding part of my career so far, yet it has come with so many obstacles. The biggest obstacle is the inconsistent definition state to state of an independent hygienist. This has created confusion for insurance companies countrywide and they have taken on a stance where some do not recognize an independent hygienist as a provider and therefore, do not feel that they need to reimburse. I will give an example: I have a patient and her family who has Principal Dental Insurance. We are based in Oregon, while the...
insurance company is based in Des Moines, Iowa. After providing procedures for her and her family, the insurance company decided that since Iowa has different stipulations regarding an independent dental hygienist in their state, they have decided not to reimburse at all. The interesting piece is that Principal is a partner in the Lifelong Smiles Coalition helping to bring access to care to Iowans. They are certainly very aware of the need. I have discussed this matter with the Iowa Board of Dentistry, Oregon Board of Dentistry, the ADHA and have still not been able to make headway. This has taken hours upon hours away from serving my patients.

Another example is the code D0180, which states it is a comprehensive periodontal exam. I use this with all new patients that present with periodontal disease to assess for treatment. Some insurance companies will reimburse for this code, others state I am not a “legal provider” and will deny the claim. Not only is this a terrible inconvenience further preventing patients getting the correct care, but it also gives my business the loss of credibility as it’s confusing to patient’s why I am not considered a “legal provider” with insurance companies even though my credentialing is legal. In a small town like mine, a new business, you can see how this can be detrimental.

I have been denied by dental supply companies, insurance companies, medical credit companies and many others because of their lack of understanding and consistency state to state on the role and legitimacy of an independent hygienist as well as wording in the CDT. Thank you for your consideration in making these changes!

Tommie Kell, EPDH

<table>
<thead>
<tr>
<th>4. Complete a) – c) only if Action Request is for a New CDT Code</th>
<th>Mark if Revise or Delete</th>
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<td>a) CDT Code currently used to report the procedure D0190</td>
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<tr>
<td>b) Procedure technical description</td>
<td></td>
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<tr>
<td>c) Clinical scenario</td>
<td></td>
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</tbody>
</table>

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided.
   - All material must be submitted in electronic format.

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6. Additional Comment or Explanation:

None

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Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: 11/1/2019

Name: Betsy Davis DMD MS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☒ | If Yes, Name: American College of Prosthodontists |
|     |     | 211 E. Chicago Avenue, Suite 1000 |
|     |     | Chicago IL 60611 |

Part 2 – Submission Details

1. Action (Mark one only) | New ☒ Revise ☐ Delete ☐

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   Nomenclature: scanning for diagnostic purposes

   Descriptor: None

3. Rationale for this request; your persuasive argument for CMC acceptance

   The clinical practice of dentistry is transforming more into the digital world with many practices using virtual design software. In many instances, the dental arches may be scanned so the intraoral images can be uploaded into the design software to aid in the diagnosing of an adverse oral condition. This code is for scanning intraorally in the clinical operatory. It is a separate code from the virtual functional analyses.

4. Complete a) – c) only if Action Request is for a New CDT Code

   a) CDT Code currently used to report the procedure D0999

   b) Procedure technical description

   Intraoral scanning in which the scan will be imported into the design software.

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c) Clinical scenario

This proposal is for those clinical scenarios in which the maxilla and mandible are scanned in order to diagnose an adverse oral condition, monitor progress of disease, or to maintain digital records of patients. An intraoral scan would be performed versus making an impression for the diagnostic cast which is already a listed code. For example, if a patient has missing teeth and supra-eruption of the opposing teeth is suspected, multiple scans taken over time may be necessary to determine if supra-eruption is happening. The proposed code is for the intraoral scan only.

Part 3 – Additional Information

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   - If protected by copyright, written authorization to reprint and distribute must be provided
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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.
Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted:  11/1/2019

Name:  Betsy Davis DMD MS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name:  American College of Prosthodontists  211 E. Chicago Avenue, Suite 1000  Chicago IL 60611 |
| No > ☐ |

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)  

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature  Required for all “New” |
| Laboratory surface scanning for diagnostic purposes |

| Descriptor  Optional for “New”; enter “None” if no descriptor |
| None |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The clinical practice of dentistry is transforming more into the digital world with many practices using virtual diagnostic software. In many instances, practices may scan a diagnostic cast (which is a listed code) into the virtual design software to diagnose an adverse oral condition. This code is for scanning an existing diagnostic cast in the laboratory to obtain a 3D image. It is a separate code from the virtual functional analyses.

4. Complete a) – c) only if Action Request is for a New CDT Code  Mark if Revise or Delete [“a) – c)” are not applicable]

   a) CDT Code currently used to report the procedure  D0999

   b) Procedure technical description

Scanning in the laboratory a diagnostic cast into the design software.

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This proposal is for those clinical scenarios in which a diagnostic cast has to be scanned in order to diagnose an adverse oral condition or to keep records to monitor progression of disease overtime. For example, if a patient has a loss of vertical dimension, the diagnostic casts have to be scanned into the software in order to design a solution to the clinical issue. The proposed code is for the scanning of the diagnostic cast only.

**Part 3 – Additional Information**

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.

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**NOTICE TO PREPARE AND SUBMITTER:**

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# CDT Code Action Request

## Part 1 – Submitter Information

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<tr>
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<tbody>
<tr>
<td>Name: Betsy Davis DMD MS</td>
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### B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

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<tr>
<th>Yes</th>
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<th>If Yes, Name: American College of Prosthodontists</th>
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<tr>
<td>No</td>
<td>☐</td>
<td>211 E. Chicago Avenue, Suite 1000</td>
</tr>
<tr>
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## Part 2 – Submission Details

1. **Action** (Mark one only)

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2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   - **Nomenclature Required for all “New”**
     - virtual diagnostic functional orofacial analysis

   - **Descriptor Optional for “New”, enter “None” if no descriptor**
     - None

3. **Rationale for this request; your persuasive argument for CMC acceptance** (Required for any type of requested action – New; Revise; Delete)

   Currently, the CDT does not have any codes to address the virtual analysis of patients with complex maxillo-mandibular relationships. For example, patients with wear who have lost vertical dimension require much time diagnosing the effect of wear on the loss of vertical dimension and the need for virtual design and virtual assessment of potential treatment options. The virtual diagnostic functional orofacial analysis procedure addresses the maxilla-mandibular relationship and its effect on function and occlusion and is used to diagnose the effect of disease on the maxilla-mandibular relationship with respect to function over time. Finally, it could also be used to monitor over time conditions affecting the oral cavity.

4. **Complete a) – c) only if Action Request is for a New CDT Code**

   - a) **CDT Code currently used to report the procedure**
     - D0999

   - Mark if Revise or Delete [“a) - c) are not applicable]

## Notice to Preparer and Submitter:

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b) Procedure technical description

The procedure consists of using surface scans of the maxilla and mandible, over time, to assess occlusion, tooth wear and tooth conditions. It also involves virtual planning of potential treatments to aid the clinicians in diagnosing the etiology and correction of adverse clinical presentation.

c) Clinical scenario

The clinical scenario could involve, but, not be limited to patients that exhibit loss of vertical dimension, broken down teeth, or missing teeth. Several designs are developed virtually to correct these clinical presentations. The various designs would then be presented to the patient to finalize a plan that could be used to correct the adverse oral condition.

### Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a”) **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.

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## Part 1 – Submitter Information

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<td>Name: Council on Dental Benefit Programs</td>
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<th>B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?</th>
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## Part 2 – Submission Details

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<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
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<tr>
<td>The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.</td>
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- **A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.**
b) Procedure technical description

Radiographic images are captured in the same manner as currently performed when delivering procedure D0330. However, the image capture only procedure does not include interpretation.

c) Clinical scenario

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

---

### Part 3 – Additional Information

<table>
<thead>
<tr>
<th>5. Supporting documentation or literature:</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

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<td>(If “b)” is “Yes”)</td>
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<th>6. Additional Comment or Explanation:</th>
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### Part 1 – Submitter Information

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<tr>
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<th>Date Submitted: 10/31/2019</th>
</tr>
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<tbody>
<tr>
<td>Name: Council on Dental Benefit Programs</td>
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<tbody>
<tr>
<td>Yes &gt; ☒ If Yes, Name: American Dental Association / Council on Dental Benefit Programs</td>
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<td>No &gt; ☐</td>
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### Part 2 – Submission Details

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<th>Delete</th>
<th>Affected Code (Revise or Delete only)</th>
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<tbody>
<tr>
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<tr>
<td>Delete ☐</td>
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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
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<th>Nomenclature Required for all “New”</th>
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<tr>
<td>2-D cephalometric radiographic image – image capture only</td>
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<table>
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<th>Descriptor Optional for “New”; enter “None” if no descriptor</th>
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<tr>
<td>None</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance

(Required for any type of requested action – New; Revise; Delete)

The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] ☐

a) CDT Code currently used to report the procedure D0999

b) Procedure technical description

Radiographic images are captured in the same manner as currently performed when delivering procedure D0340. However, the image capture only procedure does not include interpretation.

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c) Clinical scenario

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

Part 3 – Additional Information

5. Supporting documentation or literature:
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   - All material must be submitted in electronic format.

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<tr>
<td>Yes □</td>
<td>No □</td>
<td>No □</td>
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<tr>
<td>No ☒</td>
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</table>

6. Additional Comment or Explanation:
   None

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**CDT CODE ACTION REQUEST**

**Part 1 – Submitter Information**

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<tbody>
<tr>
<td>If Yes, Name: American Dental Association / Council on Dental Benefit Programs</td>
<td></td>
</tr>
</tbody>
</table>

**Part 2 – Submission Details**

1. **Action** (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only) ☐

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – *blue underline*; deleted text – *red strike-through*; unchanged text – *black*)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Descriptor</th>
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<tr>
<td>Required for all &quot;New&quot; 2-D oral/facial photographic image obtained intra-orally or extra-orally – image capture only</td>
<td>None</td>
</tr>
</tbody>
</table>

3. **Rationale for this request; your persuasive argument for CMC acceptance**

   The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 *interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.*

4. **Complete a) – c) only if Action Request is for a New CDT Code**

<table>
<thead>
<tr>
<th>a) CDT Code currently used to report the procedure</th>
<th>Mark if Revise or Delete [&quot;a) - c&quot;] are not applicable</th>
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<tr>
<td>D0999</td>
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</table>

<table>
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<tr>
<th>b) Procedure technical description</th>
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</thead>
<tbody>
<tr>
<td>Radiographic images are captured in the same manner as currently performed when delivering procedure D0350. However, the image capture only procedure does not include interpretation.</td>
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**c) Clinical scenario**

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

**Part 3 – Additional Information**

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

None

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/31/2019

| Name:     | Council on Dental Benefit Programs |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes >     | ☒ If Yes, Name: American Dental Association / Council on Dental Benefit Programs |
| No >      | ☐ |

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature Required for all “New” | 3-D photographic image – image capture only |
| Descriptor Optional for “New”; enter “None” if no descriptor | None |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. Complete a) – c) only if Action Request is for a New CDT Code D0999

a) CDT Code currently used to report the procedure
b) Procedure technical description

Radiographic images are captured in the same manner as currently performed when delivering procedure D0351. However, the image capture only procedure does not include interpretation.

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**CDT Code Action Request**

### c) Clinical scenario

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### Part 3 – Additional Information

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CDT CODE ACTION REQUEST

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| Name:                  | Council on Dental Benefit Programs |

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| Yes > ☒ | No > ☐ | If Yes, Name: | American Dental Association / Council on Dental Benefit Programs |

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)

| Nomenclature | Required for all "New" | extra-oral posterior dental radiographic image – image capture only |
| Descriptor | Optional for "New"; enter "None" if no descriptor | Image limited to exposure of complete posterior teeth in both dental arches. This is a unique image that is not derived from another image. |

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. Complete a) – c) only if Action Request is for a New CDT Code  | Mark if Revise or Delete ["a) - c") are not applicable] ☐

| a) CDT Code currently used to report the procedure | D0999 |

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**PART 2 – ACTION REQUEST**

**b) Procedure technical description**

Radiographic images are captured in the same manner as currently performed when delivering procedure D0251. However, the image capture only procedure does not include interpretation.

**c) Clinical scenario**

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

---

**PART 3 – ADDITIONAL INFORMATION**

5. Supporting documentation or literature:
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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

**Nomenclature**

- intraoral – occlusal radiographic image – image capture only

**Descriptor**

- None

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. Complete a) – c) only if Action Request is for a New CDT Code [“a) - c)” are not applicable] □

a) CDT Code currently used to report the procedure

D0999

b) Procedure technical description

Radiographic images are captured in the same manner as currently performed when delivering procedure D0240. However, the image capture only procedure does not include interpretation.

---

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c) Clinical scenario

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

Part 3 – Additional Information

5. Supporting documentation or literature:
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6. Additional Comment or Explanation:

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| Name: | Council on Dental Benefit Programs |

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| Yes > | ☒ | If Yes, Name: | American Dental Association / Council on Dental Benefit Programs |
| No > | ☐ |

Part 2 – Submission Details

1. Action (Mark one only)
   New ☒  Revise ☐ Delete ☐  

| Affected Code (Revise or Delete only) |

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature | intraoral – periapical radiographic image – image capture only |
| Descriptor | None |

3. Rationale for this request; your persuasive argument for CMC acceptance  
   (Required for any type of requested action – New; Revise; Delete)

The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. Complete a) – c) only if Action Request is for a New CDT Code
   Mark if Revise or Delete [“a) - c)” are not applicable] ☐

   a) CDT Code currently used to report the procedure  
   D0999

   b) Procedure technical description

   Radiographic images are captured in the same manner as currently performed when delivering procedure D0220. However, the image capture only procedure does not include interpretation.

Notice to Preparer and Submitter:

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c) Clinical scenario

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.
   a) Material submitted?
      - Yes > ☐
      - No > ☒
   b) Protected by copyright? (If “a)” is “Yes”)
      - Yes > ☐
      - No > ☐
   c) Permission to reprint? (If “b)” is “Yes”)
      - Yes > ☐
      - No > ☒

6. Additional Comment or Explanation:

None

NOTICE TO PREPARER AND SUBMITTER:

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## Part 1 – Submitter Information

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 10/31/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong> Council on Dental Benefit Programs</td>
<td></td>
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</table>

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<tr>
<th>B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong>: ☒</td>
</tr>
<tr>
<td><strong>If Yes, Name:</strong> American Dental Association / Council on Dental Benefit Programs</td>
</tr>
</tbody>
</table>

## Part 2 – Submission Details

1. **Action** (Mark one only)
   - New ☒
   - Revise ☐
   - Delete ☐

2. **Affected Code** (Revise or Delete only)
   - **New** intraoral – bitewing radiographic image – image capture only
   - **Descriptor** Image axis may be horizontal or vertical.

3. **Rationale for this request; your persuasive argument for CMC acceptance** (Required for any type of requested action – New; Revise; Delete)
   - The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - **a)** CDT Code currently used to report the procedure D0999
   - **Mark if Revise or Delete [“a) - c)” are not applicable]** ☐

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**b) Procedure technical description**

Radiographic images are captured in the same manner as currently performed when delivering procedure D0270, D0272, D0273, D0274 or D0277. However, the image capture only procedure does not include interpretation.

**c) Clinical scenario**

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

### Part 3 – Additional Information

5. **Supporting documentation or literature:**
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. **Additional Comment or Explanation:**

None

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</tr>
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<td>No ☐</td>
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</table>

If Yes, Name: American Dental Association / Council on Dental Benefit Programs

### Part 2 – Submission Details

<table>
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<tr>
<th>1. Action (Mark one only)</th>
<th>New ☒</th>
<th>Revise ☐</th>
<th>Delete ☐</th>
<th>Affected Code (Revise or Delete only)</th>
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<tr>
<th>2. Full nomenclature and descriptor (For &quot;Revise&quot; mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nomenclature Required for all &quot;New&quot; intraoral – complete series of radiographic images – image capture only</td>
</tr>
<tr>
<td>Descriptor Optional for &quot;New&quot;; enter &quot;None&quot; if no descriptor A radiographic survey of the whole mouth, usually consisting of 14-22 images (periapical and posterior bitewing as indicated) intended to display the crowns and roots of all teeth, periapical areas and alveolar bone.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
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<td>The need for additional codes to document image capture only procedures was identified during the May 2019 CMC meeting discussion of such procedures. Image capture only procedures have the greatest applicability in teledentistry encounters where a locally licensed practitioner captures image(s) that are forwarded to a dentist for interpretation. The image interpretation procedure is reported with CDT Code D0391 interpretation of diagnostic image by a practitioner not associated by capture of the image, including report.</td>
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<td>a) CDT Code currently used to report the procedure</td>
<td>D0999</td>
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- A submission will be returned for correction if it is: a) **not** an unprotected MS Word document; b) **not** on the current Action Request format; or c) it is missing "Required" information.
b) Procedure technical description

Radiographic images are captured in the same manner as currently performed when delivering procedure D0210. However, the image capture only procedure does not include interpretation.

c) Clinical scenario

Dentist determines that there are clinical reasons for capturing this type of radiographic images (e.g., determination of a diagnosis and treatment plan during the course of an oral evaluation).

### Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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<th>c) Permission to reprint? (if “b)” is “Yes”)</th>
<th>Yes &gt; ☐</th>
</tr>
</thead>
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<tr>
<td>submitted?</td>
<td>No &gt; ☒</td>
<td></td>
<td>No &gt; ☒</td>
<td></td>
<td>No &gt; ☒</td>
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6. Additional Comment or Explanation:

None

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**CDT Code Action Request**

**Part 1 – Submitter Information**

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<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 10/30/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Rubi Figueroa-Garcia</td>
<td></td>
</tr>
</tbody>
</table>

**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

- Yes ☒
  - If Yes, Name: Center for Pediatric Dentistry
- No ☐

**Part 2 – Submission Details**

1. **Action** (Mark one only)
   - New ☒
   - Revise ☐
   - Delete ☐

2. **Affected Code**
   - (Revise or Delete only) D

3. **Nomenclature**
   - Required for all "New": intraoral occlusal radiograph – mandibular

4. **Descriptor**
   - Optional for "New": enter “None” if no descriptor
   - None

**Rationale for this request; your persuasive argument for CMC acceptance**

(Please provide a compelling argument for the new code, explaining why the current codes do not adequately describe the procedure.)

Pediatric Dental offices take Occlusal radiographs on children 3-4 years old. A mandibular and maxillary occlusal radiograph is taken, but it is difficult for the insurances to pay correctly due to needing the arch information or they think it is a duplicate. Even when it is mailed and written on the claim they deny it due to missing information or duplicate codes. It would be beneficial for the insurances and offices to have two separate codes to determine two different radiographs have been taken.

**Complete a) – c) only if Action Request is for a New CDT Code**

- **a) CDT Code currently used to report the procedure**
  - D0240

- **b) Procedure technical description**
  - Intraoral - Occlusal Radiographic Image

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c) Clinical scenario

A three year old comes in and we take a mandibular and maxillary occlusal radiographs. The claim is sent, but the insurance denies it. Some insurances believe it is a duplicate and only pay one and others are needing the arch information. I call the insurance, the ones that deny it as a duplicate will reprocess, but the ones that need arch information need a claim mailed out to them. Therefore it is unproductive for us dental office and for the insurance to have to go through this process every time.

Part 3 – Additional Information

5. Supporting documentation or literature:
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<th>Yes</th>
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<th>If Yes, Name: Center for Pediatric Dentistry</th>
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### Part 2 – Submission Details

1. **Action** (Mark one only): New ☒, Revise ☐, Delete ☐

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – **blue underline**; deleted text – **red strike-through**; unchanged text – **black**)

   - **Nomenclature**: intraoral-occlusal radiograph – maxillary
   - **Descriptor**: None

3. **Rationale for this request; your persuasive argument for CMC acceptance** (Required for any type of requested action – New; Revise; Delete)

   Pediatric Dental offices take Occlusal radiographs on children 3-4 years old. A mandibular and maxillary occlusal radiograph is taken, but it is difficult for the insurances to pay correctly due to needing the arch information or they think it is a duplicate. Even when it is mailed and written on the claim they deny it due to missing information or duplicate codes. It would be beneficial for the insurances and offices to have two separate codes to determine two different radiographs have been taken.

4. **Complete a) – c) only if Action Request is for a New CDT Code**

   - **a)** CDT Code currently used to report the procedure
     - D0240
   - **b)** Procedure technical description
     - Intraoral- Occlusal Radiographic Image

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   a) Material submitted?  Yes > ☐
   No > ☒

   b) Protected by copyright?  Yes > ☐
   (If “a)” is “Yes”)
   No > ☒

   c) Permission to reprint?  Yes > ☐
   (If “b)” is “Yes”)
   No > ☒

6. Additional Comment or Explanation:

None

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**CDT Code Action Request**

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<tbody>
<tr>
<td>Name: Alan E Friedel, DDS</td>
<td></td>
</tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Yes &gt; ☒ If Yes, Name: OraVu®</td>
</tr>
<tr>
<td>No &gt; ☐</td>
</tr>
<tr>
<td>1475 N. Scottsdale Road, Suite 200</td>
</tr>
<tr>
<td>Scottsdale, AZ 85257</td>
</tr>
</tbody>
</table>

**Part 2 – Submission Details**

<table>
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<tbody>
<tr>
<td>Nomenclature Required for all &quot;New&quot; endoscopy – intrasulcular</td>
</tr>
<tr>
<td>Descriptor Optional for &quot;New&quot;; enter “None” if no descriptor Provides enhanced view of subgingival anatomy in field to facilitate diagnosis; treatment.</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
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<tr>
<td>Camera/Canula placed into sulcus provides live visual access to field, permits enhanced or magnified view of root surfaces of teeth and implants and sulcular epithelium. Allows for more definitive diagnosis of cracked teeth, ailing implants, location of calculus et. al. Permits view of subgingival treatment in real time as it is performed in a closed flap environment.</td>
</tr>
</tbody>
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<th>4. Complete a) – c) only if Action Request is for a New CDT Code Mark if Revise or Delete [&quot;a) - c&quot;] are not applicable</th>
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b) Procedure technical description

Canula containing camera lens is inserted into gingival sulcus providing enhanced or magnified live imagery of subgingival anatomy and surrounding area. View on monitor is both live and magnified, thus permitting practitioner a real time view of treatment as it is being provided, therefore enhancing diagnostic capabilities.

c) Clinical scenario

1. Practitioner notes distal bone loss of a tooth, inserts camera/canula to determine if root has a vertical crack.
2. Practitioner attempting removal of calculus in subgingival field can see root surface to monitor removal of calculus in real time or to determine if calculus has been completely removed. Replaces tactile sensation that often passes over retained calculus, especially if smooth.
3. View of ailing implant may reveal retained cement or other potential reasons for bone loss.

Part 3 – Additional Information

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<td></td>
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6. Additional Comment or Explanation:

Video animation available of root planing using endoscope

https://vimeo.com/256251638

Video available of live visual closed flap calculus scaling

https://vimeo.com/308651503

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 7/22/2019

Name: Peter Milgrom, DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☐  No ☒

If Yes, Name: I am submitting this as an individual and not representing the University of Washington where I am an Emeritus Professor.

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐

Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature  Required for all “New”
caries preventive medicament application – per arch

Descriptor  Optional for “New”; enter “None” if no descriptor
For primary prevention or remineralization. Medicaments applied do not include topical fluorides whose application procedures have their own codes.

3. Rationale for this request; your persuasive argument for CMC acceptance  (Required for any type of requested action – New; Revise; Delete)

There is a gap in the current code. D1354 covers the application of medicaments for secondary (2o) prevention; that is, interim arrest of caries. But these same materials, particularly silver diamine fluoride, silver nitrate, and chlorhexidine, are used to prevent caries lesions on high-risk tooth surfaces, such as exposed root surfaces in older adults, deep fissures in permanent or primary teeth or around molar bands in fixed orthodontic treatment. The procedure as described below may not be documented with D1354 as there are no carious lesions, nor are D1206 or D1208 applicable as they are full-mouth procedures.

4. Complete a) – c) only if Action Request is for a New CDT Code  Mark if Revise or Delete ["a) - c)"] are not applicable ☐

a) CDT Code currently used to report the procedure  D9999

NOTICE TO PREPARDER AND SUBMITTER:

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- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
- Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.
- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
b) Procedure technical description

Each tooth surface to be treated in the arch is cleaned, isolated and dried gently prior to topical medicament application with a microbrush. Patients are asked not to eat or drink for one hour. To be maximally effective, the procedure is repeated once per six months.

c) Clinical scenario

1. An older adult presents with periodontal attachment loss and exposed root surfaces. Often the tooth is an abutment for a removable partial denture or the crown has been heavily restored. The patient’s hygiene may be not be optimal, and or salivary function may have been reduced by disease, medication side-effects etc., and these surfaces are at high risk for caries.

2. A teenager presents with fixed orthodontic appliances and bands on permanent molars. Hygiene among many orthodontic patients is difficult and often sub-optimal. These surfaces are at high risk for caries.

3. A child presents with a heavily fissured molar that has not erupted sufficiently to be sealed. The occlusal surface is at high risk for caries in individuals with previous with previous caries experience. Hygiene is difficult.

4. A developmentally or physically disabled patient presents who cannot practice adequate hygiene. Such patients are at high risk for repeated hospitalizations for caries treatment. Key surfaces can be treated to reduce the need for or postpone hospital based treatment.

5. A head and neck cancer patient presents before radiation and chemotherapy. The medicament can be used to protect surfaces that may be in the radiation beam and prevent radiation induced caries.

6. A child has clinically evident caries in the distal of a primary second molar which must be restored. The mesial surface of the first permanent molar is at high risk. Restoration of the primary tooth allows access to the at risk surface for preventive treatment.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

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6. Additional Comment or Explanation:

Please see supporting papers included with this submission.

NOTICE TO PREPARER AND SUBMITTER:

- All requested information in Parts 1-3 is required; limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
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- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
Prevention of Dental Caries by Silver Diamine Fluoride
Jeremy A. Horst, DDS, PhD; and Masahiro Heima, DDS, PhD

Abstract: The use of silver diamine fluoride (SDF) for management of dental caries has gained considerable attention due to recent regulatory clearance in the United States. The primary focus of policies, presentations, and publications has been the arrest of caries lesions (cavities) because of the material's unique ability to non-invasively achieve this elusive and clinically important goal. However, SDF also has proven efficacy in prevention, ie, decreasing the incidence of new caries lesions. Analysis of nine clinical trials in children shows that SDF prevented 61% of new lesions compared to controls. To prevent one new caries lesion, clinicians need to treat four primary teeth (one patient) or 12.1 permanent molars (three patients) with SDF. The preventive effect appears to be immediate and maintains at the same fraction over time. Direct comparisons of SDF applied once per year with alternative treatments show that SDF is more effective than other topical fluorides placed two to four times per year and more cost-effective than dental sealants. Enamel lesions may be even more responsive than cavitated dentin lesions. Annual application of SDF to high-risk surfaces (eg, mesial surfaces of permanent first molars where the distal surface of the second primary molar is carious) in patients with any risk of new caries lesions appears to be the most cost-effective approach available to prevent dental caries. SDF is an underutilized evidence-based preventive agent for dental caries.

Consistent results in many high-quality clinical trials and clearance by the US Food and Drug Administration have driven a reemergence of interest in 38% silver diamine fluoride (SDF) for managing dental caries. Ease of use and low material cost create the opportunity for fundamental change in first-line management of caries. The implications of non-invasive treatment for the individual practice and improvement of worldwide public health have kept the discussion of SDF on the arrest of active lesions. Indeed, the first experiments using SDF were studies in a rat caries model where the investigators evaluated the incidence of new lesions after preventive application. In the very first study, SDF prevented 62% of caries lesions in the molars of treated rats compared to litter-mate controls. SDF decreased the severity of lesions as well: 30% of teeth in the control group developed deep lesions (rat caries index 2 and 3), while none of the teeth in the SDF group had any. The second rat model caries study elucidated (to some extent) the benefit of both silver and fluoride ions in the preventive effect: SDF treatment resulted in 65% less new lesions than no treatment.

LEARNING OBJECTIVES
- Explain the indications, benefits, and risks for using silver diamine fluoride (SDF) to prevent caries lesions
- Discuss the clinical studies that assess the preventive effect of SDF
- Compare the effectiveness and cost-effectiveness of SDF to other preventive strategies

DISCLOSURE: The authors report that this review was funded in part by Advantage Silver Dental Arrest, LLC.
control, while 10% stannous fluoride (SnF2) prevented only 51%, and 25% silver nitrate had no effect.

The one early human clinical trial documenting the powerful preventive effect on caries lesions was a split-mouth study in the permanent lower first molars of 25 children ages 6 to 8. Nine months after three SDF treatments within 1 week, 24% of treatment side molars had developed new lesions while 88% did on the untreated side, a 73% reduction.

After three decades of infrequent studies, contemporary clinical trials with more rigorous experimental designs evaluated the effectiveness of SDF in the management of dental caries. The first two such trials focused on caries arrest in young children but also evaluated the incidence of new lesions as a secondary outcome. In one study, patients treated with SDF had 0.37 new carious surfaces (decayed/missing/filled surfaces [DMFS]), while patients in the control group had 1.58. In the other study, these numbers were 0.67 (DMFS) and 2.46. The prevented fractions (percent less new lesions) were 77% and 73% after 2.5 years. These impressive results fueled five more trials since, reviewed in the text below.

Open issues that motivate this review include: whether the preventive effect is consistent across clinical trials, whether silver contributes to prevention beyond fluoride, how the effectiveness and cost-effectiveness of SDF compares to other methods and materials, the safety and side effects of SDF, and what the optimal application protocol and frequency should be.

Systematic Literature Review
A literature review was designed to search NIH NCBI PubMed with the following search terms: ("33040-28-7" OR "1Z00ZK3E66" OR "silver diamine fluoride" OR "silver fluoride" OR "diammine silver fluoride" OR "ammonical silver fluoride" OR "ammoniacal silver fluoride" OR "silver" AND "fluoride") AND ("incidence" OR "prevent") AND ("caries" OR "clinical" OR "trial" OR "control") OR ("enamel" OR "incipient" OR "white spot" OR "pit" OR "fissure"). Meta-analyses and other systematic reviews identified by the search were scoured for any missed primary articles. Papers not published in English were translated as necessary.

A total of 114 papers were retrieved. Titles and abstracts were evaluated by the first author (JAH) for: (A) human clinical studies with incidence of new caries lesions as an outcome, and (B) clinical studies on the progression of enamel lesions into dentin. All other papers were considered based on clinical relevance, which identified two papers on cost-effectiveness and two on patient preference. Most papers were reviews or other opinion pieces without primary data. No meta-analysis was found that summarized the preventive effects of SDF.

Prevention
Seventeen papers described human clinical studies with prevented caries lesions as an outcome. The study design and reporting of these studies vary considerably in their risk of biases. The clinical caries studies (n = 15) focused on the use of SDF in children 1 to 12 years old (yo) or adults 60 yo and older (n = 3). Of these, one case series of 12% SDF on newly erupted molars in 120 children 5.5 to 6 yo found no new lesions after 1 year but included no control group. One paper describing 88% caries arrest in children 0 to 2 yo a year after treatment with 30% SDF noted in the discussion a strong inverse correlation between the arrest of caries and the incidence of new lesions in each patient, but did not publish the actual data. The titles of three other papers suggest that they may be relevant, but were not considered based on clinical relevance, which identified two papers on cost-effectiveness and two on patient preference. Most papers were reviews or other opinion pieces without primary data. No meta-analysis was found that summarized the preventive effects of SDF.
accessible to the present authors.12-14 Three high-quality trials have been performed in elders and will be discussed elsewhere.15,16 The remaining nine papers described comparative studies on the incidence of new caries lesions after the use of 38% SDF or 40% silver fluoride (AgF) versus no treatment or placebo control groups in children. These papers are summarized below.

Children

Nine studies evaluated prevention of new lesions in children. The outcomes and design of these studies are summarized in Figure 1.2.2-7 The Japanese nonrandomized split-mouth study in 25 children 6 to 8 yo described above showed 73% less new lesions compared to 0.88 mean new lesions in the control group.6 A similar split-mouth study in 26 toddlers 1 to 2 yo randomized quadrants to SDF versus control separately by upper and lower arch. While caries arrest was observed for existing lesions in the SDF group, no prevention with respect to the untreated side (2.2 new lesions) was observed at any timepoint from 3 to 12 months. This outcome is an outlier with respect to other studies (Figure 1); it is possible that isolation was not achieved between occluding SDF-treated and control teeth.7

Another randomized split-mouth study examined the effect of SDF on proximal surfaces of primary molars with and without existing enamel lesions in 58 children 5 to 7 yo. SDF was applied and examined every 3 months clinically and radiographically. After 18 months, 56% less lesions were observed in SDF-treated upper teeth and 71% less in lower teeth, with respect to the contralateral control (the quantity of lesions was not reported).8 A study of 849 children 5 to 8 yo in Australia evaluated the incidence of new lesions in newly erupted first permanent molars after 10% SnF2 only versus placement of 40% AgF followed by 10% SnF2. Each treatment was performed once only, with one treatment modality per each of two nearby clinics that served socioeconomically similar patients. Relative to 1.17 new lesions in the control group, after 18 months patients treated with SDF had 76% less new lesions.14

Four contemporary randomized controlled trials studied prevention by SDF compared to placebo or no treatment controls. In the first, after 2.5 years 77% less new lesions were observed in the anterior teeth of 308 children 3 to 5 yo whose lesions were treated with SDF once per year and 50% in those who were treated topically with 5% sodium fluoride varnish four times per year, with respect to the average of 1.6 new lesions of those who received a water placebo.9 The next study found 75% less new lesions in the primary and permanent molars of 373 children initially 6 yo after 3 years of twice-per-year SDF treatment to lesions only, as compared to 2.5 new lesions in no treatment controls.10 A third study in 708 children 6 to 8 yo found the incidence of new lesions 18 months after a single placement of SDF or a glass-ionomer sealant in permanent first molars to be 23% and 70%, respectively, less than no treatment controls, who had 0.44 new lesions.11 The fourth study evaluated the incidence of new lesions in permanent first molars of 482 children 9.1 yo, 2 years after a single placement of a resin sealant, annual application of SDF, or twice annual fluoride varnish, to be 65%, 52%, and 48%, respectively, less than the 4.6 new surfaces of caries lesions in the placebo control.12

The most recent published clinical study evaluated SDF in 295 children 2 to 3 yo. This study used as its control group children who were part of the overarching prevention program but were not consented for SDF treatment. Examiners were not blinded. Initial lesions in all groups were similar. All three groups received 2% sodium fluoride gel every 6 months. SDF was placed on caries lesions only, either once or twice annually. After a year the SDF treatment groups had 55% and 57% less new lesions on primary tooth surfaces, compared to 9 new lesions in controls.13

Enamel Lesions

Treatment of lesions limited to enamel and not involving the dentin, also known as incipient lesions, demineralization spots, or white-spot lesions, with the goal of stopping progression into dentin, is within the spectrum of prevention. Four studies were found on this topic. In three studies the control group showed no disease progression2,17 in two, differences were seen in how quickly lesions became arrested, but final outcomes were similar.18,19 The positive outcomes in control groups shows that the overwhelming majority of enamel lesions in patients with access to care will not grow in 2 to 3 years and, therefore, should not be treated operatively at this stage. One of these clinical trials found that treatment with SDF was more comfortable and quicker than with infiltration resin. SDF treatment was no different in terms of discomfort than flossing instructions.20

Only one study documented the progression of enamel lesions into dentin in control groups. In the randomized split-mouth study of 58 children 5 to 7 yo mentioned earlier, after 18 months 46% less initial lesions in upper primary molars and 59% less initial lesions in lower primary molars progressed into the dentin after application of SDF every 3 months compared to controls.21 Data on the numbers of lesions that grew in the control teeth were not reported, so it is impossible to fully evaluate the magnitude of the clinical effects.

Summary of Clinical Trial Evidence

These clinical studies can be summarized as demonstrating clinically significant prevention of effects of new caries lesions in children in
primary and permanent teeth. Moreover, the prevention trials, conducted in varying populations by a range of investigators, showed a strongly consistent prevented fraction of 61% in children (Figure 1). This means a patient treated with SDF will have 61% less new lesions than if he or she had not received SDF.

In Figure 2 the number of children included in the summary analysis (SDF and control groups) is plotted against the prevented fraction observed in each study. This type of plot characterizes the overall trend in clinical outcomes and is expected to appear as an upward-pointing funnel converging on the true clinical effect. The estimate of 61% prevented fraction appears reasonable.

Sufficient data was presented in the papers to perform a “number needed to treat” (NNT) analysis for three studies on prevention of lesions by surface on any tooth. While permanent molars were considered in one of these studies, the majority of teeth treated were deciduous (DMFS). Assuming all relevant teeth were present in all patients, the NNT for these studies is 19.9 surfaces, or 4 teeth. This means that only a single child needs to be treated with SDF to prevent one new lesion in primary teeth. Sufficient data were also available from three studies on the prevention of cavious first permanent molars (decayed/missing/filled teeth [DMFT]); the NNT is 12.1 teeth. Therefore, children need to be treated to prevent one cavious permanent first molar.

Unlike the trend the authors have observed in increasing rates of caries arrest over time, no such pattern is observed with caries prevention (Figure 1). The preventive effect of SDF appears to be immediate and long-lasting.

Comparison to Other Topical Preventive Agents
In direct comparison with four times applications per year of 5% sodium fluoride varnish in young children, once annual application of SDF showed significantly higher prevented fraction. This exact result was duplicated in a large study of elders. However, another study showed no significant differences between twice annual fluoride varnish and once annual SDF. These results suggest that one application of SDF per year is at least as effective as two to four applications of fluoride varnish per year, and may be more so.

Comparison to Sealants
Application of SDF for preventing new lesions on newly erupted permanent first molars has been compared directly to dental sealants. In one study, a non-significant trend was observed for higher prevented fraction compared to controls by resin sealants. In another, there was a much greater prevented fraction by glass-ionomer sealants than SDF. Functionally, SDF-mediated prevention likely depends on continued application over the years as it does with other fluorides and as is the case with SDF-mediated caries arrest. Sealants need to be monitored at a similar frequency. Maintenance of SDF treatments and sealant monitoring may require similar resources. Thus, clinicians should consider whether SDF or sealants are more cost-effective.

Cost-Effectiveness
Although the absolute effectiveness of sealants appears to be greater than that of SDF, the material and expert time has been estimated to be 20 times more for sealants than SDF. Indeed it has long been noted that sealants are more effective per tooth but much more expensive than SDF. In 2004 in Argentina, the cost-effectiveness of stabilizing one lesion with SDF was US$1.08. The incremental cost of SDF treatment of four molars has been measured in a clinical trial adding 3.8 minutes. Thus, the incremental cost of a dental assistant paid $20 per hour to place SDF for prevention is $1.27, while a hygienist paid $50 per hour to place four sealants in 30 minutes costs $2.5, which is indeed 20 times more. The marginal improvement in clinical outcome from the significantly larger expense for sealants is questionable.

Esthetics
Mature enamel and non-cavious dentin will not stain. However, any superficial defect in enamel—hypomineralized, carious/demineralized, and immature enamel—may stain black if it is sufficiently porous to allow penetration of significant amounts of silver. This includes early decay in fissures that may be difficult to see until it is stained as well as superficial defects from fluorosis. Subsurface defects of any type covered by mature enamel will not stain. Stains do indicate treatment of a defect in the tooth and are a very effective caries indicator, but may elicit cosmetic concerns. In most cases the stain from caries arrest in cavitated lesions can be handled (when desired) after minimal preparative cleaning of the cavosurface margins by placing an opaque dental material such as a high-viscosity glass-ionomer cement or resin opaquer. Similarly, stains in pits and fissures can be covered by an opaque material. Smooth non-cavitated surfaces, particularly in primary teeth, are less likely to hold these restorative materials.

Application to erupting teeth in esthetic areas should be considered with caution. It is important to note that permanent teeth crowns can enter the mouth incompletely mineralized. While enamel always goes through a maturation process for years after eruption, in some patients (who do not have amelogenesis imperfecta) the emerging enamel is actually porous and takes at least a few weeks to close. This concern is compounded because enamel hypomineralization increases caries risk, and, thus, the children...
who would benefit most from the preventive effect are also at the highest risk for stain. Figure 3 shows an example of stain at the gingival margin when SDF was applied. The enamel surface gingival to the dark stain shows by contrast that all other exposed enamel may have been more subtly stained. The inciso-gingival thickness of the stain shows that the enamel was no longer susceptible to stain after being bathed in saliva for a few weeks.

**Bonding**

Various studies have documented that SDF does not affect the bond strength of glass-ionomer cement or resin to dentin.\(^{20-23}\) No published study has evaluated enamel bond strength.

**Safety Considerations**

Application of SDF to gingiva can cause desquamation without any sensation, akin to a bleach burn. If SDF touches a wound in the mucosa or a raw area of the tongue, it will sting. Blood fluoride levels do not rise above baseline in adults; thus, systemic exposure appears similar to a dose of toothpaste, not causing clinical risk of fluorosis.\(^{34}\)

**Dose Limit**

Hypothetically, higher levels of systemic absorption may occur when using SDF for prevention rather than treatment. While SDF is almost completely absorbed into the tooth when applied to cavious lesions, not as high of a proportion will be absorbed when applying to sound surfaces for prevention. This may increase the amount that will interact with the soft tissues and possibly be absorbed into the systemic circulation. Thus, increased doses should be justified, as in infants with early dental eruption and considerable caries risk.

Multiple-use vials and single-use (0.1 mL or two drops) ampules of SDF are available in the United States. The single-use ampules help prevent overdosing and spillage. The authors previously suggested a limit of one drop per 10 kg of body weight per visit, based on the esthetically pleasing 500-fold safety margin.\(^{22}\) This dose is in line with that evaluated in human safety studies\(^{34-35}\) and has been widely adopted in the United States.\(^{22,36}\) However, all indications show that it can be safely surpassed. Teeth tend to erupt very early in the populations who would benefit most from the preventive effect are also at the highest risk for stain. Figure 3 shows an example of stain at the gingival margin when SDF was applied. The enamel surface gingival to the dark stain shows by contrast that all other exposed enamel may have been more subtly stained. The inciso-gingival thickness of the stain shows that the enamel was no longer susceptible to stain after being bathed in saliva for a few weeks.

**Recommended Application Protocol**

Prior to application of SDF for prevention of new caries lesions, caregivers or patients should be properly informed of the risks, benefits, and alternatives of SDF as described previously.\(^{22}\) The noted risks should include photographs of SDF-induced stains, appropriate to prevention situations. The stated benefits should include a description of the size and number of new caries lesions anticipated without SDF and the difference in time, cost, and experience of the alternative treatments.

**Application Frequency**

The only study found in this review that evaluated different application frequencies found no difference in outcomes between once or twice per year application in a population with a high caries rate of children.\(^{7}\) It is as yet unclear from available studies whether re-application of SDF is necessary to maintain the preventative effect of the first application, or if so, how often re-application is indicated. Annual reapplication of SDF has been found to be superior or equivalent to multiple applications per year of other contemporary topical preventives.\(^{5,24}\) Considering the patterns of clinical outcomes observed in the published trials in children, until more data is available the present authors suggest annual re-application. Because there is considerable evidence that risk factors correlate to incidence of new lesions, it would be logical to apply more frequently for patients with salivary dysfunction. Also, infants and toddlers with very high caries risk should be treated more frequently due to the rapid influx of high-risk surfaces.

**Selection of Surfaces**

SDF should be placed on the highest-risk surfaces as a priority. Usually, pits, fissures, and proximal surfaces have the highest risk. However, all surfaces are at similar risk in the upper anterior teeth of infants, exposed root surfaces bear the highest risk in older adults, and teenagers can suddenly develop proximal lesions on all posterior teeth. Thus, the pattern of lesions for the patient’s demographics should be considered. Additionally, the patient’s caries risk and esthetic concerns should be balanced in deciding which surfaces to treat.

**Billing**

SDF is a topical fluoride. Thus, D1208 is an appropriate billing code when SDF is used for prevention of new lesions. D1208 is typically billed as whole-mouth treatment. When SDF is used to stop the progression of enamel lesions into dentin, D1354 may be the most appropriate code. As of January 2018, D1354 is billed per tooth.

**Conclusion**

Considerable evidence supports the annual use of SDF for preventing new caries lesions in primary teeth and permanent molars. Multiple clinical trials show higher levels of prevention with less frequent applications of SDF than other topical therapies such as fluoride varnish. Considering all the evidence, the authors recommend annual application of SDF targeted to high-risk surfaces in high caries-risk patients of any age.
SDF seems to have a modestly less preventive effect but substantially greater cost-effectiveness than either resin or glass-ionomer cement sealants for preventing new lesions in permanent molars. SDF is also easier for patients to tolerate and can be more quickly applied than other preventive materials. Unlike sealants, SDF can be placed on any tooth surface, and the fluoride released may protect proximal surfaces not directly treated.

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Queries to the author regarding this course may be submitted to authorqueries@aegiscomm.com.

**REFERENCES**


Prevention of Dental Caries by Silver Diamine Fluoride

Jeremy A. Horst, DDS, PhD; and Masahiro Heima, DDS, PhD

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1. The use of silver diamine fluoride (SDF) for managing dental caries was pioneered:
   A. in Japan in the 1960s.
   B. in the United States in the 1980s.
   C. in Argentina in the 2000s.
   D. upon receiving clearance from the US FDA in 2016.

2. In an early split-mouth study of permanent lower first molars in 6- to 8-year-old children, 9 months after three SDF treatments within 1 week:
   A. a 24% increase in new lesions resulted.
   B. a 24% reduction in new lesions resulted.
   C. a 73% reduction in new lesions resulted.
   D. a 88% reduction in new lesions resulted.

3. How many contemporary randomized controlled trials studied prevention by SDF in children compared to placebo or no treatment controls?
   A. 2
   B. 4
   C. 6
   D. 8

4. Treatment of lesions limited to enamel, with the goal of stopping progression into dentin, is within the spectrum of:
   A. oral surgery.
   B. prevention.
   C. endodontics.
   D. teeth whitening.

5. The prevention trials reviewed in this study, conducted in varying populations by a range of investigators, showed:
   A. an initial large effect that dwindled with time.
   B. no observable effect at first but a strong effect by 18 months.
   C. a strongly consistent prevented fraction.
   D. an initial effect similar to that of fluoride varnish, which increased to its final effectiveness by 18 months.

6. According to the article, one application of SDF per year is at least as effective as two to four applications of what per year?
   A. fluoride varnish
   B. glass-ionomer sealant
   C. resin opaquer
   D. hydrogen peroxide

7. Superficial defects in enamel, if sufficiently porous to allow penetration of significant amounts of silver, may stain:
   A. white.
   B. yellow.
   C. red.
   D. black.

8. Enamel hypomineralization:
   A. increases caries risk.
   B. decreases caries risk.
   C. decreases the risk for stain.
   D. increases salivary flow.

9. When using SDF for prevention the authors suggest considering a dose limit of:
   A. one bottle per patient.
   B. one drop per 10 kg per visit.
   C. two drops per 10 kg per visit.
   D. five drops.

10. Prior to SDF application for prevention, prophylaxis is:
    A. preferred.
    B. required.
    C. advisable.
    D. neither required nor advisable.
## CE QUIZ ANSWER FORM

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<td>8. Relevance of review questions</td>
<td>4 3 2 1 0</td>
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<tr>
<td>9. Did this lesson achieve its educational objectives? Yes No Yes No</td>
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<td>10. Did this article present new information? Yes No Yes No</td>
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<tr>
<td>11. How much time did it take you to complete this lesson? min min</td>
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A systematic review of silver diamine fluoride: Effectiveness and application in older adults

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Objective: This systematic review examines the effectiveness of silver diamine fluoride (SDF) in the management of caries in older adults.

Background: Silver diamine fluoride has been extensively researched and proven effective for caries prevention and arrest in children. Limited studies support its effectiveness in adult and older adult populations.

Materials and methods: Multiple databases were searched according to specified inclusion-exclusion criteria. Quality assessment used modified Centre for Evidence-Based Medicine worksheets.

Results: Three randomised controlled trials were identified that addressed the effectiveness of SDF on root caries in older adults, but none addressed coronal caries. Root caries prevented fraction and arrest rate for SDF were significantly higher than placebo. The prevented fraction for caries prevention for SDF compared to placebo was 71% in a 3-year study and 25% in a 2-year study. The prevented fraction for caries arrest for SDF was 725% greater in a 24-month study and 100% greater than placebo in a 30-month study. No severe adverse effects were observed.

Conclusion: This systematic review evaluates the use of SDF for both root caries prevention and arrest in older adults. Existing reports of SDF trials support effectiveness in root caries prevention and arrest, remineralization of deep occlusal lesions and treatment of hypersensitive dentin.

KEYWORDS
arrest, caries, older adults, prevent, safety, silver diamine fluoride, systematic review

1 | INTRODUCTION

In 2030, 19% of the U.S. population will be aged 65 years or older, and 2.3% over age 85. The number of adults aged 65 years and older per 100 working-age adults will increase from 0.22 in 2010 to 0.35 in 2030, indicating a growing burden on the healthcare system. Nationally, 19% of community-dwelling adults in the United States aged 65 and older have untreated coronal caries. The most current estimates for root caries prevalence in U.S. adults aged 65 and older are 14%, with 12% for non-Hispanic Whites and 31% and 30% for Mexican Americans and African Americans, respectively. The rise in the proportion of older adults in the population living with chronic disease, the longer retention of natural teeth, combined with pre-existing dental restorations and persistent caries experience is poised to create a dental public health crisis.

The World Health Organization (WHO) has included oral health as an important component of their active ageing policy, which promotes healthy living, disease prevention and focusing on improving the quality of life of older adults. In concordance with the WHO global goals for 2020, Healthy People 2020 has included for the first time objectives to reduce the proportion of older adults with untreated coronal and root caries. In order to achieve these objectives, it is important to consider how the oral health needs of an older population change with fluctuations in functional status and level of dependency over a...
lifetime. The goals for oral health and the factors that influence the provision of care may vary with different stages of dependency.9

Silver diamine fluoride (SDF) is an emerging caries preventive treatment option that is inexpensive, safe and easily accessible.9 Treatment with SDF requires minimal instrumentation and application at less frequent intervals than other caries preventive materials. Current evidence supports SDF use in children.10,11 However, older adults, especially those with high caries risk and/or with limited to no access to dental services due to economic, social or functional challenges, may benefit from this treatment as well.

1.1 Background of SDF

Silver nitrate was first used to arrest caries in the 19th century. Rapid development to create more effective formulations occurred during the 20th century starting with Howe’s ammoniacal silver nitrate, followed by silver fluoride, and later SDF. Since 1970, a solution of 38% SDF has been widely used outside the United States, primarily for caries prevention and arrest in children.12 The U.S. Food and Drug Administration (FDA) approved the use of SDF as a desensitising agent in 2014. In January 2016, a new Code on Dental Procedures and Nomenclature (CDT) D1354 allowed billing claims for off-label use of SDF as an interim caries arresting medicament.13,14 Thirty-eight per cent SDF is an alkaline (pH 10) colourless solution, containing 24%-27% silver (Ag), 8.5%-10.5% ammonia (NH₃) and 5.0%-6.0% fluoride (F).15

SDF affects the tooth structure and the caries process. The effect on enamel is primarily due to fluoride, while the effect on dentin is predominantly due to silver.16,17 Formation of silver phosphate turns SDF-treated carious lesions black.18 SDF does not affect the bond strength of composite resin to noncarious dentin, but may reduce bond strength to caries-affected dentin.19,20 SDF is compatible with glass-ionomer cements (GIC) and may increase resistance of GIC and composite restorations to secondary caries.21,22

Excavation of caries is not required prior to application. Teeth are air-dried, and SDF is applied to the carious lesions using a microbrush for 1 minute and rinsed.9 The effect of SDF diminishes over time, therefore follow-up applications are required as the lesion can revert to further carious demineralization in 24 months.23 The recommended safest maximum dose of SDF per visit is 1 drop/10 Kg.9

Although numerous randomised clinical trials have been conducted in children, very few randomised controlled24-26 trials have been conducted in older populations. The purpose of this report is to provide a systematic review of the evidence regarding the effectiveness of SDF in arresting or preventing root caries in older adults.

2 METHODS

2.1 Search strategy

This systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement (PRISMA).27(Figure 1)

Databases used:
PubMed, PubMed Clinical Queries, EMBASE, the American Dental Association’s Evidence-Based Dentistry Website, Cochrane Library, Web of Science, repository of the Journal of the American Dental Association and Google Scholar.

1) Search terms (MeSH, brand names, Other terms) for SDF:
“Silver Diamine Fluoride” OR “Diammine Silver Fluoride” OR “Ammonical Silver Fluoride” OR Silver Ammonia Fluoride” OR “Silver Fluoride” OR “Quaternary Ammonium Compounds”(MeSH) OR “Saforide” OR “Riva-Star” OR “Silver Nitrate + Caries”

2) MeSH terms for caries in older adults:
“Elderly + Caries + Silver” OR “Dental Caries + Therapy + Silver” OR “Older Adult + Care Management + Dental” OR “Caricostatic Agents + Therapeutic + Elderly” OR “Dental Atraumatic Restorative Treatment/Methods” OR “Dental Caries + Prevention + Control+ Silver” OR “Dental Caries + Drug Therapy” OR “Aged” OR “Frail” OR “Institutionalized”.

FIGURE 1 Search strategy

PubMed, PubMed Clinical Queries, EMBASE, the American Dental Association’s Evidence-Based Dentistry Website, Cochrane Library, Web of Science, repository of the Journal of the American Dental Association and Google Scholar were searched for articles published from 1946 to November 2015 with monthly reruns of search terms in PubMed through August 2016.

A literature search was conducted under two broad categories:

- **Silver diamine fluoride:** Under search terms (MeSH, Brand names, Other terms) “Silver Diamine Fluoride” OR “Diammine Silver Fluoride” OR “Ammonical Silver Fluoride” OR Silver Ammonia Fluoride” OR “Silver Fluoride” OR “Quaternary Ammonium Compounds”(MeSH) OR “Saforide” OR “Riva-Star” OR “Silver Nitrate + Caries”
- **Caries in older adults:** Under search terms “Elderly + Caries + Silver” OR “Dental Caries + Therapy + Silver” OR “Older Adult + Care Management + Dental” OR “Caricostatic Agents + Therapeutic + Elderly” OR “Dental Atraumatic Restorative Treatment/Methods” OR “Dental Caries + Prevention + Control + Silver” OR “Dental Caries + Drug Therapy” OR “Aged” OR “Frail” OR “Institutionalized.”

We continued to update our search through monthly reruns of our search terms in PubMed. The bibliographies of the selected manuscripts were subsequently hand-searched.

2.1.1 Inclusion criteria

Type of study: randomized controlled trials, cohort studies; Dentition: permanent; Population: adults aged 18 and older, community dwelling,
or institutionalized; Treatment outcomes: caries prevention, arrest, remineralization; Language: English.

2.1.2 Exclusion criteria

Type of report: systematic reviews, meta-analysis, case reports, in vitro studies, comments on articles, reports on caries in older adults that excluded SDF, and narrative reviews; Dentition: studies of primary dentition, exclusively; Population: children and animals; Language: any other than English.

Clinical trials included in this systematic review are registered with the Hong Kong University Clinical Trials Registry (available from: http://www.hkuctr.com/search) and the U.S. National Institutes of Health Registry (available from: https://clinicaltrials.gov) (clinical trial registration numbers: HKUCTR-343, HKUCTR-1297, HKUCTR-1583 and NCT02360124).

2.2 Data extraction

Summary tables were used to organise the study characteristics and results for each study (Table 1). Prevented fraction (PF), number needed to treat (NNT) and relative risk (RR) were calculated by the authors of this review to augment the results reported by Zhang et al and Li et al.

2.3 Quality assessment

The critical appraisal worksheet for randomised controlled trials from the Oxford Centre for Evidence-based Medicine (CEBM 2005) provided the framework to assess the quality and risk of bias of the selected articles. All four authors recorded their findings in an assessment table (Table 2) and discussed disagreements until achieving consensus. The appraisal worksheet was slightly modified: Question 3b was added to the therapy appraisal for clinical trials to gauge inter-examiner calibration.

2.4 Clinical recommendations

To thoroughly evaluate the published evidence regarding its safety and effectiveness before making clinical recommendations, the authors also reviewed studies on remineralization by Sinha et al. and hypersensitivity and safety by Castillo et al. These studies were conducted in younger adult populations but provided evidence to support extending SDF application for use in coronal caries.

3 RESULTS

The initial search identified 2931 articles. Category #1 “SDF” yielded 509 articles. Search for articles in category #2, “caries in older adults,” yielded 2419 articles. An additional 3 articles were subsequently identified. After removing duplicates and applying inclusion and exclusion criteria, 176 abstracts were selected for initial review by all authors. Eighteen articles were selected for full review. One article, published in May 2016, was identified during a monthly search rerun. Three articles were selected for final inclusion in this systematic review (Figure 2).

Selected RCT’s investigated the effect of SDF on root caries compared to other preventive agents or placebo. Measures used to quantify findings of the studies reviewed are shown in Table 1. Our search did not find studies investigating effect of SDF on coronal caries.

4 ASSESSMENT OF CLINICAL TRIALS REVIEWED

Using the quality assessment framework, Zhang et al. met all CEBM criteria, while Li et al. and Tan et al. met 8 of 9 CEBM criteria. All three studies exhibited a low degree of bias. (Tables 1 and 2)

All three RCT’s investigated the effect of SDF on root caries and reported a significant effect of SDF on the prevention and/or arrest of root caries. Effectiveness of SDF was measured using the following parameters:

- Number needed to treat (NNT): number of patients required to treat in the intervention group(s) in order to prevent a root surface caries lesion from occurring or to prevent a carious root surface from progressing relative to the control group.
- Prevented fraction (PF): reduction in the rate of incident caries surfaces or the increase in the rate of preventing root surface caries from progressing in the intervention group(s) relative to the control group.
- Mean number new carious surfaces and mean number of arrested root surfaces.
- Relative risk (RR): how much more likely new root surface caries will occur, or existing root surface caries will be prevented from progressing in the intervention group(s) relative to the control group.
- Arrest rate: percentage of active carious lesions at baseline that subsequently became arrested per time period at 12, 24, 30 months.

We calculated PF, NNT and RR for Zhang et al. and Li et al. to increase homogeneity of the reported results.

Tan et al. investigated the effect of 38% SDF on root caries prevention in institutionalized older adults and found the preventive effect of SDF was comparable to other preventive agents and greater than placebo. The effectiveness of annual application of SDF was compared with four quarterly applications of 5% sodium fluoride varnish (NaF), 1% chlorhexidine varnish (CHX) and placebo. Each group received oral hygiene instruction (OHI). The NNT for preventing new caries was 2.5, 3.1 and 3.2 for SDF, NaF and CHX varnish, respectively. The PF, compared to placebo and OHI, was 71%, 64% and 57% for SDF, NaF and CHX varnish, respectively (P<.001).

Zhang et al. investigated the effect of SDF on root caries prevention and arrest and concluded annual SDF application is more effective than placebo in arresting and preventing root caries. In that study, community-dwelling older adults were randomly assigned to...
The PF and NNT have negative values for arrested caries because the formulae for PF and NNT are designed to yield positive values when the incidence of the adverse outcome (or event) is higher in the control group than in the intervention group. In the case of arrested caries, the event is a beneficial outcome (arrested caries surfaces) and is actually greater in the intervention group, thus yielding negative values for PF and NNT. Nevertheless, the interpretation for PF and NNT ignores the negative signs and uses the absolute value.
three groups who received one of the following: (i) annual application of 38% SDF on root caries and on sound exposed root surfaces with oral hygiene instruction (SDF/OHI); (ii) SDF application and oral hygiene instruction supplemented with tailored biannual oral hygiene education (SDF/OHI+OHE); or (iii) oral hygiene instruction and placebo (OHI+P), the control group.25

The mean increments of new root caries surfaces in Zhang et al25 were 0.70, 1.00 and 1.33, respectively, for the (SDF/OHI+OHE), (SDF/OHI) and (OHI+P) groups (P<.05). Our calculated PF (ie 1—RR) was 25% for (SDF/OHI) group and 47% for (SDF/OHI+OHE) group, using the control group as the referent group. For NNT, to prevent one new root caries surface, the (SDF/OHI) and (SDF/OHI+OHE) groups required treating of 3.03 and 1.59 patients, respectively.

The mean number of arrested root caries surfaces for Zhang et al25 was 0.33 (SDF/OHI+OHE), 0.28 (SDF/OHI) and 0.04 (OHI+P) (P<.01). The RR for caries arrest was 7 for (SDF/OHI) and 8.25 for (SDF/OHI+OHE), respectively. This means participants who received (SDF/OHI) or (SDF/OHI+OHE) had a sevenfold or 8.25 greater chance of experiencing caries arrest, respectively, than those who received (OHI+P). The PF for arrested caries was 600% greater in the (SDF/OHI) group and 725% greater in the (SDF/OHI+OHE) than in the (OHI+P) group. The NNT to arrest one carious surface was 4.17 for (SDF/OHI) and 3.45 for (SDF/OHI+OHE).

Li et al26 investigated the effectiveness of SDF in arresting root caries in community-dwelling older adults and assessed the effectiveness of potassium iodide (KI) for reducing the colour of the arrested lesions. SDF was effective in arresting caries, KI had no effect on the arrest rate, and all arrested lesions eventually changed colour to the characteristic black stain. Effectiveness of annual application of 38% SDF was compared with annual application of 38% SDF immediately followed by KI application (SDF+KI), and with annual application of soda water used as placebo. Individualised oral hygiene instructions were provided to all participants at baseline and subsequently every 6 months. The caries arrest rate at the 30-month follow-up was 90% in the SDF group, 93% in the (SDF+KI) group and 45% in the placebo group (P<.001).26

5 | DISCUSSION

Our search for studies on SDF in older populations resulted in only 3 well-conducted randomised clinical trials on root caries.24-26 None investigated SDF treatment of coronal caries in older adults. We extended our search to include SDF safety, remineralization and desensitization studies in adults’ aged 18-65 but found no systematic reviews or meta-analyses of these topics.

All three studies were high quality and had a low degree of bias. While Zhang et al study clearly met all evaluation criteria, the description of the equal treatment of the study groups was unclear in the Tan et al study, and the description of the similarity of the groups at baseline was unclear in the Li et al study.

Taken together, the three clinical trials reviewed support the use of SDF for prevention and arrest of root caries in older adults. The PF
for prevention was lower in the Zhang et al study than that in the Tan et al study. This difference could be due to differences in study duration, number of SDF applications during the study and health status of the study groups. Although the PF differed, the mean numbers of new caries in both studies were similar. Importantly, only one application of SDF was required to achieve results comparable to four applications of either NaF or CHX varnish. Similar to this systematic review, a meta-analysis of root caries prevention and arrest in older adults by Wierichs et al that reviewed the studies by Tan et al and Zhang et al found fewer new carious root surfaces with a mean difference of −0.33 (95% CI=−0.39,−0.28) in SDF-treated teeth than placebo. Additionally, a systematic review of root caries prevention in older adults by Gluzman et al that reviewed the study by Tan et al reported that SDF reduced incidence of new root surface caries by 72%. SDF effectively arrested root caries in the studies assessing root caries arrest. The arrest rate for SDF and SDF-KI groups in the Li et al study was 2 times (200%) greater than placebo, while Zhang et al reported the arrest rate being 6 times (600%) greater for the SDF group and 7.25 times (725%) greater for the (SDF+OHE) group than placebo. All participants in the Li et al study received individualised OHI, instructions for using manual toothbrush and interdental brush and received fluoride toothpaste during each follow-up examination every 6 months. The difference in arrest rates between Zhang et al and Li et al studies could be due the difference in their placebo groups where in addition to individualised oral hygiene instructions, the placebo group in the Li et al study received one fluoride toothpaste tube and a manual toothbrush at each visit. For the Zhang et al study, as a part of OHE, the (SDF+OHI+OHE) group was engaged in establishing their oral hygiene goals and were evaluated every 6 months.

KI application following SDF application inhibits biofilm formation and improves fluoride uptake from glass-ionomer fillings. The formation of silver iodide in SDF+KI reaction is thought to reduce staining. However, Li et al reported KI application had no effect on reducing the characteristic black stain of SDF (P>.05). Carious lesions turned yellow immediately after KI application, but after 30 months, the colour of arrested lesions in the SDF and SDF-KI groups was similar. KI application may delay the staining process but eventually the arrested lesion will darken.

Our search found no studies testing the effect of SDF on coronal caries in older populations. However, SDF studies in children aged 18-36 months dominate the literature and provide evidence supporting the effectiveness of SDF in the prevention and arrest of coronal caries, with results comparable to other caries preventing and arresting agents such as NaF varnish, CHX, sealants and GIC. SDF was significantly more effective than no treatment in children.

Evidence suggests SDF is effective in reducing pain in hypersensitive dentin in permanent teeth. Castillo et al reported significant reduction in the pain response of hypersensitive teeth, 24 hours after initial SDF application. Sensitivity continued to diminish further during the 7-day study period. Sinha et al demonstrated effectiveness of SDF as a remineralizing agent and possible use as an indirect pulp capping agent in deep carious lesions.

**FIGURE 2** Data selection schematic
Dental caries is caused by demineralization of tooth structure following loss of calcium and phosphate ions. Hypersensitivity is an early sign of demineralization. Although older adults may not report hypersensitivity, the process of demineralization continues. SDF enhances deposition of calcium and phosphate ions, remineralization of tooth structure and reversal of the disease process. Based on findings from studies in children, as well as from Sinha et al (age group 18-35 years old) and Castillo et al (average age 43-44 years old), studies, SDF could be effective in arresting and preventing coronal caries in older adults. SDF application on coronal surfaces may help retention of natural teeth and increase their resistance to many of the risk factors for caries such as xerostomia, poor oral hygiene and low pH that are more prevalent in older adults coping with chronic diseases and functional impairments.

Professional application of SDF is considered safe. No serious adverse effects are reported from clinical trials of SDF. A pilot study by Vasquez et al addressed safety and reported that the serum concentrations for fluoride and silver were significantly less than the U.S. Environmental Protection Agency’s oral reference dose for daily fluoride exposure and lifetime silver exposure. No significant mucosal changes were noticed.

SDF is inexpensive relative to other caries preventive agents. A simulated study about cost-effectiveness of root caries preventive treatment concluded that SDF application is more effective and less costly in high-risk populations.

6 | KNOWLEDGE GAP ANALYSIS

There is no established frequency for SDF application; suggested frequencies in children range from annual to biannual to three consecutive weekly applications followed by semi-annual recall applications. Increased frequency is linked to a greater arrest rate over the first 6-12 months in children. Annual application of SDF effectively prevents and arrests root caries in older adults who are capable of self-care and are not affected by serious medical conditions. Multiple applications may benefit a more dependent and at-risk older population. Clinicians should use their clinical judgement about application frequency based on current evidence and individual caries risk factors. More studies are required to determine effective application frequency for caries prevention and arrest rates in older adults, at different stages of dependency and risk.

The studies included in this report were conducted in locales with community water fluoridation. However, in the United States, water fluoridation is not uniform. Black staining of carious lesions by SDF was reported to be acceptable by parents and young children, possibly because primary teeth exfoliate. Future studies should evaluate aesthetic acceptability for older adults and ways to reduce staining in permanent dentition. Acceptability may also vary depending on patient expectations.

The few clinical trials focused on older adults indicate SDF is effective in the prevention and arrest of root caries for this population. However, additional clinical trials in heterogeneous populations of older adults, investigating root, coronal, primary and secondary caries, would be beneficial to better establish the full range of optimal use.

7 | RECOMMENDATIONS

Our recommendations for the use of SDF in older adults are based on the current state of evidence found in this systematic review. The Seattle Care Pathway (SCP) provides an evidence-based approach to oral care for older adults. SCP is a framework for dental providers to assess the risks, needs and barriers to oral health care for older adults and determine best practices for prevention and treatment based upon functional status. The schema assists practitioners in appropriate assessment, prevention, treatment and communication strategies, based on functional dependency and is adaptable to patients’ needs and population-based needs. The pathway provides an important framework through which standardised care can be delivered to patients throughout the dependency continuum with consistent outcomes.

Following SCP criteria and the results of this review, SDF is appropriate for a wide spectrum of seniors, from those who are independent with high to extreme caries risk to highly dependent older adults with limited access to care and increased caries risk. SDF could be used as a standalone measure or in conjunction with oral hygiene education and other treatment. Some states permit dental hygienists, dental assistants, physicians, nurses and their assistants to apply SDF for the control of caries, thereby increasing access to care for many older adults. Communication between patients, care givers and healthcare providers, is crucial for setting expectations and achieving successful outcomes. SDF is an appropriate option to manage dentin sensitivity and for caries prevention and management to optimise oral health across the life course.

8 | CONCLUSION

This systematic review evaluates the use of SDF for both root caries prevention and arrest in older adults. Existing reports of SDF trials support effectiveness in root caries prevention and arrest, remineralization of deep occlusal lesions and treatment of hypersensitive dentin.

ACKNOWLEDGEMENTS

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REFERENCES


A clinical evaluation of two methods of caries prevention in newly-erupted first permanent molars

Eleonore Green, FDS, RCS(Eng), BDS(Hons) (Lond)*

Key words: Caries prevention, first permanent molars, silver fluoride, stannous fluoride.

Abstract
A two-stage topical treatment regime, AgF followed by SnF₂, was used as a caries preventive measure in newly-erupted first permanent molars in a group of children. Another group of children, from similar geographic and socio-economic backgrounds was treated by a one stage topical application of SnF₂ only. The teeth treated were observed at six-monthly intervals for a period of 18 months, and showed a significantly higher incidence of caries developing when treated with SnF₂ only.

(Received for publication December 1987. Accepted September 1988.)

Introduction
The Department of Preventive Dentistry at the University of Sydney has been carrying out studies in the use of AgF/SnF₂ in the prevention and treatment of caries in deciduous teeth for some time. Craig, Powell and Cooper¹ described the treatment of early carious lesions with AgF/SnF₂ in a group of children in Bourke, New South Wales.

In 1983 the Dental Health Service of Western Australia introduced a pilot study of AgF/SnF₂ preventive treatment on deciduous molars. In 1984 this was introduced to the whole of the Field Service in Western Australia. Routine SnF₂ application to newly-erupted permanent molars has been in force in the Dental Health Service since 1981. It was decided to carry out a comparative study of the effectiveness in caries prevention (and incipient caries progression) on first permanent molars of the use of SnF₂ only, and that of AgF/SnF₂.

Materials and methods
The studies were carried out at Forrestfield Dental Therapy Centre and at Gosnells Dental Therapy Centre in Perth, Western Australia, between September 1984 and February 1987. These clinics are geographically close and socio-economically similar. Gosnells and Forrestfield Primary Schools are classified as being of equal socio-economic status. This status is given by the Western Australian Ministry of Education’s Index of Educational Disadvantage, which is calculated from Australian Bureau of Statistics data.

The subjects were all Year 1, 2 or 3 children — the age range being 5 to 8 years. Sex distribution was normal for this school age (males 51, females 49). No dmfs or dmft were recorded.

For ethical reasons, no placebo group was used, as the effects of topical fluorides on newly-erupted permanent molars are well documented. Examination and treatment was done by a total of three dentists and eight dental therapists.

The patients were examined by clinical means only (compressed air, mirror and probe), and any frankly carious teeth were excluded from the study. Hypoplastic teeth and teeth with ‘initial caries’, that is, decalcification, or a fissured groove with no obvious surface breakdown, were included.

Teeth in the SnF₂ study were isolated with cotton wool rolls, and dried with compressed air. Prophylaxis was carried out only on teeth with visible debris. A 10 per cent solution of SnF₂ spot application paste was applied to the occlusal surface...
(and buccal and lingual grooves if enough eruption had occurred) with a probe, or plastic instrument. Orobase† was then applied over it to act as a temporary moisture seal and to keep the SnF₂ on the tooth for a reasonable period of time. The patient was instructed not to rinse, eat or drink for one hour.

In the AgF/SnF₂ study, after prophylaxis only if the teeth were dirty, the teeth were isolated with cotton rolls, dried with compressed air, and a 40 per cent solution of AgF applied on a very small cotton wool pellet. After approximately 60 seconds, a layer of SnF₂ spot application paste was applied, and Orobase placed over it. The patient was instructed not to move the tongue over the teeth, and not to rinse, eat or drink for one hour.

Both SnF₂ and AgF/SnF₂ were applied once only. Black staining was noticed in the fissures of all teeth treated with AgF/SnF₂, and this appeared to persist, although it faded slightly over 18 months. Occasional brown or yellow staining was noticed with SnF₂ only.

The procedure was explained to parents in person, if present, and by letter if not. No one objected to the staining when the preventive benefits of the treatment were explained.

The patients were recalled at six-monthly intervals, for a period of 18 months. Further studies on some patients are still continuing. Records were kept of the number of children, and the number of teeth treated, and which children and teeth developed caries in both centres.

Statistical analysis

The chi-square test was used to compare the effects of the two preventive treatments. Significance was set at 0.05.

All first permanent molars (with the exceptions stated above) at Forrestfield Dental Therapy Centre were treated by the two stage technique, and those at Gosnells Dental Therapy Centre by the one stage technique.

Results of the study (Tables 1-3)

Only those results where the patient could be checked up to 18 months were included. Some patients had left the areas, and some had gone on to a longer recall, due to an administrative error. The number of children leaving each Centre was approximately 5 per cent per year of the total number enrolled, and therefore not significant.

<table>
<thead>
<tr>
<th>Interval between application of AgF/SnF₂ and examination</th>
<th>Number of children with caries*</th>
<th>Number of teeth with caries*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>20 (4.5)</td>
<td>23 (1.8)</td>
</tr>
<tr>
<td>12 months</td>
<td>25 (5.6)</td>
<td>35 (2.7)</td>
</tr>
<tr>
<td>18 months</td>
<td>26 (6.4)</td>
<td>37 (2.9)</td>
</tr>
</tbody>
</table>

*Percentage in parenthesis.

Children: N = 439

Teeth: N = 1300

Table 2. Results for SnF₂ (Gosnells)

<table>
<thead>
<tr>
<th>Interval between application of SnF₂ and examination</th>
<th>Number of children with caries*</th>
<th>Number of teeth with caries*</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 months</td>
<td>46 (11.2)</td>
<td>69 (4.4)</td>
</tr>
<tr>
<td>12 months</td>
<td>84 (20.5)</td>
<td>134 (8.6)</td>
</tr>
<tr>
<td>18 months</td>
<td>96 (23.4)</td>
<td>182 (11.7)</td>
</tr>
</tbody>
</table>

*Percentage in parenthesis.

Children: N = 410

Teeth: N = 1563

Table 3. Proportion of children and teeth with caries after 18 months, by treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Children</th>
<th>Teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>AgF/SnF₂</td>
<td>7.5</td>
<td>32.0</td>
</tr>
<tr>
<td>SnF₂</td>
<td>2.8</td>
<td>11.6</td>
</tr>
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</table>

Caries included occlusal caries, and buccal and lingual pits, which are not well reached by either preventive method in newly-erupting teeth, and also surface breakdown in hypoplastic teeth (the only interstitial caries found).

Discussion

The caries prevention results with AgF/SnF₂ seem consistently better than those with SnF₂ only. Not only was the total amount of developing caries less, but also the number of teeth which developed caries appeared to drop sharply with time when AgF/SnF₂ was applied so that only as much new decay was found after 18 months as after six months following SnF₂ application alone (Table 4).

Also statistically significant is the fact that the proportion of new children, that is, children with no previous caries in first permanent molars, with caries after 12 months was much higher after the one stage treatment, than the two stage treatment (Table 5).

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†E. R. Squibb & Sons Pty Ltd, Noble Park, Victoria.

408 Australian Dental Journal 1989;34:5.
Table 4. Children: new caries after 18 months

<table>
<thead>
<tr>
<th></th>
<th>SnF₂</th>
<th>AgF/SnF₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>New caries</td>
<td>96</td>
<td>26</td>
</tr>
<tr>
<td>No new caries</td>
<td>314</td>
<td>413</td>
</tr>
</tbody>
</table>

Chi-squared = 51.30
DF = 1
P = 0.000

Table 5. Teeth: after 18 months

<table>
<thead>
<tr>
<th></th>
<th>SnF₂</th>
<th>AgF/SnF₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carious</td>
<td>182</td>
<td>37</td>
</tr>
<tr>
<td>Non-carious</td>
<td>1381</td>
<td>1263</td>
</tr>
</tbody>
</table>

Chi-squared = 76.527
DF = 1
P = 0.000

Silver fluoride, like other silver salts, possesses appreciable anti-bacterial properties. It also occludes dentinal tubules (Histological studies, unpublished). Stannous fluoride is a reducing agent for AgF, but also has anti-bacterial properties.

As a final comment, no cases of so called ‘caries explosion’, that is, rapid and hidden development of occlusal caries have so far been found after AgF/SnF₂ treatment; all caries discovered was of a comparatively minor nature, and easily detected and treated. This does not appear to be the case with SnF₂ treatment, although no case of ‘caries explosion’ was found in this study.

In view of these findings, the application of AgF/SnF₂ seems a better caries prevention method than any other means except fissure sealants with glass ionomer cement. These are aesthetically preferable, and slightly more effective in caries prevention. The comparative cost of fissure sealants, particularly in time is a significant factor, especially in the field of Public Dentistry.

Acknowledgements

I wish to thank Dr Harry Lamplough (past Director, Dental Health Service), who encouraged me to begin this study, and whose help and interest has been invaluable.

I would also like to thank Dr Antony Stockwell who checked my statistics, and Dr Peter Jarman for help in the writing of this paper. Finally, I would like to thank the Dentists and Therapists who carried out the clinical evaluation, especially Ms Maria Oversby, Area Dental Therapist.

References


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INTRODUCTION

Dental caries is common among schoolchildren worldwide (Petersen, 2003) and occurs mostly in molars in the permanent dentition (Batchelor and Sheiham, 2004; Sheiham and Sabbah, 2010). This poses a significant problem in populous developing countries, such as China (Lo et al., 1999; Hu et al., 2011). There is a great need to implement effective programs to prevent caries in the pits and fissures of the permanent molars of schoolchildren. In rural or less-developed areas, where resources and dental care services are limited, innovative and cost-effective preventive methods are called for.

Systematic review has shown that dental sealant is effective for the prevention of fissure caries (Ahovuo-Saloranta et al., 2008). However, the good performance of sealants depends on high-quality placement aided by electrically powered devices (Beauchamp et al., 2008). Therefore, using this method in areas where access to dental clinics is limited may be problematic.

Sodium fluoride (NaF) varnish has been shown to be effective in preventing dental caries in children and adolescents (Marinho et al., 2002; Marinho, 2009). However, few clinical studies have been conducted specifically to assess its effectiveness in preventing caries in the pits and fissures of permanent molars (Hiiri et al., 2010).

A recent systematic review found silver diamine fluoride (SDF) solution to be effective in preventing and arresting dental caries in young children (Rosenblatt et al., 2009). So far, only one study reported on its use to prevent caries in permanent first molars (Llodra et al., 2005).

The aim of this study was to investigate the effectiveness of resin fissure sealant, NaF varnish, and SDF solution in preventing pit and fissure caries in permanent molars of schoolchildren. The null hypothesis was that all three treatments had no caries-preventive effect compared with a placebo control.

MATERIALS & METHODS

A randomized clinical trial with parallel groups was implemented in April 2008 in a suburb of Guangzhou in southern China. There was no systemic fluoridation, but approximately 90% of the toothpastes on sale contained fluoride. Ethical approval was granted by the University of Hong Kong (www.ClinicalTrials.gov #NCT01446107).

Children studying in grades 2 or 3 in the four largest primary schools of the study site were invited. Children with parental consent were clinically examined by one trained dentist in the schools. Generally healthy children who had at least one sound permanent first molar with deep fissures or fissures with signs of early (enamel) caries viewed as wet, with opacities and discoloration, similar to ICDAS code 2 (Ismail et al., 2007), were included. Molars with caries in dentin and fissures with potential dentin caries indicated by DIAGNOdent (KaVo, Biberach, Germany) readings ≥ 40 (Lussi et al., 2004) were excluded.
Each included molar was assessed at 2 sites (upper molar — mesial pit/fossa and distal-palatal groove; lower molar — occlusal fissure and buccal pit/groove). The recorded status included fissure morphology (deep/shallow), sign of early caries (yes/no), and DIAGNOdent reading. Information on the child’s toothbrushing habits, snacking habits, and dental visit history was collected through a questionnaire.

An assistant, using computer-generated random numbers, allocated the children individually among four groups: (1) sealant — placement of resin sealant (Clinpro Sealant, 3M ESPE, St. Paul, MN, USA) with no replacement; (2) NaF — semi-annual application of a 5% NaF varnish (Duraphat, Colgate-Palmolive Ltd, Waltrop, Germany); (3) SDF — annual application of a 38% SDF solution (Saforide, Toyo Seiyaku Kasei Co. Ltd., Osaka, Japan); or (4) placebo control — annual application of water. Treatments were applied by another dentist according to group allocation.

In the sealant group, the tooth was isolated with cotton rolls. Pits and fissures were etched with 37% phosphoric acid for 15 sec, washed with water, and then dried with gently blown air. The sealant was applied and then light-cured. Complete setting and retention of sealant were confirmed before the child left. In the NaF varnish and the SDF solution groups, the tooth was isolated with cotton rolls. The topical fluoride agent was painted on the pits/fissures by means of a small disposable brush. The child was instructed not to drink or eat for half an hour.

Status of the molars, including sealant retention and development of caries into dentin (ICDAS codes 4-6) (Ismail et al., 2007), was assessed every 6 mos by the same blinded examiner using disposable mouth-mirrors attached to an intra-oral LED light and CPI probes. Sites with sealant fully retained were regard as sound. The primary study outcome was carious cavity development into dentin. A 10% random sample was re-examined during every examination to monitor intra-examiner reproducibility. Carious cavities in the study molars were treated with placement of ART restorations.

In sample size calculation, an 80% survival (no dentin caries) of the molars receiving fissure sealant was anticipated, and a 10% absolute difference in caries incidence among groups was regarded as clinically significant. Based on a 5% statistical significance level and an 80% power, calculated by K*C cross-tabulation in SamplePower 2.0, 950 teeth were required. This number was multiplied by [1 + (m−1)ICC] to adjust for the clustering effect of several teeth within one child (Murray et al., 2004). The intraclass correlation (ICC) was estimated to be 0.2, and 3 molars were expected in each child (i.e., m = 3). With an anticipated 10% drop-out rate, the numbers of teeth and children required at baseline were 1,478 and 493, respectively.

Data Analysis
A chi-square test was used to compare the caries incidence of the four groups with the statistical software SPSS 19.0 (SPSS Inc., Chicago, IL, USA). To study the effects of various factors and to account for clustering of data, we performed a multi-level logistic regression analysis using generalized estimating equation (GEE) modeling with SAS 9.2 software (SAS Institute Inc., Cary, NC, USA). Outcome was recorded at the tooth-site level, and a two-level structure (level 1 — pit/fissure; level 2 — child) was adopted. The dependent variable was the presence of dentin
caries at the 24-month examination. Independent variables included those at the participant and tooth levels—treatment (sealant, NaF, SDF), gender (boy/girl), grade (2/3), snacking (frequent or not), toothbrushing (frequent or not), baseline dental visit history (yes/no), baseline dmft score, and molar location (upper/lower)—as well as variables at the site level—early caries at baseline (present/absent), DIAGNOdent reading (high/low), and fissure morphology (shallow/deep). Interaction effects between and among the independent variables were considered. Exchangeable and independent correlation structure of the clustering of sites in each child was also assessed, and the model yielding the highest QIC value was selected as the final model.

RESULTS

Among the 1,000 invited children, 499 were excluded because they did not fulfill the inclusion criteria (Fig.). In total, 3,078 pit/fissure sites (1,539 molars) in 501 children (50% boys), mean age 9.1 yrs, were included. In total, 485 children with 1,491 molars and 2,982 sites (97%) were followed for 24 mos. Eighteen sites in three children were excluded because orthodontic bands had been attached to the involved teeth. The only complaint received was a transient bitter taste associated with SDF, and no adverse side-effects were observed.

Regarding distribution of participant- and site-level factors in the four groups at baseline (Table 1), proportionately more children in the sealant group than in other groups had visited a dentist or consumed snacks once a day or less (p < 0.05). There were no significant differences in other factors.

Intra-examiner reliability was excellent (kappa > 0.9). At the 24-month examination, 46% of the sealants were partially or fully retained. Proportions of pit/fissure sites with dentin caries were not significantly different (p > 0.05) in the sealant, NaF, and SDF groups, at 1.6%, 2.4%, and 2.2%, respectively (Table 2). The percentage of sites with dentin caries in the control group, 4.6%, was significantly higher than those in the 3 treatment groups (p = 0.002). The site-level prevented fractions (PF) were 65%, 48%, and 52% for sealant, NaF varnish, and SDF solution, respectively.

The GEE logistic regression analysis results showed that sealant placement (OR = 0.32, p = 0.017), NaF varnish (OR = 0.43, p = 0.033), and SDF solution (OR = 0.44, p = 0.029) were protective factors, while lower molar (OR = 2.43, p = 0.009), early caries at baseline (OR = 3.09, p < 0.001), high baseline
DISCUSSION

In this study, effectiveness of the treatments was studied at the pit/fissure level. The 24-month incidence rates of dentin caries in the three treatment groups were lower than that in the control group. Thus, the null hypothesis was rejected. This is supported by the multi-level logistic regression analysis when the effects of data clustering and selected confounding factors were accounted for.

In this study, the prevented fraction (PF) of NaF varnish application after 24 mos at the tooth level was 39%. This is similar to the 38% PF found in a comparable study (Bravo et al., 1996). Hardman et al. (2007) did not find significant caries reduction when NaF varnish was applied to molars in schoolchildren, and they suggested the poor response and low caries incidence rates of the study sample as possible explanations. It has been suggested that children should be restricted from drinking and eating for half an hour (Adair, 2006) or 4 hrs (Hawkins et al., 2003) after fluoride varnish application. In this study, due to practical reasons (children would return home for a meal after school), the children were asked not to eat for at least half an hour. It is not clear to what extent this affected treatment effectiveness.

The tooth-level PF of the SDF solution application in this study, 41%, is lower than the PF of 65% found in a study conducted in Cuba (Llodra et al., 2005). This may be due to the difference in application frequency, once vs. twice per yr, between this and that study.

In this study, the tooth-level PF of resin sealant 24 mos after placement was 60%, which is lower than those reported in most of the previous studies (approximately 80%) (Ahovuo-Saloranta et al., 2008). This may be related to the lower sealant retention rate in this study compared with other studies, 46% vs. 80% (Muller-Bolla et al., 2006; Ahovuo-Saloranta et al., 2008). Most likely, the field setting and the use of portable dental equipment in this study were less than optimal for good placement of resin sealant. Difficulty in moisture control during sealant placement was sometimes encountered, which may have affected the retention of the resin-based fissure sealants, a main factor for its effectiveness. Under more optimal working conditions, a higher sealant retention rate and a higher PF would be expected (Gooch et al., 2009).

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The incidence of fissure caries in the control group in this study is in line with the recently reported national average.
prevalence of dental caries in 12-year-old children in China (Hu et al., 2011), but it is low compared with the results of previous studies conducted among high-caries-risk populations (Songpaisan et al., 1995; Bravo et al., 1996). This low 24-month caries incidence may be partially explained by today’s slower dental caries progression rate (Whelton, 2004). Similarly, low levels of fissure caries incidence have also been observed in schoolchildren at similar ages in other countries (Rugarabamu et al., 2002; Parner et al., 2007). In addition, the oral health education delivered to all of the children and the popularity of fluoridated toothpaste in the area of this study may have had an effect on decreasing caries development in the study population. This may in turn have led to a reduced difference in caries development among the four study groups.

Multilevel modeling with a Bayesian approach for survival analysis has been used to analyze hierarchical clustered interval-censored data from longitudinal clinical studies (Harkanen et al., 2002; Wong et al., 2005). In survival analysis, event development is linked with time. For events that take a long time to develop, such as carious cavity development in dentin, substantial bias may arise in survival analysis if the observation period is relatively short and the event occurrence rates are low for the early portions of the time scale. Since the caries progression rate in this study was low, the advantage of survival analysis may not be achieved. Therefore, multilevel logistic regression modeling, a method that uses single-time-point outcome data, was adopted.

In this study, although some of the background factors were not balanced at baseline, the possible interactions among these factors, together with the factor of treatment, were considered in the multivariate GEE logistic modeling. After the GEE model was used to adjust for the effects of data clustering and confounding factors, the factor of treatment remained in the final model. The effectiveness of the 3 study treatments in preventing pit and fissure caries in permanent molars was confirmed.

In the final model, it was found that study teeth with early caries at baseline, as indicated by clinical signs or a DIAGNOdent reading ≥ 16, were more likely to develop dentin caries after 24 mos. The lower molars in this study were also at a higher risk than the upper molars. This is in agreement with other epidemiological findings (Batchelor and Sheiham, 2004). These molars are at a higher risk of developing caries and warrant a higher priority for prevention (Beauchamp et al., 2008). In this study, children who had a dental visit history at baseline developed more dental caries during the 24-month period than those who did not. These children probably had a higher previous caries experience, which is commonly considered as a risk indicator for new caries development (Bader et al., 2008; Sarmadi et al., 2009).

The 2-year results of this clinical trial provide some support for the use of topical fluoride applications for the prevention of caries in the permanent molars of schoolchildren, given that it is their major dental disease. In areas or populations where resources and availability of dental care service do not present a major problem, resin sealant placement may be the preventive treatment of choice among schoolchildren. However, in less-developed areas, where economic consideration and resource limitations are more influential in decision-making, this may not be possible. Application of NaF varnish or SDF solution to the pits and fissures of the molars may be considered as an alternative preventive method to the placement of a fissure sealant. Topical fluoride application is technically simple, does not require powered dental equipment, and may be performed by trained auxiliary health personnel. These are advantages for its use in dental public health programs or community projects for the prevention of dental caries in schoolchildren, especially those living in places where there are shortages of dental personnel and necessary equipment for the placement of fissure sealant. Before recommendations can be made regarding these new alternative methods for fissure caries prevention, however, more information is needed from studies on longer-term outcomes and economic evaluation, such as their cost-effectiveness.

Based on the 24-month results and within the limitations of this study, it is concluded that the 3 preventive methods—placement of resin sealant, semi-annual application of NaF varnish, and annual application of SDF solution—are effective in preventing pit and fissure caries in permanent molars. Furthermore, they are not significantly different from one another in their effectiveness.

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REFERENCES


Efficacy of Silver Diamine Fluoride for Caries Reduction in Primary Teeth and First Permanent Molars of Schoolchildren: 36-month Clinical Trial

INTRODUCTION

The utilization of silver diamine fluoride (SDF) as a cariostatic agent is not novel. Recent reports (Klein et al., 1999; Chu et al., 2002) of its effects in deciduous teeth follow classic studies (Yamaga et al., 1972; Shimizu and Kawagoe, 1976; McDonald and Sheiham, 1994) that had already reported its utility in the treatment and prevention of caries in these teeth. To our best knowledge, no controlled clinical trial has evaluated the effectiveness of SDF in first permanent molars. Fissure sealants are recognized to be the most effective approach for the prevention of caries in fissured surfaces of permanent teeth (Llodra et al., 1993). However, further research on less costly alternatives is warranted, because of their wide use in countries or regions with fewer resources. We hypothesized that the six-monthly application of SDF can arrest the development of caries in the deciduous dentition and prevent caries in first permanent molars.

We conducted a 36-month controlled clinical trial to evaluate whether the six-monthly application of a 38% SDF solution is effective to prevent and arrest caries in deciduous and permanent teeth of a sample of Cuban schoolchildren.

MATERIALS & METHODS

A 36-month controlled clinical trial was conducted from February, 2000, to March, 2003, in a cohort of schoolchildren from Santiago de Cuba (Cuba), a city with a low fluoride content (0.09 ppm F ion) in the drinking water. All children from each school were registered with a government-funded dental health center that they visit annually for dental examination and treatment. All schools in the city run a program for 6- to 15-year-old schoolchildren, which includes toothbrushing instruction, dietary recommendations, and, during term time, mouthrinses every 2 wks with 0.2% sodium fluoride. The population receives no fluoridated water or salt, which, coupled with the extremely limited availability of fluoride toothpastes in this area, meant that all members of the study population shared the same low exposure to fluoride. Moreover, the subjects received no professional fluoride treatments.

The study included 452 schoolchildren of both sexes, none below 6 years of age, and all recruited from the "Colegio 26 de Julio" school. The study was approved by the Ethics Committee of the Institute of Medical Science of the University of Santiago de Cuba. The parents of all participants gave signed informed consent. Two previously calibrated examiners were responsible for all of the dental examinations. Each child underwent 7 examinations, one at baseline and then every 6 mos until the end of the study at 3 yrs. At each examination stage, we re-examined 10% of the schoolchildren to determine the intra-observer agreement. Inter-observer agreement was similarly tested, at baseline and at 1, 2, and 3 yrs. The schoolchildren were assigned on an individual random basis to the SDF or control group by a third researcher.
ensuring that the examiners were blinded to the group of each child. Examinations were carried out at the school by an examiner using an explorer and flat mirror. In deciduous teeth, data were gathered for the surfaces of only canines and molars. In permanent teeth, data were gathered only on first molars. Each surface was classified as healthy, with active caries (presence of cavity with soft floor/walls), with inactive caries (cavity with hard floor/walls), filled, or absent. In the case of deciduous teeth, only those extracted for caries were considered absent. On healthy surfaces or those with inactive caries, the presence or absence of black stain was recorded. Teeth with an abscess, evidence of pulp exposure, premature hypermobility, fissure, or abnormal coloring were considered non-vital. The treatment of each tooth (restoration, pulpal treatment, extraction) was also recorded at every examination stage, and Kappa values for intra-observer reliability was >0.93 at all examination stages, and Kappa values for inter-observer reliability were 0.92 at baseline (tested on 38 children), 0.94 at 12 mos (45 children), 0.89 at 24 mos (41 children), and 0.91 at 36 mos (47 children). In the 373 children followed up throughout the study, the mean baseline decayed, missing, and filled surface (dmfs) index scores were 3.68 ± 0.30 and 3.35 ± 0.26 in the SDF and control groups, respectively. The mean number of surfaces with active caries was 3.29 ± 0.28 in the SDF group and 2.91 ± 0.22 in the control group (Table 1). At baseline, there were no statistically significant differences between the groups in dmfs score or number of surfaces with active caries. There were no significant differences in baseline dmfs or number of surfaces with active caries between the children lost to the follow-up and the group that completed the study (results not shown).

In the deciduous dentition (Table 2), significant differences were observed between the groups in the mean of new decayed surfaces appearing during the study (Student’s t test, p < 0.001). The preventive fraction of SDF in deciduous teeth was 79.7%. The children in the SDF group had significantly more surfaces with active caries (Student’s t test, p < 0.05) and a higher percentage of black stains (97%), compared with the control group, in which only 48% of the inactive lesions were black ($\chi^2$ test, p < 0.001). There was no significant difference between the groups in mean number of non-vital deciduous teeth (Student’s t test, p = 0.65).

In first permanent molars (Table 3), the control group showed a higher mean number of new decayed surfaces vs. the SDF group (Student’s t test, p < 0.001). The preventive fraction of the SDF group was 65% in first permanent molars. Compared with the controls, the SDF-treated children presented more surfaces with inactive caries (Student’s t test, p < 0.05) and a higher proportion of black stains in inactive lesions ($\chi^2$ test, p < 0.001). Throughout the study, only 5 first permanent molars with pulpal lesions were observed (2 in the SDF group and 3 in the control group), and no first permanent molar was extracted.

Most of the children studied, 73.9% of the SDF group and 50.2% of the control group, presented no increment or reduction in the DFT-1m index (decayed + filled first permanent molars) at the end of the study. The differences

### Table 1. Analysis of Baseline dmfs and Surfaces with Active Caries in the Whole Sample and the Children Completing the 36-month Follow-up (SE in parentheses)

<table>
<thead>
<tr>
<th>Group</th>
<th>Whole Sample</th>
<th>Schoolchildren Followed for 36 mos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. schoolchildren</td>
<td>dmfs$^a$</td>
</tr>
<tr>
<td>SDF</td>
<td>225</td>
<td>3.6 [0.2]</td>
</tr>
<tr>
<td>Control</td>
<td>227</td>
<td>3.5 [0.3]</td>
</tr>
<tr>
<td>Significance</td>
<td>p = 0.74$^b$</td>
<td>p = 0.81$^b$</td>
</tr>
</tbody>
</table>

$^a$ Decayed, missing, and filled surface index of deciduous canines and molars.

$^b$ Student’s t test.

$^c$ $\chi^2$ test.

### Table 2. Analysis of Mean Numbers of New Surfaces with Active Caries, Surfaces with Inactive Caries, and Non-vital Teeth in Deciduous Dentition at 36 Months of Follow-up (SE in parentheses)

<table>
<thead>
<tr>
<th>Group</th>
<th>No. Schoolchildren</th>
<th>New Surfaces</th>
<th>Surfaces with Inactive Caries</th>
<th>% Surface with Inactive Caries and Black Stain</th>
<th>Non-vital Teeth</th>
</tr>
</thead>
<tbody>
<tr>
<td>SDF</td>
<td>180</td>
<td>0.3 [0.1]</td>
<td>2.8 [0.3]</td>
<td>97</td>
<td>0.1 [0.0]</td>
</tr>
<tr>
<td>Control</td>
<td>193</td>
<td>1.4 [0.2]</td>
<td>1.8 [0.3]</td>
<td>48</td>
<td>0.1 [0.0]</td>
</tr>
<tr>
<td>Significance</td>
<td>p &lt; 0.001</td>
<td>p &lt; 0.05</td>
<td>P &lt; 0.001</td>
<td>p = 0.65</td>
<td></td>
</tr>
</tbody>
</table>

### Statistical Analysis

Sample size estimation was conducted with a 95% confidence interval and statistical power of 80%. Intra-observer and inter-observer agreements were measured with the Kappa test. The comparison of means was studied by the Student’s t test and multiple linear regression analysis. We used the chi-square ($\chi^2$) test to study the distribution of children lost to follow-up and the distribution of black stain between the two groups. The significance level considered was 0.05. Analyses were performed with use of the SPSS statistical program (version 11.0).
between the groups were mainly in children showing 3 or 4 new decayed or filled teeth (Table 4).

**DISCUSSION**

The design of our study is worthy of comment. The validity of the results was strengthened by the use of two previously calibrated examiners and by systematic testing of the intra- and inter-observer agreement. The presence of a cavity was the sole diagnostic criterion for caries, which may be a study limitation, since it excludes incipient caries lesions. It could be argued that black stains, much more frequent in the SDF group, compromised the blinded nature of the analysis. However, numerous black stains also appeared in the control group, making it impossible for the examiner to know the group of the child on this basis. With respect to any possible Hawthorne effect in the SDF group, it should be remembered that all of the schoolchildren continued to receive identical treatments, with the sole exception of the SDF application, regardless of the group to which they were assigned. We chose to conduct our study in Santiago de Cuba for two main reasons: There was an existing school dental health program that had been functioning for more than 40 years, and it was economically impossible in this setting to offer other preventive options, such as fissure sealing, to control caries in first permanent molars.

The main aim of our study was to test the anti-caries efficacy of a six-monthly application of a 38% SDF solution in both deciduous teeth and first permanent molars. Both the preventive and therapeutic (possibility to arrest or reverse active caries) effects of this technique were analyzed. With respect to the prevention of new caries lesions, our SDF treatments showed a greater percentage of efficacy in deciduous teeth (around 80%) than in first permanent molar (65%) teeth. A recent Chinese study of deciduous incisors (Chu et al., 2002) reported a percentage of efficacy of 70-83%, depending on the clinical application protocol, similar to our results. In the present study, the baseline level of caries was much higher in deciduous teeth (mean of > 3 surfaces with caries) than in first permanent molars (0.3 surfaces with caries), which may explain the greater efficacy of the SDF solution in the deciduous dentition.

The application of fissure sealants is the most widespread model for the prevention of caries in first permanent molars. Llrodra et al. (1993) published a meta-analysis that demonstrated a preventive fraction of 70% at 36 mos of follow-up. Our search of the literature disclosed no controlled clinical study based on the use of SDF in permanent teeth, although some clinical studies with small sample sizes have been published. Green (1989) reported that a solution of SDF + SnF$_2$ was more effective in reducing caries in first permanent molars, compared with the application of SnF$_2$ alone. Yamaga et al. (1972) studied 25 schoolchildren and found an 8% incidence of caries in SDF-treated first permanent molars, compared with 32% in controls, after a nine-month follow-up. With respect to the therapeutic effect of SDF (arrest of caries), around 77% of treated caries that was active at baseline became inactive during the study, both in deciduous teeth and in first permanent molars. In the SDF group, practically all surfaces with inactive caries in first permanent molars. In the SDF group, practically all surfaces with inactive caries (Table 4).

**Table 3. Analysis of Mean Numbers of New Surfaces with Active Caries and Surfaces with Inactive Caries in First Permanent Molars (1M) at 36 Months of Follow-up (SE in parentheses)**

<table>
<thead>
<tr>
<th></th>
<th>SDF (N = 180)</th>
<th>Control (n = 193)</th>
<th>Comparison, p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DFS-1M$^a$</td>
<td>0.3 (0.0)</td>
<td>0.4 (0.1)</td>
<td>p = 0.66</td>
</tr>
<tr>
<td>DS-1M</td>
<td>0.3 (0.0)</td>
<td>0.3 (0.1)</td>
<td>p = 0.87</td>
</tr>
<tr>
<td>FS-1M</td>
<td>0.0 (0.0)</td>
<td>0.1 (0.0)</td>
<td>p = 0.02</td>
</tr>
<tr>
<td>New with active caries: DFS-1M</td>
<td>0.4 (0.1)</td>
<td>1.1 (0.1)</td>
<td>p &lt; 0.001$^c$</td>
</tr>
<tr>
<td>DS-1M</td>
<td>0.1 (0.0)</td>
<td>0.2 (0.1)</td>
<td>p = 0.09</td>
</tr>
<tr>
<td>FS-1M</td>
<td>0.3 (0.0)</td>
<td>0.9 (0.1)</td>
<td>p &lt; 0.001</td>
</tr>
<tr>
<td>Surfaces with inactive caries-1M$^b$</td>
<td>0.3 (0.1)</td>
<td>0.1 (0.0)</td>
<td>p &lt; 0.05</td>
</tr>
<tr>
<td>% surfaces with inactive caries and black stain-1M</td>
<td>96%</td>
<td>67%</td>
<td>p &lt; 0.001</td>
</tr>
</tbody>
</table>

$^a$ DFS-1M = Active Decayed (DS)+ filled surfaces (FS) in first permanent molars.

$^b$ They were arrested, and correspond to baseline surfaces with active caries.

$^c$ The adjusted difference between groups in DMFT (M1) by linear regression analysis (including the initial value as a potential confounder) arrives at the same conclusion (results not shown).
washing with water. Another proposed drawback of SDF treatment is the appearance of black stains, although in our view this is far outweighed by the caries-preventive benefits of SDF treatment.

There are no published recommendations for the frequency of SDF applications. Some authors applied the solution annually and others six-monthly. There is no documented evidence that starting treatment with multiple applications in a short period is preferable to starting with a single initial application. The application of a 38% SDF solution is a simple and low-cost method that does not require the cooperation of the patient or the complex training of the health professional. This approach may be of great utility as an alternative to more costly preventive methods in communities with limited resources. Its mechanism of action means that it can be useful to prevent and arrest caries in all teeth and surfaces. Wider studies of this treatment are required to investigate alternative protocols, different age groups, and high-risk groups, to evaluate long-term outcomes, and to evaluate the efficiency of this approach, using more sensitive criteria for caries diagnosis.

The outcomes at 36 mos showed that the six-monthly application of a 38% SDF solution is efficacious to control caries in deciduous teeth. Our findings indicate that this approach is also efficacious to control caries in first permanent molars.

ACKNOWLEDGMENTS

The authors are grateful to the School of Dentistry of the University of Santiago, Cuba, for its assistance, and to the NGO Odontología Solidaria for its support. The study was funded by the local government of the Balearic Islands. The authors have no financial interest in the products cited in the text.

REFERENCES

Because of its high prevalence,1 dental caries is the focus of many interventions targeted toward prevention and control. The use of fluoridated toothpastes,2 other topically applied fluorides,3 fluoridated municipal water4 and pit-and-fissure sealants,5-7 along with dietary improvement, remain mainstays of caries management. These modalities, which are based on high-quality evidence, are the first choice for prevention and control of dental caries.

Nonfluoride agents may serve as adjunctive therapeutics for preventing, arresting or even reversing dental caries. This article presents a summary of the evidence-based clinical recommendations developed by a multidisciplinary panel of experts convened by the American Dental Association (ADA) Council on Scientific Affairs. The report addresses nonfluoride caries-preventive agents including sucrose-free polyol chewing gums, xylitol dentifrices, chlorhexidine, chlorhexidine in combination with...
thymol, calcium-containing agents, phosphate-containing agents, casein derivatives, sialogogues, iodine and triclosan. (The full report can be accessed online at “http://ebd.ada.org/ClinicalRecommendations.aspx”.) The Centers for Disease Control and Prevention partly funded this project.

This report is intended to assist practitioners with decision making about the use of nonfluoride caries-preventive agents to arrest, prevent or reverse caries. The recommendations in this article are not intended to define a standard of care and rather should be integrated with a practitioner’s professional judgment and a patient’s needs and preferences.

**METHODS**

The panel conducted a systematic review of the literature (the complete version of which is available at “http://ebd.ada.org/ClinicalRecommendations.aspx”). The panel developed evidence statements based on the body of evidence and graded the level of certainty of the evidence as high, moderate or low on the basis of a standardized grading system (Table 1).

Then the panel developed clinical recommendations and graded the strength of each recommendation (Table 2). When the panel found evidence supporting efficacy, the members assessed adverse events reported in the trials and discussed any potential adverse events that could be associated with the intervention based on their knowledge of the existing literature.

(Note that the panel did not conduct a review of the data specifically for adverse effects). When the panel was unable to reach a consensus in interpreting evidence into clinically relevant recommendations or when it made recommendations based largely on expert consensus, it used a simple majority vote to make final determinations.

**RESULTS**

**Summary of evidence.** The panel included 71 published articles whose authors described 50 randomized controlled trials (RCTs) and 15 non-randomized studies to assess the efficacy of various non-fluoride caries-preventive agents. (Some clinical studies were published as multiple articles.) Only six of these studies were conducted in the United States. Although most studies were conducted in communities with low levels of fluoride in the water supply, participants often used fluoridated toothpaste, received regular dental care that included in-office fluoride therapies or both.

Table 3*10-45 (page 1068) presents the evidence statements for each agent. Table 2 presents the recommendations from the expert panel.

**DISCUSSION**

**Clinical considerations.** Overall, the published literature on these topics lacks clinical trials that follow the Consolidated Standards of Reporting Trials guidelines, especially with regard to appropriate methods of randomization, sample allocation concealment, accounting for losses to follow-up and intention-to-treat analyses. Most trials included in this systematic review involved assessment of the efficacy of nonfluoride agents. In efficacy trials (explanatory trials), researchers aim to determine whether an intervention produces the expected result under ideal circumstances. In effectiveness trials (pragmatic trials), researchers measure the degree of beneficial effect in real-world clinical settings. The panel noted that effectiveness trials have greater clinical relevance. The panel found that available study findings provided limited information about the caries risk status of participants. The lack of uniformity in description of the background fluoride exposure of study samples, in part, led the panel to conclude that the nonfluoride preventive agents should be considered as adjunctive to a regular caries-prevention program. The evidence does not indicate that these agents are effective in patients whose condition is refractory to proven methods of caries prevention.

**Sucrose-free polyol chewing gums.** With

TABLE 2

Recommendations from the American Dental Association Council on Scientific Affairs Nonfluoride Caries-Preventive Agents Expert Panel.

| Strength of Recommendations: Each recommendation is based on the best available evidence. The level of evidence available to support each recommendation may differ. |
|---|---|---|---|---|
| **STONG** | **IN FAVOR** | **WEAK** | **AGAINST** | **EXPERT OPINION** |
| Evidence strongly supports providing this intervention | Evidence favors providing this intervention | Evidence suggests implementing this intervention only after alternatives have been considered | Evidence suggests not implementing this intervention | Evidence is lacking; any recommendation for or against is based on expert opinion |

The panel acknowledges the oral and systemic benefits of lowering the quantity and frequency of sugar consumption and encourages practitioners to provide dietary counseling. The panel also strongly recommends that practitioners first implement evidence-based recommendations regarding topical fluorides and sealants before attempting to use any nonfluoride therapies. The following recommendations may be considered adjuncts to dietary counseling and a regular caries-preventive program offered to patients at higher risk of developing caries.

<table>
<thead>
<tr>
<th>Polyl (Coronal Caries)</th>
<th>Advise parents and caregivers of children 5 years or older that use of sucrose-free polyl (xylitol only or polyl combinations) chewing gum for 10 to 20 minutes after meals may reduce incidence of coronal caries</th>
<th><img src="1" alt="IN FAVOR" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Advise adults that use of sucrose-free polyl (xylitol only or polyl combinations) chewing gum for 10 to 20 minutes after meals may reduce incidence of coronal caries</td>
<td><img src="1" alt="IN FAVOR" /></td>
</tr>
<tr>
<td></td>
<td>Advise parents and caregivers of children 5 years or older that the daily use of xylitol-containing lozenges or hard candies that are dissolved slowly in the mouth after meals may reduce incidence of coronal caries (5-8 grams/day divided into two to three doses)</td>
<td><img src="1" alt="WEAK" /></td>
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<table>
<thead>
<tr>
<th>Chlorhexidine (Root Caries)</th>
<th>Apply 1:1 mixture of chlorhexidine-thymol varnish every three months to reduce the incidence of root caries</th>
<th><img src="1" alt="IN FAVOR" /></th>
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<tr>
<td></td>
<td>Applying 0.5 to 1.0 percent chlorhexidine gel alone or in combination with fluoride for prevention of root caries is not recommended</td>
<td><img src="1" alt="AGAINST" /></td>
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<tr>
<td></td>
<td>Using 0.12 percent chlorhexidine rinse alone or in combination with fluoride for prevention of root caries is not recommended</td>
<td><img src="1" alt="AGAINST" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Chlorhexidine (Coronal Caries)</th>
<th>Applying 1:1 mixture of chlorhexidine-thymol varnish alone or in combination with fluoride for prevention of coronal caries is not recommended</th>
<th><img src="1" alt="AGAINST" /></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Applying 10 to 40 percent chlorhexidine varnish alone or in combination with fluoride for prevention of coronal caries is not recommended</td>
<td><img src="1" alt="AGAINST" /></td>
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<tr>
<td></td>
<td>Applying 0.5 to 1.0 percent chlorhexidine gel alone or in combination with fluoride for prevention of coronal caries is not recommended</td>
<td><img src="1" alt="AGAINST" /></td>
</tr>
<tr>
<td></td>
<td>Using 0.12 percent chlorhexidine rinse alone or in combination with fluoride for prevention of coronal caries is not recommended</td>
<td><img src="1" alt="AGAINST" /></td>
</tr>
</tbody>
</table>

* Sources: Tinanoff and Palmer and Johnson and colleagues.
† Source: American Dental Association Council on Scientific Affairs.
‡ Source: Beauchamp and colleagues.
§ A regular caries-preventive program includes routine and periodic examination by a dentist, patient education, dietary advice from a health care professional and appropriate use of professional and home fluoride products and dental sealants.
TABLE 3

<table>
<thead>
<tr>
<th>AGENT</th>
<th>EVIDENCE STATEMENT</th>
<th>LEVEL OF CERTAINTY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sucrose-Free Polyol Chewing Gums</td>
<td>In children aged 5 to 16 years, supervised consumption of chewing gum sweetened with sucrose-free polyol (xylitol only or polyol combinations) for 10 to 20 minutes after meals marginally reduces incidence of caries†</td>
<td>Moderate</td>
</tr>
<tr>
<td>Xylitol Candy and Lozenges</td>
<td>In children reporting caries experience, consumption of xylitol-containing lozenges or hard candy reduces incidence of coronal caries§</td>
<td>Low</td>
</tr>
<tr>
<td>Chlorhexidine Varnish for Coronal Caries</td>
<td>In children aged 4 to 18 years, professionally applied 10 to 40 percent chlorhexidine varnish does not reduce the incidence of caries§</td>
<td>Moderate</td>
</tr>
<tr>
<td>Chlorhexidine-Thymol Varnish for Coronal Caries</td>
<td>In children up to 15 years, application of a 1:1 mixture of chlorhexidine-thymol varnish does not reduce the incidence of caries§</td>
<td>Low</td>
</tr>
<tr>
<td>Chlorhexidine-Thymol Varnish for Root Caries</td>
<td>In adults and elderly people, application of a 1:1 mixture of chlorhexidine-thymol varnish reduces the incidence of root caries§</td>
<td>Moderate</td>
</tr>
<tr>
<td>Chlorhexidine Rinse for Coronal Caries</td>
<td>In children and adults, use of 0.05 to 0.12 percent chlorhexidine rinse does not reduce the incidence of coronal caries§</td>
<td>High</td>
</tr>
<tr>
<td>Chlorhexidine Rinse for Root Caries</td>
<td>In adults and elderly people, use of 0.12 percent chlorhexidine rinse does not reduce the incidence of root caries§</td>
<td>Moderate</td>
</tr>
</tbody>
</table>

* There is insufficient evidence to support any statement regarding the caries-preventive effects of xylitol syrup, xylitol in dentifrices, chlorhexidine varnish for root caries, chlorhexidine gels, triclosan, iodine, sialogogues, calcium phosphate products and use of nonfluoride agents in pregnant women. A conclusion of “insufficient” evidence does not mean that the intervention is ineffective but rather that the panel did not find enough evidence to support a recommendation.

† Sources: Finn and colleagues,60 Richardson and colleagues,61 Szoke and colleagues,62 Beiswanger and colleagues,63 Glass,64 Machiulskiene and colleagues,65 Alalen and colleagues,65 Alalen and colleagues,66 Kovari and colleagues,66 Peng and colleagues,66 Makinen and colleagues,67 Makinen and colleagues,67 Kandelmian and Gagnon,68 Petersen and Razanamihaja39 and Isokangas and colleagues.69

‡ Sources: Alalen and colleagues,65 Oscarson and colleagues70 and Honkala and colleagues.71

§ Sources: Du and colleagues,72 de Soet and colleagues,73 Jenatschke and colleagues,73 Fennis-le and colleagues74 and Forgie and colleagues.75

¶ Sources: Petersson and colleagues,76 Splieth and colleagues,77 Ogaard and colleagues,77 Baca and colleagues,78 Twetman and Petersson36 and Plotzitza and colleagues.79

# Sources: Baca and colleagues,78 Brailsford and colleagues80 and Tan and colleagues.81

** Sources: Wyatt and colleagues,64 Wyatt and MacEntee,82 Spets-Happonen and colleagues,82 Luoma and colleagues83 and Duarte and colleagues.84

†† Sources: Wyatt and colleagues84 and Wyatt and MacEntee.84

regard to sucrose-free polyol chewing gums, the panel noted that it is biologically plausible that the act of chewing itself increases the rate of food clearance from the mouth, increases saliva production and more quickly neutralizes plaque acids, thereby potentially lowering the incidence and progression of caries. Unfortunately, study participants in the control arms of the reviewed studies did not chew gum, making it impossible to distinguish between possible benefits associated with chewing itself versus those associated with the effects of the polyol.

In balancing the benefits and the potential adverse effects of use of these chewing gums, the majority of the panel believed that the benefits of supervised gum chewing added to a caries-prevention regimen, especially in children at high risk of experiencing caries, could outweigh the potential adverse effects (for example, choking hazard for children younger than 4 years86 and adverse health effects89-94). Therefore, the panelists agreed with the recommendation that practitioners advise parents and caregivers of healthy children older than 5 years and at high risk of experiencing caries that the children use sucrose-free polyol chewing gum (containing either xylitol only or polyol combinations) after meals. Chewing gum use should be reserved for neurologically healthy children 5 years and older who are willing and able to chew for an extended period (the investigators in most of the studies included in this review reported that the participants chewed for at least 10 minutes). The panel extrapolated the evidence to adults who are at higher risk of developing caries and recommended chewing sucrose-free polyol gum (containing either xylitol only or polyol combinations) after meals. In balancing the benefits and risks of a chewing gum regimen, some panel members thought that the evidence for efficacy was not
strong enough to make a recommendation in favor of instituting gum chewing after meals.

**Xylitol candy, lozenges and syrup.** On the basis of results from three studies, a majority of the panel recommended the use of xylitol lozenges or hard candy after meals for children older than 5 years. The majority of the panel also suggested a dose of 5 to 8 grams per day divided into two or three doses to maximize clinical benefits. As discussed previously, hard candy also should be used under supervised conditions in neurologically healthy children to reduce the risk of choking. The panel did not find sufficient evidence to support recommendations for use of xylitol by children younger than 5 years. Some members of the panel thought that the existing weak evidence was not sufficient to support a recommendation for the use of xylitol delivered through lozenges.

**Topical chlorhexidine products.** In the United States, chlorhexidine is marketed as a 1:1 mixture of chlorhexidine-thymol varnish (such as Cervitec Gel, Ivoclar Vivadent, Schaan, Liechtenstein) and a 0.12 percent chlorhexidine gluconate mouthrinse (such as Peridex Chlorhexidine Gluconate 0.12% Oral Rinse [3M ESPE, St. Paul, Minn.] and PerioGard [Colgate, New York City]). The U.S. Food and Drug Administration has not approved either of these agents for caries prevention. In Europe, 10 to 40 percent chlorhexidine varnishes (for example, EC40 [Biovent, Nijmegen, Netherlands], BioC [Biovent] and Chlorzoin [Knowell Therapeutic Technologies, Toronto]) are marketed. Chlorhexidine gels also are not available in the United States.

Although chlorhexidine has been shown to reduce *Streptococcus mutans* in the oral cavity temporarily, most of the clinical study investigators who evaluated coronal caries as the outcome did not show a statistically significant reduction in caries with the use of chlorhexidine in any vehicle. On the basis of the results of these studies, the panel recommended against using chlorhexidine products for coronal caries prevention at this time. With respect to root caries, the panel concluded that application of chlorhexidine-thymol varnish may help reduce the incidence of root caries in adults and elderly people and reported insufficient evidence supporting the use of 10 to 40 percent chlorhexidine varnish.

**CONCLUSIONS**

After conducting a comprehensive review of the literature, the panel concluded that certain nonfluoride agents may provide some benefit as adjunctive therapies in children and adults who are at higher risk of experiencing caries. The panel found at least 10 ongoing clinical trials that may in the future provide additional evidence for or against the effectiveness of many of these modalities. Therefore, on the basis of available evidence, the panel recommended sucrose-free chewing gum (containing either xylitol only or polyol combinations) or xylitol lozenges for caries prevention. In addition, the panel found that a 1:1 mixture of chlorhexidine-thymol varnish may be efficacious in the prevention of root caries.

A clinician must consider a patient’s risk of experiencing disease and other factors such as readiness for change, oral health literacy and compliance when developing an optimal caries prevention plan. Patient education, dietary advice and periodic clinical examinations should be part of such a plan. Clinicians should encourage parents and caregivers to limit a child’s consumption of sugar-containing foods and drinks and, when possible, to confine consumption to mealtimes. In light of good supportive evidence, the panel reminds clinicians that professional and home-use fluoride products, including fluoridated toothpastes and dental sealants, remain the primary interventions effective in preventing caries and recommends that clinicians follow published evidence-based guidelines for these modalities. In contrast, the modalities examined in this review had less evidentiary support, both for and against. Regarding some studies in which the evidence was lacking, of poor quality or contradictory, and in which the panelists could not reliably estimate the benefits versus harms on the basis of the findings of published studies, the panelists concluded that there was insufficient evidence. In such cases, clinicians and patients alike should understand fully the uncertainty in the underlying evidence, as well as any potential risks of using or not using a particular intervention. The patient’s caries risk status, the practitioner’s professional judgment and a patient’s needs and preferences should guide all decision making.

Use of any adjunctive strategies does not eliminate or change the requirements for proven modalities for caries prevention, including topical fluorides and sealants. The panelists did not compare fluoride with nonfluoride therapies because they strongly recommend using proven caries-prevention modalities—including dietary improvement, fluorides and sealants—before attempting to use other strategies, including those that are the topic of this report.
Dr. Rethman is an adjunct assistant professor of periodontology, College of Dentistry, The Ohio State University College of Dentistry, Columbus; and an adjunct assistant professor of periodontics, Baltimore College of Dental Surgery, University of Maryland. He also is vice president for scientific research, American Dental Association, Chicago, and a past chair, Council on Scientific Affairs, American Dental Association.

Dr. Beltrán-Aguilar is a senior epidemiologist and an adviser to the director, Division of Oral Health, Centers for Disease Control and Prevention, Atlanta. He represented the Centers for Disease Control and Prevention on the panel.

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Dr. Clark is an assistant professor of pediatrics, Albany Medical Center, N.Y. She represented the American Academy of Pediatrics on the panel.

Dr. Dony is a professor and the chair, Department of Pediatric Dentistry, Dental School, University of Texas Health Science Center San Antonio. He represented the American Academy of Pediatric Dentistry on the panel.

Dr. Hujoe is a professor, Department of Dental Public Health Sciences, School of Dentistry, University of Washington, Seattle.

Dr. Katz is a professor and the chair, Department of Biostatistics, School of Medicine, Indiana University, Indianapolis.

Dr. Milgrom is a professor, Department of Dental Public Health Sciences, School of Dentistry, University of Washington, Seattle.

Dr. Sohn is an associate professor, Department of Cariology, Restorative Sciences, and Endodontics, School of Dentistry, University of Michigan, Ann Arbor. He represented the American Association of Public Health Dentistry on the panel.

Dr. Stamm is a professor, Department of Dental Ecology, School of Dentistry, University of North Carolina, Chapel Hill.

Dr. Watson is an associate professor, Department of Dentistry, School of Medicine and Dentistry, University of Rochester, N.Y.

Dr. Wolff is a professor and the chair, Department of Cariology and Comprehensive Care, College of Dentistry, New York University, New York City.

Dr. Wright is a professor and the chair, Department of Pediatric Dentistry, School of Dentistry, University of North Carolina, Chapel Hill.

Dr. Zeno is a professor and the chair, Department of Preventive and Community Dentistry, and the director and the associate dean for research, Oral Health Research Institute, School of Dentistry, Indiana University, Indianapolis.

Dr. Aravamudhan was the associate director, Center for Evidence-Based Dentistry, Division of Science, American Dental Association, Chicago, when this article was written. She now is the senior manager, Office of Quality Assessment and Improvement, Council on Dental Practice, American Dental Association, Chicago.

Dr. Frantsve-Hawley is the director, Research Institute and Center for Evidence-Based Dentistry, Division of Science, American Dental Association, 211 E. Chicago Ave., Chicago, Ill. 60611, e-mail “frantsvej@ada.org”. Address reprint requests to Dr. Frantsve-Hawley.

Dr. Meyer is the senior vice president for scientific and professional affairs, American Dental Association, Chicago.

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The American Dental Association (ADA) Council on Scientific Affairs Expert Panel on Nonfluoride Caries-Preventive Agents acknowledges the efforts of the following people and their commitment in helping complete this project: Dr. Jane Atkinson, National Institute of Dental and Craniofacial Research (NIDCR), Bethesda, Md.; Sam Cole, ADA Health Policy Resource Center, Chicago; Dr. Tariq Javed, ADA Council on Dental Education and Licensure, Chicago; Dr. Brian Scott, ADA Council on Access, Prevention and Interprofessional Relations, Chicago; Dr. Douglas Torbush, ADA Council on Dental Practice, Chicago; Dr. Bruce Toy, ADA Council on Dental Benefit Programs, Chicago; and Tom Wall, ADA Health Policy Research Center, Chicago. The panel thanks the following people and organizations whose valuable input during the external review process helped improve this report: Dr. James Badar, University of North Carolina, Chapel Hill; Dr. David Banting, University of Western Ontario, London, Ontario, Canada; Dr. Page Caufield, New York University, New York City; Dr. Deborah Dawson, University of Iowa, Iowa City; Dr. Paul Farsai, Boston University; Dr. Helen Whelton, National University of Ireland, Cork; the Agency for Healthcare Research and Quality, Rockville, Md.; America’s Health Insurance Plans, Washington; the American Academy of Pediatrics, Elk Grove Village, Ill.; the ADA Council on Communications, the ADA Council on Dental Education and Licensure, the ADA Council on Dental Practice and the ADA Council on Scientific Affairs, all in Chicago; the Cochrane Oral Health Group, Manchester, England; the Canadian Dental Association, Ottawa, Ontario, Canada; the Centers for Disease Control and Prevention, Atlanta; and NIDCR.

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.


Part 1 – Submitter Information

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<td>Name: Dental Codeology Consortium</td>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☐ | No > ☒ |

If Yes, Name: [Name]

Part 2 – Submission Details

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

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<thead>
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<th>Nomenclature</th>
<th>Descriptor</th>
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<td>Counseling for the control and prevention of adverse oral, behavioral, and systemic health effects associated with high-risk substance use</td>
<td>Counseling services may include patient education about adverse oral, behavioral, and systemic effects associated with high-risk substance use and administration routes. This includes ingesting, injecting, inhaling and vaping. Substances used in a high-risk manner may include but are not limited to alcohol, opioids, nicotine, cannabis, methamphetamine and other pharmaceuticals or chemicals.</td>
</tr>
</tbody>
</table>

NOTICE TO PREPARER AND SUBMITTER:

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3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

The CDT Procedure Code Manual includes D1320 for tobacco counseling and D1310 for nutritional counseling. **There currently is no procedure code for counseling for high-risk substance use that may lead to adverse health effects.**

The CDC has issued warning against use of all **vaping devices** effective September 2019 surrounding the risk of acute severe lung disease. The list of negative long term oral and systemic effects of **electronic cigarette use** is widening and forthcoming. The U.S. Surgeon General has issued warnings regarding the “epidemic of teen vaping” and associated dangers.

**As of Oct 17, 2019,** E-cigarette or vaping device use is being investigated as the suspected causative link with dozens of seizures and linked to at least 31 deaths. Vaping is suspected of being linked to 1300+ cases of severe lung disease as of October 2019 and more are being reported every day.

The CDC has issued a warning to the general public to refrain from all e-cigarette and vaping use.

**Opioid use** and abuse are rising in the US with approximately 130 people dying each day by overdose. Addiction to opioids is alarmingly on the rise. And recent research reports show that more than 50% of **people who have ever taken opioids for pain management received their first prescription from a dentist** – making the dental profession reexamine their role in the current crisis.

**Heavy alcohol use** is a well-known risk factor for oral-pharyngeal cancer according to the CDC and contributes to 88,000 deaths each year in the US.

There have been many calls to action by the FDA, CDC and other organizations for healthcare professionals to educate themselves and their patients on the dangers of high-risk substance use.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>a) CDT Code currently used to report the procedure</th>
<th>none</th>
</tr>
</thead>
<tbody>
<tr>
<td>b) Procedure technical description</td>
<td>Counseling and advising patients at moderate to high-risk of substance use.</td>
</tr>
<tr>
<td>c) Clinical scenario</td>
<td>Counseling and advising is provided to patients who exhibit or report high-risk substance use. The dental professional provides appropriate education, advice and consultation as well as information about resources and cessation referrals as needed.</td>
</tr>
</tbody>
</table>

**NOTICE TO PREPARER AND SUBMITTER:**

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Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

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<thead>
<tr>
<th>a) Material submitted?</th>
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<td>Yes</td>
<td>☐</td>
<td>No</td>
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</tr>
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</table>

6. Additional Comment or Explanation:

These are just a very few of the references related to this procedure.

**CDC Call to Action:** “The Call to Action on e-cigarette use among teens and young adults” “E-cigarette use, particularly among youth and young adults, has become a public health concern that warrants immediate and coordinated action.”. [https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/pdfs/2016_SGR_The_Call-508.pdf](https://www.cdc.gov/tobacco/data_statistics/sgr/e-cigarettes/pdfs/2016_SGR_The_Call-508.pdf)


**Opioid Use Disorder in Dental Patients: The Latest on How to Identify, Treat, Refer and Apply Laws and Regulations in Your Practice.** “Opioid use disorder is a persistent problem in the United States and has become an important issue to medical and dental professionals. Americans are the largest users of opioids by a large margin. The importance of knowing how to identify, handle, refer, and treat patients with opioid use disorder cannot be understated.” [https://www.ncbi.nlm.nih.gov/pubmed/28858946](https://www.ncbi.nlm.nih.gov/pubmed/28858946)


Evaluation of methamphetamine-associated socioeconomic status and addictive behaviors, and their impact on oral health. “Chronic methamphetamine abuse can lead to multiple health hazards. In particular, the substance is associated with devastating effects on oral health including symptoms such as rampant caries, gingiva inflammation, and xerostomia, whereby the term "Meth Mouth" occurs in the current literature.” [https://www.ncbi.nlm.nih.gov/pubmed/26151583](https://www.ncbi.nlm.nih.gov/pubmed/26151583)

**American Dental Association: A look at e-cigarettes:** [https://jada.ada.org/article/S0002-8177(19)30037-6/fulltext](https://jada.ada.org/article/S0002-8177(19)30037-6/fulltext)

Acting FDA Commissioner Ned Sharpless, M.D.: “We must act swiftly against flavored e-cigarette products that are especially attractive to children. Moreover, if we see a migration to tobacco-flavored products by kids, we will take additional steps to address youth use of these products. The tremendous progress we’ve made in reducing youth tobacco use in the U.S. is jeopardized by this onslaught of e-cigarette use. Nobody wants to see children becoming addicted to nicotine, and we will continue to use the full scope of our regulatory authority thoughtfully and thoroughly to tackle this mounting public health crisis.” [https://www.hhs.gov/about/news/2019/09/11/trump-administration-combating-epidemic-youth-ecigarette-use-plan-clear-market.html](https://www.hhs.gov/about/news/2019/09/11/trump-administration-combating-epidemic-youth-ecigarette-use-plan-clear-market.html)

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/17/2019

Name: Dental Codeology Consortium

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes > ☐  If Yes, Name:  
No > ☒

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature  Required for all “New”

the disruption of dental biofilm by mechanical instrumentation, with or without the use of chemotherapeutic agents for the maintenance and health of gingival tissues and the reduction of inflammation

Descriptor  Optional for “New”; enter “None” if no descriptor

Preventive and therapeutic modalities that are safe and conducive to the maintenance and health of hard and soft tissues of the oral cavity focusing on biofilm disruption therapies.

NOTICE TO PREPARE AND SUBMITTER:

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3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

There currently is no procedure code for disruption of dental biofilm. Dental clinicians need to recognize and adopt new treatment modalities to aide in the disruption of oral bacteria and the associated inflammation.

Emerging medical science, research and technologies have enabled dental professionals to provide biofilm disruption therapies that are more effective than traditional methods. These more thorough therapies are more comprehensive for improving the oral and systemic health of patients. Recent medical science and research link oral bacteria, i.e. P. Gingivalis, to many noncommunicable diseases such as; cardiovascular disease, Alzheimer’s, rheumatoid arthritis, kidney disease, chronic Inflammation and an increased risk for some cancers.

A direct link has been proven through medical research and documented in medical journals that make a direct correlation between P. Gingivalis and multiple systemic disease states; for example, P. Gingivalis has been found in the synovial of rheumatoid arthritis patients and in the brain matter of Alzheimer’s patients.

There has been enough scientific evidence for the American Academy of Periodontology to update their periodontal classification system at the World Workshop for Classification of Periodontal Disease and Peri-Implant Diseases in 2017 to include the grading system that reflects the systemic impact on patient’s periodontal disease. The new classification of periodontal diseases and conditions also includes systemic diseases and conditions that affect the periodontal supporting tissues.

At the 2017 CMC hearing a procedure code was proposed for the disruption of subgingival biofilm using air and water pressure combined with a low abrasive powder on tooth surfaces and implants. The CMC response determined that this action request is for a technique that is appropriately reported with CDT code “D6101 debridement of a peri-implant defect or defects surrounding a single implant, and surface cleaning of the exposed implant surfaces, including flap entry and closure.” Considering the complex, organized nature of biofilm in its attachment to all hard and soft oral tissues and implants, the D6101 does not fully apply to the process of biofilm management. As scientific evidence and medical science continue to correlate the influence that oral biofilm has on noncommunicable systemic diseases, dentistry must recognize the capacity that dental professionals have to aide in lowering the impact of, active disease, management of disease and prevention of disease through the biofilm disruption and inflammation management.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] □

a) CDT Code currently used to report the procedure none

b) Procedure technical description

The disruption of dental biofilm on teeth, prosthetics, and oral structures to achieve health preservation and be utilized as a therapeutic adjunct for the management of disease and corresponding inflammation caused by oral bacteria.

NOTICE TO PREPARER AND SUBMITTER:

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c) Clinical scenario

Preventive, therapeutic or maintenance services that pertain to the use of treatment modalities that disrupt dental biofilm to aide in the promotion of oral and systemic health by bacterial reduction to manage inflammation.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

Supportive statements are followed by the citation from which it is drawn.

**STATEMENT:** Recent medical science and research are making a direct linking oral bacteria, *P. Gingivalis*, to many noncommunicable diseases, such as; cardiovascular disease, diabetes, Alzheimer’s, rheumatoid arthritis, kidney disease, chronic inflammation and increased risk for some cancers, erectile disfunction, and infertility, dental clinicians need to recognize and adapt new treatment modalities to aide in the disruption of oral bacteria and the associated inflammation.


STATEMENT: A direct link has been proven through medical research and documented in medical journals making a direct correlation between *P. Gingivalis*, in the synovial of rheumatoid arthritis patients and in the brains of Alzheimer’s patients.


STATEMENT: There has been enough scientific evidence for the American Academy of Periodontology to update their periodontal classification system at the World Workshop for Classification of Periodontal Disease and Peri-Implant Diseases in 2017 to include the grading system that reflects the systemic impact on patient’s periodontal disease. The new classification of periodontal diseases and conditions also includes systemic diseases and conditions that affect the periodontal supporting tissues.

PART 1 – SUBMITTER INFORMATION

A. Contact Information (Action Requestor)  Date Submitted: 10/31/2019

| Name: | Mark Mihalo |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > | ☐ |
| No > | ☒ |

If Yes, Name:

PART 2 – SUBMISSION DETAILS

1. Action (Mark one only)  New ☐  Revise ☒  Delete ☐  Affected Code (Revise or Delete only) D1110

| Nomenclature | Required for all "New" |
| Nomenclature | prophylaxis – adult |

| Descriptor | Optional for "New"; enter "None" if no descriptor |
| Descriptor | Removal of plaque, calculus and stains from tooth structures in the permanent and transitional dentition, or implants. It is intended to control local irritational factors. |

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature: prophylaxis – adult

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

A prophylaxis’ removal of plaque calculus and stains is a procedure that is applicable to both natural dentition and any implant replacements. Delivery of this procedure to all such structures is an aid to maintaining a patient’s oral health.

Although the instruments used to remove plaque and calculus et. al. from an implant (plastic) differ from those used in natural dentition (metal) the procedure’s techniques are the same.

Inclusion of “implants” in the descriptor recognizes common usage of this procedure code by clarifying its scope. This revision also explicitly closes what can be seen as a CDT Code gap.

4. Complete a) – c) only if Action Request is for a New CDT Code

| Mark if Revise or Delete ["a) - c"] are not applicable |
| Mark if Revise or Delete | ☒ |

| a) CDT Code currently used to report the procedure |
| D |

NOTICE TO PREPARER AND SUBMITTER:

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### b) Procedure technical description


### c) Clinical scenario


## Part 3 – Additional Information

5. Supporting documentation or literature:
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6. Additional Comment or Explanation: None
**CDT Code Action Request**

### Part 1 – Submitter Information

<table>
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<tr>
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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

Yes ☐

No ☒

If Yes, Name: [Insert Name]

### Part 2 – Submission Details

1. **Action** (Mark one only)

   - New ☐
   - Revise ☒
   - Delete ☐

2. **Affected Code** (Revise or Delete only) D1120

3. **Nomenclature**

   - Required for all "New"
   - "prophylaxis – child"

4. **Descriptor**

   - Optional for "New"
   - Removal of plaque, calculus and stains from tooth structures in the primary and transitional dentition, or implants. This is intended to control local irritational factors.

3. **Rationale for this request; your persuasive argument for CMC acceptance**

   (Required for any type of requested action – New; Revise; Delete)

   A prophylaxis' removal of plaque calculus and stains is a procedure that is applicable to both natural dentition and any implant replacements. Delivery of this procedure to all such structures is an aid to maintaining a patient’s oral health.

   Although the instruments used to remove plaque and calculus et. al. from an implant (plastic) differ from those used in natural dentition (metal) the procedure’s techniques are the same.

   Inclusion of “implants” in the descriptor recognizes common usage of this procedure code by clarifying its scope. This revision also explicitly closes what can be seen as a CDT Code gap.

4. **Complete a) – c) only if Action Request is for a New CDT Code**

   [“a) - c)” are not applicable]

   ☒

   a) CDT Code currently used to report the procedure

   Mark if Revise or Delete ☒

   [“a) - c)” are not applicable]

### Notice to Preparer and Submitter:

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### Part 3 – Additional Information

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6. Additional Comment or Explanation:

None
## Part 1 – Submitter Information

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### B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

- **Yes >** [ ]
- **No >** ☒

If Yes, Name:

---

## Part 2 – Submission Details

1. **Action** (Mark one only)
   - New [ ]
   - Revise ☒
   - Delete [ ]

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**Affected Code** (Revise or Delete only)

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

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**oral prophylaxis - adult**

<table>
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<tr>
<td>Optional for &quot;New&quot;; enter &quot;None&quot; if no descriptor</td>
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**Removal of plaque, calculus, and stains and the disruption of dental biofilm from the tooth and prosthetic structures in the permanent and transitional dentition. It is intended to control local irritational factors preserve health.**

---

**NOTICE TO PREPARER AND SUBMITTER:**

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3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

By including “oral” in the nomenclature it would provide a much clearer description for medical and dental professionals who consider the term “prophylaxis” to mean antibiotic coverage, etc. The addition of ‘prosthetic’ structures would more accurately describe those cases where patients present with prosthetics, such as, but not limited to fixed bridges, dental implants, space maintainers, orthodontic brackets and wires, etc.

AAP recognizes clinical gingival health from the 2017 World Workshop: Caton JG et al. A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification. J Periodontol. 2018;89(Suppl 1): S1–S8. DOI: 10.1002/JPER.18-0157. Referenced from the 2017 World Workshop is the language being mirrored in this action request form: “If the biofilm is not disrupted/removed, frank dysbiosis results and perpetuates a chronic non-resolving and destructive inflammation.” The suggested descriptor includes current language as it applies to the purpose of the procedure itself (what is being removed/disrupted). See Figure 1 below for reference.

Figure 1

The intent of performing an ‘oral prophylaxis’ is to preserve health and promote a healthy biofilm. There’s varying thoughts regarding what ‘control local irritational factors’ pertains to exactly; omitting this state would clear up the descriptor. Overall, the requested changes allow for more accurate tracking related to evidence-based treatment protocols and patient care outcomes with little disruption to the current ADA descriptor for D1110.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [*a) - c* are not applicable]

☒

a) CDT Code currently used to report the procedure
D1110

b) Procedure technical description

The removal of plaque, calculus, stains and the disruption of dental biofilm from tooth and prosthetic structures by mechanical means. Includes coronal polishing when indicated.

NOTICE TO PREPARER AND SUBMITTER:

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**c) Clinical scenario**

The removal of plaque, calculus, stains and the disruption of dental biofilm from tooth and prosthetic structures on patients presenting with clinical gingival health (as recently defined by the 2018 AAP Classifications of Periodontal and Peri-Implant Diseases) on the permanent and transitional dentition. A specific clinical scenario would be a patient who presents with clinical gingival health. The patient has a dental implant at site of #10 which exhibits peri-implant health. The dental implant was placed as result of a congenitally missing #10. The D1110 descriptor as it stands only addresses ‘tooth structures,’ which doesn’t accurately describe the procedure being rendered when a dental professional removes plaque, calculus, stains and disrupts dental biofilm from this type of ‘prosthetic structure’ during a prophylaxis procedure.

**Part 3 – Additional Information**

5. Supporting documentation or literature:
- "5.a) must be completed for all requested actions; "b)" and "c)" are completed when indicated.
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6. Additional Comment or Explanation:

The requested changes are not intended to be disruptive, rather to more accurately describe the procedure being rendered. Slight changes will bring more clarity to dental and medical professionals alike.

There is currently no mention of prosthetic structures in the D1110 procedure code. Prosthetic structures may include, but are not limited to, space maintainers, fixed bridges, dental implants, palatal obturators, orthodontic brackets and wires and partial and complete dentures.

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/17/2019

Name: DentalCodeology Consortium

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes > ☐  If Yes, Name:
No > ☒

Part 2 – Submission Details

1. Action (Mark one only)  New ☐  Revise ☒  Delete ☐  Affected Code (Revise or Delete only)  D1120

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature Required for all “New”

oral prophylaxis - child

Descriptor Optional for “New”; enter “None” if no descriptor

Removal of plaque, calculus, and stains and the disruption of dental biofilm from the tooth and prosthetic structures in the primary and transitional dentition. It is intended to control local irritational factors and preserve health.

NOTICE TO PREPARER AND SUBMITTER:

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- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☑) by moving the cursor over the box and making a “left-click”.
- Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.
- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
3. Rationale for this request; your persuasive argument for CMC acceptance  
(Required for any type of requested action – New; Revise; Delete)

By including “oral” in the nomenclature it would provide a much clearer description for medical and dental professionals who consider the term “prophylaxis” to mean antibiotic coverage, etc.

The addition of ‘prosthetic’ structures would more accurately describe those cases where patients present with prosthetics, such as, but not limited to fixed bridges, dental implants, space maintainers, orthodontic brackets and wires, etc.


Referenced from the 2017 World Workshop is the language being mirrored in this action request form: “If the biofilm is not disrupted/removed, frank dysbiosis results and perpetuates a chronic non-resolving and destructive inflammation.” The suggested descriptor includes current language as it applies to the purpose of the procedure itself (what is being removed/disrupted). See Figure 1 below for reference.

![Image of Figure 1]

The intent of performing an ‘oral prophylaxis’ is to preserve health and promote a healthy biofilm. There are varying thoughts regarding what ‘control local irritational factors’ means; omitting this from the descriptor and replacing it with ‘preserve health’ would be more current and accurate. Overall, the requested changes allow for more accurate tracking related to evidence-based treatment protocols and patient care outcomes with little disruption to the current ADA descriptor for D1120.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [*“a) - c)” are not applicable]

☒

a) CDT Code currently used to report the procedure

D1120

b) Procedure technical description

The removal of plaque, calculus, stains and the disruption of dental biofilm from tooth and prosthetic structures by mechanical means. Includes coronal polishing when indicated.
c) Clinical scenario

The removal of plaque, calculus, stains and the disruption of dental biofilm from tooth and prosthetic structures on patients presenting with clinical gingival health (as recently defined by the 2018 AAP Classifications of Periodontal and Peri-Implant Diseases) on the primary and transitional dentition.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>Yes &gt;</th>
<th>☐</th>
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</tbody>
</table>

6. Additional Comment or Explanation:

The requested changes are not intended to be disruptive, rather to more accurately describe the procedure being rendered. Slight changes will bring more clarity to dental and medical professionals alike.

There is currently no mention of prosthetic structures in the D1120 procedure code. Prosthetic structures may include, but are not limited to, space maintainers, dental implants, palatal obturators, orthodontic brackets and wires and pediatric partial or full dentures for children suffering from partial or complete anodontia.

**CDT CODE ACTION REQUEST**

### Part 1 – Submitter Information

**A. Contact Information (Action Requestor)**

<table>
<thead>
<tr>
<th>Name:</th>
<th>National Association of Dental Plans (NADP)</th>
</tr>
</thead>
</table>

**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

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<tbody>
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**If Yes, Name:** National Association of Dental Plans (NADP)

### Part 2 – Submission Details

1. **Action** (Mark one only)
   - New ☐
   - Revise ☒
   - Delete ☐

   **Affected Code** (Revise or Delete only) D1556

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   - **Nomenclature**
     - Required for all "New"
     - removal of fixed unilateral space maintainer – per quadrant

   - **Descriptor**
     - Optional for "New"; enter "None" if no descriptor
     - Procedure performed by dentist or practice that did not originally place the appliance.

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)

   This will add the descriptor already included with D1557 and D1558 as was NADP’s original intent as the submitter of these procedures in the last CMC cycle. This will create uniformity between D1556, D1557, and D1558 and eliminate any confusion with the three codes.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   [“a) - c)” are not applicable]

   - a) CDT Code currently used to report the procedure
     - D

   - b) Procedure technical description

### NOTICE TO PREPARER AND SUBMITTER:

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**Part 3 – Additional Information**

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6. Additional Comment or Explanation:

None
**CDT CODE ACTION REQUEST**

**Part 1 – Submitter Information**

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<tr>
<th><strong>A. Contact Information (Action Requestor)</strong></th>
<th><strong>Date Submitted:</strong> 10/8/2019</th>
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<tbody>
<tr>
<td><strong>Name:</strong> Jim Nickman DDS, MS</td>
<td></td>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: American Academy of Pediatric Dentistry |
| No > ☐   |                                                      |

**Part 2 – Submission Details**

1. **Action** (Mark one only)
   - New ☐
   - Revise ☒
   - Delete ☐
   - Affected Code (Revise or Delete only) D1557

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – **blue underline**; deleted text – **red strike-through**; unchanged text – **black**)
   - **Nomenclature**: removal of fixed bilateral space maintainer – maxillary
   - **Descriptor**: Procedure performed by dentist or practice that did not originally place the appliance.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)
   
   There is currently a gap in the code to report the removal of a fixed bilateral space maintainer for the dentist or practice that placed the appliance. During the CDT2020 CMC meeting, a new code (D1556) was created to report the removal of a fixed unilateral space maintainer. The new D1556 code does not contain a descriptor allowing the code to be used regardless of who placed the appliance. The editorial revision to the new D1157 code fixes the current gap in the code set improving reporting accuracy.

4. Complete a) – c) only if Action Request is for a New CDT Code
   - Mark if Revise or Delete ["a) - c") are not applicable] ☒
   - a) CDT Code currently used to report the procedure D
   - b) Procedure technical description

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c) Clinical scenario

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6. Additional Comment or Explanation:
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<th>Affected Code (Revise or Delete only)</th>
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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature: removal of fixed bilateral space maintainer – mandibular

Descriptor: Procedure performed by dentist or practice that did not originally place the appliance.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

There is currently a gap in the code to report the removal of a fixed bilateral space maintainer for the dentist or practice that placed the appliance. During the CDT2020 CMC meeting, a new code (D1556) was created to report the removal of a fixed unilateral space maintainer. The new D1556 code does not contain a descriptor allowing the code to be used regardless of who placed the appliance. The editorial revision to the new D1158 code fixes the current gap in the code set improving reporting accuracy.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] ☒

a) CDT Code currently used to report the procedure: D

b) Procedure technical description:

---

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### CDT Code Action Request

**c) Clinical scenario**

**Part 3 – Additional Information**

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6. Additional Comment or Explanation:

None
## Part 1 – Submitter Information

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<th>A. Contact Information (Action Requestor)</th>
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<tr>
<td>Name: Mohamed Harunani</td>
<td></td>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

- Yes ☐
- No ☒

If Yes, Name: 

## Part 2 – Submission Details

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<th>Revise ☐</th>
<th>Delete ☐</th>
<th>Affected Code (Revise or Delete only)</th>
<th>D</th>
</tr>
</thead>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

- **Nomenclature**: prefabricated porcelain - ceramic crown – permanent tooth

- **Descriptor**: None

---

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3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

With the increasing scrutiny on dental coding, the need for accurately reporting for an esthetic anterior and posterior restoration is increasing in order to decrease the risk to the dentists. Prefabricated zirconium crown for permanent teeth are individually milled to a generic tooth preparation model rather than to finished tooth preparation. In many ways, it is similar to the prefabricated stainless steel crown (D2930, D2931), the prefabricated resin crown (D2932), and the prefabricated stainless steel crown with resin window (D2934) in all but material (and some details of tooth prep and design). Today, we have a code for primary teeth but not for a permanent tooth and since the material is porcelain/ceramic, some dental practices have reported this procedure as D2740. However, the D2700-D2799 series is reserved for custom fabricated crowns, so a new code was needed specifically for a porcelain/ceramic prefabricated crown for a permanent tooth just like one exists for primary teeth (D2929) tooth.

Since there exists a code for preformed zirconia crowns for primary teeth but none for permanent teeth and that Preformed Zirconia crowns are no different than preformed Stainless steel crowns in their use and purpose, it only makes sense to have a code to support the dentist in providing the care that is best suited to that specific patient. Lack of codes should be the factor that limits them to what most patients would consider an unsightly stainless steel crown when they can get a preformed Zirconia crown. Not having a code limits billing to the insurance company and as such limits the dentist in providing and/or the patient from choosing this option, even though it maybe the best option for the patient as determined by their own dentist and agreed on by the patient.

These crowns can be an excellent long term temporary solution or even a long term solution for the patients that cannot afford the custom crowns or until they can afford the custom fabricated crowns. The crowns can be cemented with a glass ionomer cement to help prevent further breakdown or bonded to further strengthen the tooth.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
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<tr>
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<tr>
<td>a) CDT Code currently used to report the procedure</td>
<td>D2740</td>
</tr>
<tr>
<td>b) Procedure technical description</td>
<td></td>
</tr>
</tbody>
</table>

Tooth is prepper for a pre-fabricated crowns, the crown is fitted and cemented or bonded into place. Occlusion is checked and adjusted, if needed.

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c) Clinical scenario

Scenario #1
A 20 year old patient with a history of bruxing and limited means presents with extensive decay and severely broken down teeth. After a clinical and radiographic examination, the dentist recommends full-coverage (crown) restorations but the patient cannot afford custom fabricated crowns. Pt also is very conscious about esthetics and does not want multiple stainless steel crowns, which again would have a limited life due to the history of bruxing.

After consideration of the available esthetic alternatives, including a prefabricated stainless steel crown with a resin facing or window on the buccal aspect, a prefabricated esthetic coated stainless steel crown, and a prefabricated resin crown, the dentist and the patient select a prefabricated zirconium crown as the material of choice. The tooth is prepared for placement of a suitably sized prefabricated ceramic crown and is cemented with a glass ionomer cement which helps further breakdown.

Scenario #2
Pt presents with a sore tooth which, after a careful clinical and radiographic exam, is determined to be a cracked tooth with a limited long term prognosis. The patient is very self-conscious and does not want a stainless steel crown. After consideration of the available esthetic alternatives, including a prefabricated stainless steel crown with a resin facing or window on the buccal aspect, a prefabricated esthetic coated stainless steel crown, and a prefabricated resin crown, the dentist and the patient select a prefabricated zirconium crown as the material of choice. The tooth is prepared for placement of a suitably sized prefabricated ceramic crown and is secured with a bonding cement which further holds the tooth together and helps further propagation of the crack.

Scenario #3
A 60 year old terminally ill patient with a history of bisphosphonates, xerostomia, limited means and and bruxing presents with severely broken down teeth. After a clinical and radiographic examination, the dentist recommends multiple full-coverage (crown) restorations but the patient cannot afford custom fabricated crowns. Pt also is very conscious about esthetics and does not want to end their life with multiple stainless steel crowns. After consideration of the available esthetic alternatives, including a prefabricated stainless steel crown with a resin facing or window on the buccal aspect, a prefabricated esthetic coated stainless steel crown, and a prefabricated resin crown, the dentist and the patient select a prefabricated zirconium crown as the material of choice. The tooth is prepared for placement of a suitably sized prefabricated ceramic crown and is cemented with a glass ionomer cement which helps further breakdown.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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   a) Material submitted?  Yes > ☐ No > ☒

   b) Protected by copyright? (If “a)” is “Yes”)  Yes > ☐ No > ☒

   c) Permission to reprint? (If “b)” is “Yes”)  Yes > ☒ No > ☒

6. Additional Comment or Explanation:

D2929 already exists for primary teeth and this request is for a similar code for permanent teeth. Just like we have D2930 for Stainless steel primary teeth and D2931 for stainless permanent teeth. We do have D2932 for prefab resin crown, but Zirconia is not resin and so cannot be used. Some clinicians are billing it as #2730, which is for a custom fabricated ceramic crown, not a prefabricated one.

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)                      Date Submitted: 10/16/2019

Name: Katalin Janosi-Fair, DMD, MPH

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☐ No ☒

If Yes, Name: Click here to enter text.

Part 2 – Submission Details

1. Action (Mark one only)                                      New ☒ Revise ☐ Delete ☐

Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature

Required for all “New”

crown retreatment

Descriptor

Optional for “New”; enter “None” if no descriptor

Retreatment of previous crown.

3. Rationale for this request; your persuasive argument for CMC acceptance

(Required for any type of requested action – New; Revise; Delete)

Currently there are no diagnostic codes in dentistry, and they may not be necessary if we start implementing codes for restorative and prosthodontic procedures which distinguish initial treatments from retreatments due to disease; i.e., recurrent caries. At present, only endodontic codes make this distinction; for example: D3310 is the endodontic code for initial therapy and D3346 is for endodontic retreatment. By adding this new code, the profession can begin collecting much needed statistical information on the economic burden of crown retreatments due to caries, and these new codes will also clarify communication with the insurance companies and facilitate a more seamless claim processing.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] ☐

a) CDT Code currently used to report the procedure D

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b) Procedure technical description

Retreatment of previous crown, includes failed crown removal, removal of failed core buildup, excavation of recurrent caries, fabrication and placement of a new crown.

c) Clinical scenario

Patient presents with a failing crown due to recurrent caries. Failure due to material fracture, or various cosmetic reasons will necessitate separate codes.

Part 3 – Additional Information

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6. Additional Comment or Explanation:

None

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**CDT Code Action Request**

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<th>A. Contact Information (Action Requestor)</th>
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<td>Name: Katalin Janosi-Fair, DMD, MPH</td>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

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### Part 2 – Submission Details

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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

- **Nomenclature**: direct restoration retreatment
- **Descriptor**: Retreatment of previous amalgam or resin-based restorations.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Currently there are no diagnostic codes in dentistry, and they may not be necessary if we start implementing codes for restorative and prosthodontic procedures which distinguish initial treatments from retreatments due to disease; i.e., recurrent caries. At present, only endodontic codes make this distinction; for example: D3310 is the endodontic code for initial therapy and D3346 is for endodontic retreatment. Adding this new code, the profession can begin collecting much needed statistical information on the economic burden of crown retreatments due to caries, and these new codes will also clarify communication with the insurance companies and facilitate a more seamless claim processing.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
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</table>
b) Procedure technical description

Retreatment of previous amalgam or resin-based composite direct restorations- includes failed material removal, excavation of recurrent caries, tooth preparation, acid etching, adhesives, liners and bases, and placement of new material. Antibacterial scrubs used to augment the mechanical removal of caries may need to be reported separately.

c) Clinical scenario

Patient presents with a failing amalgam or resin direct restoration due to recurrent caries. Failure due to material fracture, debonding or various cosmetic reasons will necessitate separate codes.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

   a) Material submitted?
      | Yes > ☐ | No > ☒ |

   b) Protected by copyright? (If “a)” is “Yes”)
      | Yes > ☐ | No > ☒ |

   c) Permission to reprint? (If “b)” is “Yes”)
      | Yes > ☐ | No > ☒ |

6. Additional Comment or Explanation:

By implementing these new procedure codes which distinguish between initial restorations and retreatments, the profession may not need to adopt separate diagnostic codes. Also, these new codes may facilitate the collection of much needed epidemiological statistics: incidence and prevalence data for recurrent caries, so we may glean much needed evidence for future precision prevention and treatment protocols.
Part 1 – Submitter Information

1. Contact Information (Action Requestor)  
   Date Submitted: 10/31/2019
   
   Name: Scott D. Davis

2. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

   Yes ☒  
   If Yes, Name: The Academy of Biomimetic Dentistry

   No ☐

Part 2 – Submission Details

3. Action ("X" one only)  
   New ☒  
   Revise ☐  
   Delete ☐  
   Affected Code – Revise or Delete (Leave blank if New) D

4. Full illustration of nomenclature and descriptor text actions (additions in blue underline; deletions in red strike-through; unchanged in black)

   Nomenclature  
   Required for all "New" advanced minimally invasive procedures and protocols for biomimetic restorations using adhesives for both direct composites or indirect restorations. Foundational tooth preparation and adhesive procedures and protocols. Minimally invasive restorations are ethical restorations

   Descriptor  
   Optional for "New"; enter "None" if no descriptor Biomimetic tooth preparation uses caries dye and non-ionizing radiation (use D0600 and record values), which visually assist caries removal with accurate dissection of diseased dentin and enamel to establish a caries free zone confirmed by lack of dye and low values called the caries removal end point which establishes the "Peripheral seal zone." If a dentinal crack is present it can be removed (use this code D0000). Tooth preparation also involves Air abrasion to clean enamel and dentin and increases bond strength. Use of CHX or a bonding agent containing MDPB monomer to neutralize MMPs which degrades bonds. Immediate dentin sealing (IDS) and resin coat is required for direct and indirect restorations (use this code for IDS D000). When fibers are placed use code (D0000). The foundational adhesive procedure is the "Adhesive Bio-base" for direct or indirect restorations. (D0000)

   From this point the bio-base code now confirms that the above was done. Then a direct code or indirect code can be used with the supporting codes to document what was done.

5. Rationale for this request; your persuasive argument for CMC acceptance  
   (Required for all requested actions – New; Revise; Delete)

NOTICE TO PREPARER AND SUBMITTER:
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
- Items 1 – 6 and 8.a) must be completed in full for any type of “Action” – Add / Revise / Delete.
- Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.
I had previously submitted a letter outlining my clinical arguments however I will summarize the need for new codes for adhesive biomimetic restorations for both direct composite and indirect restorations.

1. A biomimetic preparation is the most ethical of all restorative preparations, because it only removes minimal amounts of sound or vital dentin. Doing no harm from the preparation is one of the primary advantages. The ADA “Principles of Ethics and code of Professional conduct” is foundational and demonstrates the need for Biomimetic adhesive protocols and procedures. “Patient autonomy, Non-maleficence and veracity”

“The American Dental Association calls upon dentists to follow high ethical standards which have the benefit of the patient as their primary goal.”

“The dentist should inform the patient of the proposed treatment, and any reasonable alternatives, in a manner that allows the patient to become involved in treatment decisions.”

“Education and training” of a dentist is important and is never complete but is a process of continuous learning. Improvements in methods and materials and knowledge should lead to better treatment for patients.

“The Dentist has the duty to refrain from harming the patient.” “…the dentist primary obligation include keeping knowledge and skill current, knowing one’s own limitations and when to refer…” “All dentists, therefore, have the obligation of keeping their knowledge and skill current.”

Evidence based dental knowledge should lead to better treatment for patients with dental diseases.

CDT codes should be added when “evidence based” knowledge leads to better outcomes for the patient and their oral health.

1. Infected dentin is removed and affected dentin is left. A peripheral seal zone for adhesives is created and all preparatory protocols are accomplished which increase bond strength and decreases stress. Keep the pulp vital.

2. Dental school restorative education of advanced adhesive biomimetic protocols and CE courses when teaching biomimetic protocols, then the question of dentists and students is what codes do I use to document what I did? The lack of accurate codes needs to be remedied. The CMC has said "code for what you do and do for what you code!"

3. There is need to document that dentinal cracks were removed when present when preparing the dentin for adhesion. Will attach nomenclature and descriptor for new code. A pin has a code and crown lengthening has a code. Removal of a dentin crack should have a code as it takes time and has a structural benefit.

4. IDS or Immediate Dentin Sealing, is required for all tooth preparations which involve vital and non-vital dentin. Because this procedure has value for all invasive preparations which cut into vital dentin the code is necessary to document that it was done. IDS, protects the pulp and increases the bond strength for direct and indirect restorations. Will attach nomenclature and descriptor for new code

5. There needs to be a code for “Adhesive Bio-base” Because this procedure can be used for all traditional restorations as well as direct resin restorations and all indirect restorations. Will attach nomenclature and descriptor for new code

6. Fiber placement within the bio-base is a procedure that increases bond strength and decreases stress. Very beneficial in large biomimetic restorations and in restoring root canal treated teeth. In many cases the full crown can be eliminated. Pin placement has a code.

Biomimetic nomenclature and vocabulary and necessary codes

Biological rim or Bio-Rim – want to maintain or restore.
Caries dye: infected and affected dentin – caries removal end point.
Peripheral seal zone
Air Abrasion: aluminum oxide 25-50 microns, (do we need a code?) for siliconized 30 micron (Cojet, Siljet)
SRDC stress reduced direct composite
C-factor stress
D0000-Cracks into dentin or dentinal cracks – removal (needs Code for removal)
### CDT CODE ACTION REQUEST

**D0000**-Immediate dentin sealing and Resin coat. (need a code for all dentin involved preparations on vital teeth) because it is required.

**D0000**-Fiber Net, Fiber placement – woven polyethylene fibers (needs code)

**D0000**-Adhesie Bio-base (needs code) and descriptor

- Stress reducing protocols
- Bond enhancing protocols
- Structural compromise due to previous restorations (needs diagnostic codes)

**D0000**-Deep Margin Elevation (needs code and descriptor) Procedure reduces the need for a surgical crown lengthening or enhances the final restoration.

- Incremental placement and deli-bit
- Light cured composites
- Dual cure composites
- Auto cure composites or chemical cure composites
- Stress reduced direct composite (SRDC)
- Indirect Adhesive restoration (gold, porcelain, manufactured resin etc.
- Microfil composite
- Bulkfil composite
- Hybrid composite
- Flowable composites
- Porcelain bonding with AA and silane

#### 6. Complete a) – c) only if Action Request is for a New CDT Code

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<td>Procedure technical description</td>
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<td>c)</td>
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**X** if Revise or Delete as “a) - c)” are not applicable

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8. Additional Comment or Explanation:

Gold standard bonding systems should be employed. “The available data indicates that a three-step total etch dentin bonding system and a two-step self-etching dentin bonding system offers the best clinical performance.”

“The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach” Inside Dentistry June 2017

This is an important article and the 52 cited references at the end of the article and footnoted connected to the protocols and the cited research.

Here are the links to the article.


Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy

Mathew A Nejad, DDS: Co-director Biomimetic Dentistry CE, Beverly Hills, CA, Adjunct faculty, Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA

Capt. David Scott Alleman DMD, Instructor Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia Italy.

I have submitted documentation in the past and what I had submitted had permission and still does.
Dr. Krishna Aravamudhan, Sr. Director, Center for Dental Benefits, Coding and Quality, CDBP
Frank Pokorny, MBA, Senior Manager, Dental Codes Maintenance and Development
Stacy Starnes, Dental Code Advisor
Carolyn Tatar, MBA, Senior Manager Product Development
Kathy Pulkrabek, Manager/Editor, Professional Products
CMC Committee

Resin-Based Composite Restorations – Direct

Resin-based composite refers to a broad category of materials including but not limited to composites. May include bonded composite, light-cured composites, etc. Tooth preparation, acid etching, adhesive (including resin bonding agents), liners and bases and curing are included as part of the restoration. Glass ionomer, when used as a restoration, should be reported with these codes. If pins are used, they should be reported separately (see D2951).

This descriptor needs to be upgraded to make it congruent with current science and clinical procedures, inherently leading to advanced adhesive biomimetic restoration which use up-to-date protocols. The science behind bonded composites has advanced to the point that it outdates the above descriptor. It needs to account for a composite restoration that it is bonded to dentin, enamel, and other substrates in order for the descriptor to be accurate and clear about the final restoration.

The process to get to the final restoration is important and specific—light is sometimes used to initiate polymerization of the composite, other times chemical cure and dual cure composites are used. Each step has specific benefits and risks that need to be identified and dealt with to achieve maximum bond strength with minimal stress.

It has been brought to my attention that new dentists and dental students want to know what codes to use when doing a biomimetic adhesive restoration. Here is sample of some of their questions. What code do we use for a bio-base? What code do we use for a deep margin elevation? What code do we use when using fibers? Is there a code for immediate dentin sealing and resin coat? Is there a code for Air Abrasion? Is the Academy of Biomimetic dentistry working with the ADA for codes for biomimetic dentistry?

Tooth preparation, acid etching, adhesive (including resin bonding agents), liners and bases and curing are included as part of the restoration.

Tooth preparation should proceed the process of restoring and the preparation should be defined accurately. Without a proper preparation there is not ideal adhesion to dentin, enamel or other substrates. That process needs to be defined either with a new descriptor or specific codes for each procedure. After all, there is a code for pins which are unnecessary for adhesive composite restorations because the retention is adhesive not mechanical. With this in mind the code for pins should be eliminated from the current descriptor. However, because tooth preparation is mandatory it should have codes for the individual procedures that contribute to an ideal preparation or biomimetic descriptor that identifies all clinical procedures that need to be done.
Use of caries dye is a procedure that visually identifies the infected, or diseased, part of the tooth that needs to be removed. **Tooth preparation** using biomimetic protocols is to conserve more of the sound tooth structure and to maintain pulp vitality. Use of caries dye needs to be in the descriptor or a separate code.

Code D0600 identifies values obtained from instruments that use non-ionizing radiation to identify carious activity or confirm that there is bondable dentin. Diagnodent is such an instrument. Values obtained dictate whether good adhesion could be obtained. (Values obtained should be in the outer or peripheral dentin 12 or less, 24 or less for inner dentin, 36 or less over pulp horns.)

**Tooth preparation**: Removal of carious dentin and enamel facilitated by caries dye and Diagnodent—purpose to create a peripheral seal zone for proper dentinal adhesion. Other procedures necessary to obtain the best adhesion to dentin include Air abrasion, neutralizing of MMPs with 2%CHX, IDS and resin coat (immediate dentin sealing), and these procedures need to be explained in a descriptor or separate codes.

At this time, I want to take a moment and discuss the term “Tooth Preparation” as it currently appears in the CDT Dental Procedure Codes restorative section. Tooth preparation is mentioned in the descriptor for Amalgam and Resin-Based composites but not at all for other codes for gold foil, inlay, onlay or crown preparations. How the tooth is prepared for the final restoration is imperative to retention and the potential harm than can and does occur overtime. It is assumed, in traditional restorative dentistry and in the CDT codes that tooth preparation in regards to standard of care is understood, but it’s not.

Tooth preparation is important and a discussion of which preparations do less harm now and in the future is important and it should be reflected in the descriptors so as the patients tooth receives the proper restorations which conserves tooth structure and maintains pulp vitality. Only adhesively retained restorations obtain the objective of “tooth conservation and to maintain pulp vitality”.

The ADA Code of Ethics should be our guide to this discussion using “Patient Autonomy, Non-malfeasance, Veracity”. Standard of Care and best practice needs clarification.

**Patient autonomy**: Has the patient been informed of all the choices and benefits and risks of each choice? A patient that has been given one choice “The tooth needs a crown,” has not been given all the choices with both risks and benefits. Therefore, who is making the choice?

**Non-malfeasance** or do no harm, with the same choice “The tooth needs a crown.” Has the patient been informed that 20% of all crowns on vital teeth will need a root canal in the future? Is the reason for the root canal due to the excessive preparation into the vital dentin? The ADA code of ethics states that the dentist professional obligation is to “stay current with their skills and knowledge” so that the dentist can ethically restore the tooth to the patient’s wishes.

**Veracity** or honesty, deals with integrity, and standard of care verses best practice. I like to refer to this as a choice between being just legal (standard of care) or being ethical (best practice). Neither is bad, but there is good, better, and best and all those choices can be legal in dental treatment as long as the patient made the choice.
The problem ethnically with tooth preparation of an alloy and a crown is that the treatment causes more of the tooth to be destroyed thus causing harm to the tooth. In the case of tooth preparations for alloys it is the design in addition to healthy tooth structure that creates stress due to sharp line angles and undercuts which leads to crack formation and future fractures.

It is the protocols and objective of a biomimetic advanced adhesive restoration that makes the restoration completely ethical and compliant with the ADA Code of Ethics.

The thesis of biomimetic restorations and advanced adhesive biomimetic protocols answer the ethical questions when the patient has been informed completely of all choices and the why and how.

Tooth preparation for a biomimetic restoration necessitates proper removal of caries and to create a peripheral seal zone for adhesion. The descriptor for a biomimetic restoration needs to include the use of caries dye or a code for the use or caries dye (D0000) and values obtained from instruments that document caries removal end point (Diagnodent) D0600. Values that were mentioned earlier.

The use of Air abrasion on enamel, dentin (and porcelain for porcelain repair) should be included in the descriptor or a separate code because the benefit increases bond strength. There are two applicable powders aluminum oxide (25-50 micron) and siliconized 30 micron (Cojet, Siljet) tribochemical coating. Because it can be used to treat teeth and porcelain it would be best to have a separate CDT code, one for normal use and one for tribochemical coating when repairing porcelain repairs to composite restorations.

Included in a biomimetic descriptor is neutralizing MMPs or a code that states that MMPs have been neutralized. MMPs cause bond degradation over time and must be addressed for restoring a tooth using advanced adhesive protocols. Why? Because preparing a tooth for an advanced adhesive biomimetic restoration is complex and necessary for the longevity and success of the restoration.

One of the most important steps is Immediate dentin sealing (IDS) which should be identified in the biomimetic descriptor or separate code because of the importance. When preparing the tooth for the final restoration whether direct or indirect this procedure improves bond strength by 30%. The current descriptor is too general and not specific. Immediate dentin sealing would apply to any preparation that cuts into dentin and exposes the dentinal tubules, crown preps, alloy preps, inlay and onlay preps and therefore a separate code for the procedure is warranted as there is a clinical benefit to protecting the pulp tissues when tooth is deemed vital preoperatively.

A specific procedure that needs to be in a descriptor or a separate code is a .5mm resin coat to cover the IDS layer, the literature referred to the resin coat as creating a secure bond. Prior to polymerizing the .5 mm layer, fibers can be placed which increases bond strength and decreases the stress. Fiber placement needs be in the descriptor or a separate code and documented as to purpose. The resin coat could also be placed on the IDS layer for all preps involving dentin prior to taking impressions for a final indirect restoration.

The above procedures create a foundation which can be described as “the adhesive biobase“ for a final restoration either direct or indirect. Does “adhesive biobased” deserve a code?

“CDT 2019: DPC are an essential tool for any dental practice. We all know how important it is to use accurate CDT Codes to avoid rejected claims. But codes are used for more than claims reimbursement.
Since each code consistently records a service that was delivered, practitioners can build a thorough history of patient visits and treatment plans. This documentation may also protect practitioners in case questions arise about treatment that was rendered.”

In summary, there needs to be accurate descriptors and/or codes for advanced adhesive biomimetic restorations. We need descriptors and/or codes for the use of biomimetic protocols for direct restorations like crowns, inlays, onlays and alloys when dentin has been exposed because of the preparations. The need to immediately seal the dentin prior to impressions and place a resin coat will fundamentally improve the clinical results of the final restoration for non-resin restoration. However, bond strength is better with direct composites.

I feel there is a need for a code for rubber dam placement and isolation as when used it improves the clinical results and from an ethical perspective with focus on patient autonomy, to do no harm and veracity.

The descriptors of alloys and resin-based composites needs to be improved to reflect the improvement in materials and methods and process which has improved the clinical results.

It has to be acknowledged to the fact that the research and development of IDS (immediate dentin sealing) also can and should be used for all preparations that involve vital dentin. There needs to be a code to document that it has been done and that it was done prior to impressions for an indirect restoration or a direct composite.

The meta-analysis by Opdam, Magne, and Frankenberger have proven that there is no scientific reason to do full coverage crowns.

Microtensile Bond Strengths to Cavity Floor Dentin in Indirect Composite Restorations using Resin Coating – Conclusion: The application of a resin coat should be required to improve dentin bonding performance of Panavia-F in indirect restorations. However, direct composite restorations still provide higher bond strength compared to indirect restorations.
**Part 1 – Submitter Information**

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<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 10/30/2019</th>
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<tbody>
<tr>
<td>Name: Scott D. Davis DDS</td>
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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes ☒ | If Yes, Name: The Academy of Biomimetic Dentistry www.academyofbiomimeticdent.org |
| No ☐ |

**Part 2 – Submission Details**

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<th>Delete ☐</th>
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</thead>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – **blue underline**; deleted text – **red strike-through**; unchanged text – **black**)

- Nomenclature Required for all “New”
  - ids (immediate dentin sealing) and resin coat for all preparations that cut into dentin

- Descriptor Optional for “New”; enter “None” if no descriptor
  - “The application and polymerization of dentin bonding agents at the time of preparation and a resin coat (and before the impression is taken) has numerous advantages and will ultimately increase the microtensile bond strength by 400% when compared to the traditional approach of bonding the dentin at the cementation appointment. This is fundamental to achieving maximum bond strength.”

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- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
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3. Rationale for this request; your persuasive argument for CMC acceptance
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IDS and resin coat has universal application for all restorations. This should be a required step in pulpal protection and bonded adhesive restorations when the preparation involves dentin, i.e. Alloy preparations, crown preparations, inlay preparations, onlay preparations, core preparations etc. This is an import step even for traditional preparations but it is mandatory for a better biomimetic adhesive restoration. In reduces transudation and thus illuminates post-operative sensitivity.

“The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach” Inside Dentistry June 2017

This is an important article and the 52 cited references at the end of the article and footnoted connected to the protocols and the cited research.

Here are the links to the article.  

Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy
Mathew A Nejad, DDS: Co-director Biomimetic Dentistry CE, Beverly Hills, CA, Adjunct faculty, Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA

Footnotes from article 19,46

4. Complete a) – c) only if Action Request is for a New CDT Code

   [“a) - c)” are not applicable]

   □

   a) CDT Code currently used to report the procedure

   D2999

   b) Procedure technical description

   After caries removal and establishing clean peripheral seal zone, application of CHX, AA the next step in creating a strong bond is IDS (immediate dentin seal). For all preparation that expose dentin, and for all restorations either direct or indirect.

   c) Clinical scenario

   Stops transudation and minimizes postoperative sensitivity, which seals the dentin and protects the pulp. Also coupled with resin coat and AA increases bond strength for and indirect restoration.

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“The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach” Inside Dentistry June 2017

This is an important article and the 52 cited references at the end of the article and footnoted connected to the protocols and the cited research.

Here are the links to the article.


Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy

Mathew A Nejad, DDS: Co-director Biomimetic Dentistry CE, Beverly Hills, CA, Adjunct faculty, Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA


The article reference with the request for a new subcategory the footnotes 19, 46, 17,18 are the references.
Part 4 – CMC Secretariat Use Only

Secretariat Notes:

1. There are six Action Requests concerning biomimetic procedures (Inventory #s 35-40).
2. This submission, with the exception of the text highlighted in orange by the CMC Secretariat, is identical to the submission rejected for inclusion in CDT 2020 by the CMC during its March 2019 meeting. The CMC’s rationale for rejection was –

   “The action request parses components of restorative procedures that are appropriately reported with current CDT codes. In addition, the request contains the same information provided by the submitter in the prior year’s submission that was declined by the CMC. According to Action Request Submission Instructions (https://www.ada.org/en/publications/cdt/request-to-change-to-the-code) a resubmission must include new information not available when the original change request form was prepared.

   A resubmission must be on the then current request form and must include substantive information not available at the time of the prior submission, and this new information must be clearly identified. If not, the Code Maintenance Committee chair may note this before any consideration by the CMC.

3. If this submission is accepted as presented the CDT Code entry would appear as follows:

   Dxxxx ids (immediate dentin sealing) and resin coat for all preparations that cut into dentin

   “The application and polymerization of dentin bonding agents at the time of preparation and a resin coat (and before the impression is taken) has numerous advantages and will ultimately increase the microtensile bond strength by 400% when compared to the traditional approach of bonding the dentin at the cementation appointment. This is fundamental to achieving maximum bond strength”.

---

NOTICE TO PREPARER AND SUBMITTER:

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**Part 1 – Submitter Information**

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: The Academy of Biomimetic Dentistry  
| No > ☐   | www.academyofbiomimeticdent.org                   |

**Part 2 – Submission Details**

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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
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<tr>
<th>Nomenclature Required for all “New”</th>
<th>deep margin elevation</th>
</tr>
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</table>

| Descriptor Optional for “New”; enter “None” if no descriptor | Deep margin elevation can be used for direct and indirect restorations. Becomes necessary when a proximal area is below the gingival level due to caries or a previous deep restoration. “A subgingival box margin needs to be bonded and raised to supra-gingival positions to obtain a biomimetic microtensile bond strength greater than 30 MPa. This deep margin elevation, in conjunction with immediate dentin sealing, resin coating and the composite dentin replacement” can be done direct to create a stress reduced direct composite or indirect adhesive restoration. |

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## CDT Code Action Request

### 3. Rationale for this request; your persuasive argument for CMC acceptance

**Required for any type of requested action – New; Revise; Delete**

Advanced adhesive biomimetic protocols require a new way of thinking. In the interview attached to the request for a new subcategory of Pascal Magne in the year 2012 printed in the British Dental Journal he stated that biomimetic protocols are the future of restorative dentistry. He stated that the model for biomimetic restoration is the tooth and the holy trinity “enamel, dentin and the DEJ.”

Deep margin elevation requires a separate code because it is specific to deep defects due to decay or preparation. The purpose of an adhesive biomimetic restoration is to seal out disease and restore the tooth using methods and materials that mimic the tooth in function and appearance.

The attached interview and article from inside dentistry are important and require diligent study to acquire the knowledge necessary to make an informed judgement.

I personally have read the article on biomimetics more than 10 times in writing for the new subcategory and new biomimetic codes. I have also reviewed the references cited and in so doing came to the realization that I have read and studied most of them. Because of that I have come to the conclusion there is a need for biomimetic codes. I started taking biomimetic courses in 2007 and many of the references started in 2002, however the beginning research started as early 1982. As practitioners and academics such as P. Magne, D. Alleman, S. Deliperi and many others have taken the research and clinical data and formulated a rational for biomimetic restorative dentistry, common sense tells me that it is time for biomimetic codes and thinking.

Second patients do not want more of their tooth removed and traditional codes lead to more tooth removal. Patient autonomy and to do no harm are the ethical aspirations of the ADA code of ethics and biomimetic restorations more than satisfy that requirement.

“What is the future for dentistry? The first term that comes to my mind is minimally-invasive.” Pascal Magne.

### 4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete 
[“a) - c) are not applicable”]

- **a) CDT Code currently used to report the procedure**
  - D2999

- **b) Procedure technical description**

“Subgingival box margin needs to be bonded and raised to supra-gingival positions to obtain a biomimetic microtensile bond strength greater than 30 MPa. This deep margin elevation, in conjunction with caries removal, MMP neutralization, AA, immediate dentin sealing, resin coating and the composite “dentin replacement and enamel replacement either direct or indirect.

- **c) Clinical scenario**

All tissues (enamel, dentin) are restored using materials that simulate each and the DEJ is created through adhesive protocols that allow the tooth to function as a natural tooth with no stress by using the stress reducing protocols.

The end result is a restored tooth with minimal tooth removal and that is bonded and sealed top to bottom, side to side and front to back.
Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

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6. Additional Comment or Explanation:

The protocols mentioned in the request of a new subcategory came from this article:

“The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach” Inside Dentistry June 2017

This is an important article and the 52 cited references at the end of the article and footnoted connected to the protocols and the cited research.

Here is the link to the article:

Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy

Mathew A Nejad, DDS: Co-director Biomimetic Dentistry CE, Beverly Hills, CA, Adjunct faculty, Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA


I have attached Dr. Pascal Magne interview also.
**CDT Code Action Request**

**Part 1 – Submitter Information**

A. **Contact Information (Action Requestor)**  | **Date Submitted:** 10/31/2018
---|---
**Name:** Scott D. Davis DDS

B. **Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes | ☒ |
---|---
| No | ☐ |

If Yes, Name: The Academy of Biomimetic Dentistry

www.academyofbiomimeticdent.org

**Part 2 – Submission Details**

1. **Action** (Mark one only)
   - New  ☒  
   - Revise  ☐  
   - Delete ☐

2. **Full nomenclature and descriptor**
   - **Nomenclature** Required for all “New”
     - biomimetic adhesive bio-base – a foundation for an indirect restoration or direct composite
   - **Descriptor**
     - Caries removed using caries dye and D0600, CHX used to neutralize MMPs, Air abrasion is used to clean enamel and dentin, IDS with resin coat (D0000), Fibers placed (D0000). Cracks into dentin have been removed. (D0000) This restoration is a foundation for indirect or direct restorations.

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Advanced adhesive biomimetic protocols require a new way of thinking. In the interview attached to the request for a new subcategory of Pascal Magne in the year 2012 printed in the British Dental Journal he stated that biomimetic protocols are the future of restorative dentistry. He stated that the model for biomimetic restoration is the tooth and the holy trinity “enamel, dentin and the DEJ.”

A bio-base is not a traditional core buildup therefore it needs a CDT code that documents the purpose which is unique to the biomimetic adhesive protocols, which takes into account the structure of the tooth and what tooth structures are missing and how to restore to biological function and appearance.

The attached interview and article from inside dentistry are important and require diligent study to acquire the knowledge necessary to make an informed judgement.

I personally have read the article on biomimetics more than 10 times in writing for the new subcategory and new biomimetic codes. I have also reviewed the references cited and in so doing came to the realization that I have read and studied many of them. Because of that I have come to the conclusion there is a need for biomimetic codes. I started taking biomimetic courses in 2007 and many of the references started in 2002, however the beginning research started as early 1982. As practitioners and academics such as P. Magne, D. Alleman, S. Deliperi and many others have taken the research and clinical data and formulate rational for biomimetic restorative dentistry, common sense tells me that it is time for biomimetic codes and thinking.

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4. **Complete a) – c) only if Action Request is for a New CDT Code**

   **Mark if Revise or Delete**

   [*a) - c)* are not applicable]

   a) CDT Code currently used to report the procedure

   D2999, D2949, D2950, D2953

   b) Procedure technical description

   **D2949 Restorative foundation for an indirect restoration**

   Placemnt of **restorative material** to yield more **ideal form**, including elimination of undercuts.

   **D2950 core buildup, including and pins when required**

   Refers to building up of corona structure when there is **insufficient retention** for a separate extracoronal restorative procedure. A core buildup is not a filler to eliminate any undercut, box form or concave irregularity in a preparation.

   **D2953 prefabricated post and core in addition to crown**

   Core is built around prefabricated post. This procedure includes the core material.

   I find these codes based upon mechanical dentistry and not adhesive dental biomimetic protocols. That is why we would like to see a separate section for advanced adhesive biomimetic protocols.

   "A subgingival box margin needs to be bonded and raised to supra-gingival positions to obtain a biomimetic microtensile bond strength greater than 30 MPa. This deep margin elevation, in conjunction with immediate dentin sealing, resin coating and the composite “dentin replacement,” is referred to as the “bio-base”—a term used by the Academy of Biomimetic Dentistry for the stress-reduced, highly bonded foundation that the indirect or semi-direct inlay or onlay is bonded."
c) Clinical scenario

All tissues (enamel, dentin) are restored using materials that simulate each and the DEJ is created through adhesive protocols that allow the tooth to function as a natural tooth with no stress by using the stress reducing protocols. The end result is a restored tooth with minimal tooth removal and that is bonded and sealed top to bottom, side to side and front to back.

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If cracks are not removed and covered or supported with an onlay or crown the crack will continue to propagate under the restoration. Ships do not have square portholes. Dentinal cracks are generated by the preparation design with sharp line angles and under cuts the sole purpose is for retention of the restorative material. Cracks are propagated by the stress of occlusion and cusp flexion due to the preparation design with box form and sharp angles. When restoring a tooth the crack needs to be removed if clinically possible without exposing the pulp on a clinically vital and healthy pulp.

Historically cracked tooth syndrome has been problem in that traditional mechanical solutions did not always work or solved the issue of the crack in dentin and or the symptoms. Cracks in enamel are biomimetic and natural and self-limiting because of the DEJ and are not a reason to do a crown or other invasive restorative options.

However!
Sharp pain to biting can be a symptom of a crack into dentin or a gap in an adhesive restoration at dentin-restoration interface. The solution is to think and act like a crack engineer trained in eliminating cracks. Structural cracks to a mechanical engineer is a symptom of stress and faulty design. From the dental side we create the stress by the design of our preparation the patient contributes because they chew and some brux. The solution to the crack is to remove the crack and to restore the tooth using biomimetic protocols and fibers. There is not another restorative system short of extraction that can solve the cracked tooth syndrome better than Advanced adhesive biomimetic protocols.

4. Complete a) – c) only if Action Request is for a New CDT Code
Mark if Revise or Delete ["a) - c""] are not applicable

a) CD Townsend currently used to report the procedure D2999

b) Procedure technical description

1. “Remove dentin cracks completely within 2mm of the dentinoenamel junction. This area is referred to as the ‘peripheral seal zone.’ Remove all dentin cracks inside the peripheral seal zone to a depth of 5mm from the occlusal surface and to a depth of 3mm interproximally from the axial wall. If cracks into dentin are left under the restoration, micro-movements under function will allow the cracks to get longer (ie crack propagation). Larger cracks propagate with smaller forces than shorter cracks; therefore, it is recommended to remove as much of the cracked dentin as possible without exposing the pulp.”

2. Clinical scenario

Protect the pulp and adhesively bond the tooth together either to create a bio-base for an indirect restoration, or SRDC as a final restoration.

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6. **Additional Comment or Explanation:**

The cited article and explanation in the request for a new subcategory for Biomimetic protocols for direct and indirect restorations. The 52 cited references at the end of the article and the associated footnotes for each protocol serve as documentation to the validity of the need for new codes to document precisely and clearly is done.

Last year I submitted documentation from Quintessence International which I had permission to reprint. Those sources should still be on file.

"The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach" Inside Dentistry June 2017

Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy

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Capt. David Scott Alleman DMD, Instructor Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia Italy.


footnotes 4,5,6,40

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| Yes > ☒ | No > ☐ |

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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

- **Nomenclature**
  - Required for all “New”
  - woven polyethylene fiber placement

- **Descriptor**
  - Optional for “New”;
  - enter “None” if no descriptor
  - For large restorations, place fiber inserts on pulpal floor and/or axial walls to minimize stress on the developing bond strength of the hybrid layer. The fiber nets allow the composite on either side of the net to move in different directions via micro shifting of the woven fibers. The polymer network is still highly connected, but the polymerization shrinkage does not stress the hybrid layer.

3. Rationale for this request; your persuasive argument for CMC acceptance

   (Required for any type of requested action – New; Revise; Delete)

   Like the code (D2951 pin retention – per tooth, in addition to restoration) a Code for Fiber placement in the resin coat on the floor and axial walls reduce stress and increase bond strength and Aids in minimizing C-factor stresses and is not invasive like a pin and has more benefit.

4. Complete a) – c) only if Action Request is for a New CDT Code

   Mark if Revise or Delete [“a) - c)” are not applicable]

   a) CDT Code currently used to report the procedure
    - D2999

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b) Procedure technical description

Fibers are placed on the axial walls and the floor of preparation and can be incorporated into the resin coat and adapted to the floor and wall and saturated with adhesive then light cured. Then the tooth can be restored using incremental placement of dentin like composite and then incremental placement of enamel. The specific technique is to restore one or two surfaces at a time to reduce C-factor stresses.

If an indirect restoration is desired then proceed to create a bio-base prior to taking impression use liquid lens to cure air inhibited layer.

c) Clinical scenario .

The restorative result is a tooth bonded top to bottom, side to side, and destressed. Biomimetic means to mimic life or a natural tooth. A natural tooth being the blue print for restoring a tooth adhesively.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

a) Material submitted? Yes ☒ No ☐

b) Protected by copyright? (If “a)” is “Yes”) Yes ☐

c) Permission to reprint? (If “b)” is “Yes”) Yes ☒ No ☐

6. Additional Comment or Explanation:

The Protocols of Biomimetic Restorative Dentistry: 2002 to 2017 Increase the longevity of restorations with biomimetic approach” Inside Dentistry June 2017

This is an important article and the 52 cited references at the end of the article and footnoted connected to the protocols and the cited research.

Here is the link to the article.


footnotes 24,36,37

Authors: David Starr Alleman, DDS: Co-director Alleman-Deliperi Centers for Biomimetic Dentistry, South Jordan, Utah and Cagliari, Sardinia, Italy

Mathew A Nejad, DDS: Co-director Biomimetic Dentistry CE, Beverly Hills, CA, Adjunct faculty, Herman Ostrow School of Dentistry, University of Southern California, Los Angeles, CA

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted:  Oct 31, 2019

Name: Scott D. Davis DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☒  If Yes, Name: The Academy of Biomimetic Dentistry

No ☐

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature

rubber dam placement for isolation

Descriptor

Tooth isolation for non-surgical endodontics and tooth preparation for precise preparation to avoid contamination and to aid in sterilization of the root canal system and to avoid contamination of the prepared dentin. Facilitate dentinal sealing without contamination. To protect the patient.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Rubber Dam placement for endodontic treatment is considered “best practice” therefore there needs to be a code to document the procedure. This request is consistent with “code for what you do.”

It cannot be considered unbundling because there is not a descriptor which identifies rubber dam placement and even if there was a descriptor which made rubber dam placement part of the procedure there would be no documented evidence that it was done, only an assumption. Furthermore, there are many dental treatments in which the use of a Rubber Dam is not included in the code as a technique but is still necessary in order to maintain “best practices”. It should therefore be considered, not a technique, but a procedure and as such requires a code. For this reason the addition of a code for Rubber Dam placement does not fall under the demarcation of unbundling.

From the CDT 2018 Dental Procedure Codes in the article “Endodontic Therapy (Including Treatment Plan, Clinical Procedures and Follow-Up Care)” (28), the question that I would ask is this: what clinical procedures? If the procedures are unique they need codes such as Rubber Dam Placement.

In the CDT Code Book under, “Other Endodontic Procedures” (32) there is this code, D3910 -- surgical procedure for isolation of tooth with a rubber dam. If this clinical procedure has a code for placement of a rubber dam, which of its self does not have a code, and rubber dam placement is considered best
practice then for the sake of clarity and precise documentation there needs to be a code for rubber dam placement.

There are other restorative procedures which would also benefit from being able to document that isolation was achieved with rubber dam placement.

Question? If rubber dam placement is considered standard of care and/or best practice then why do we even need a majority vote other than agreeing with the stated protocols of the American Association of Endodontists and the Endodontic Representative on the CMC? All that should then be required of other voting members is to concur with the specialist and vote in the affirmative.

Here is the pdf of the white paper from the American Association of Endodontists on Rubber Dam placement which state their position on Rubber Dam placement


4. Complete a) – c) only if Action Request is for a New CDT Code

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<th>Mark if Revise or Delete</th>
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</table>

a) CDT Code currently used to report the procedure

None

b) Procedure technical description

In every dental assisting textbook there is a technical description of the procedure and the nuances and permutations of rubber dam placement with dental rubber dam clips.

In every endodontic undergraduate curriculum and every post graduate discipline the "standard of care", is that all nonsurgical endodontic therapy should be done under a rubber dam.

In the June 2013 JADA, Volume 144, Issue 6, 572, 574 a review of dental practices, “Using a Rubber Dam” was done. It was noted from DPBRN that only 44% of general dentists use rubber dam while doing endodontic therapy. Hence, a code for rubber dam placement would minimize sub-standard of care. In addition, dental benefit providers could deny payment if a rubber dam was not used.

c) Clinical scenario

Better treatment is the outcome when standard of care is followed and when documentation of proper clinical procedures occurs, which then improves patient care.
Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
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6. Additional Comment or Explanation:

In the three years that I have submitted for new codes, I have been frustrated, because of the lack of progress. However, I am not discouraged. The reason I persist is that there needs to be adhesive codes that correlate with adhesive protocols and procedures. This code request of Rubber Dam placement is not only for endodontic therapy but also open up the door for the use of a Rubber Dam in other restorative procedures. It is the standard of care for endodontic nonsurgical therapy, it is considered best practice. Therefore, it is also considered best practice for other restorative protocols.

I am still trying to understand what a “bundle” consists of so that an understanding what is “unbundling”.

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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

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**Part 2 – Submission Details**

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<td><strong>Nomenclature</strong> Required for all “New”</td>
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<td><strong>Descriptor</strong> Optional for “New”; enter “None” if no descriptor</td>
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3. Rationale for this request; your persuasive argument for CMC acceptance  
(Required for any type of requested action – New; Revise; Delete)

Successful endodontic treatment requires a coronal seal to prevent re-contamination of the canal system. The best time to place the permanent restoration is immediately after obturation; while the tooth is still isolated under a rubber dam. However, this is not always practical and many times a temporary restoration is placed.

The canal orifice barrier procedure is a distinct procedure that is applicable to prevent recontamination when a permanent restoration has not been placed right after obturation. The canal orifice barrier is NOT a temporary restoration, nor is it closure of the access opening by a core buildup or composite. The temporary restoration may be placed over the orifice barrier as described below.

Recontamination can occur in teeth that are not permanently restored immediately after obturation, if:
1) Placement of the permanent restoration is delayed (> 2 weeks);
2) The temporary restoration or crown breaks down;
3) The surrounding tooth structure fractures; or
4) No rubber dam isolation is present during placement of the permanent restoration.

Thus, immediate protection from coronal leakage is achieved with a canal orifice barrier. Typically, a permanent restorative material is placed in the coronal 2-4mm of the canal, in the floor of the chamber. This is not the same as closure of the access opening by a core buildup or a composite. A temporary restoration may be placed over the orifice barrier to be removed by the restoring dentist and the core buildup or restoration is completed over the orifice barrier.

The goals of a canal orifice barrier are to prevent the ingress of microbes and to aid in the final restoration of the tooth. The orifice barrier does not take the place of the final restoration.

4. Complete a) – c) only if Action Request is for a New CDT Code  
Mark if Revise or Delete ["a) - c"] are not applicable]

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<tr>
<td>b) Procedure technical description</td>
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A permanent restorative material is placed in the coronal 2-4mm of the canal, in the floor of the chamber. This is not the same as closure of the access opening by a core buildup or a composite. There is presently no code to use for this procedure. The orifice barrier itself is not a one-surface restoration. A temporary restoration may be placed over the orifice barrier to be removed by the restoring dentist and the core buildup or restoration is completed over the orifice barrier.
c) Clinical scenario

Upon completion of root canal therapy with the endodontist, patient is to return to their general dentist for completion of the final restoration. An orifice barrier is placed over the canal orifices to prevent the ingress of microbes and contamination of the root canal system. The orifice barrier does not take the place of the final restoration.

Radiographic illustration:

1. Pre-op
2. Post-obturation
3. Orifice barrier placed followed by temporary restoration placed. Patient to return to general dentist for final restoration.

Photographs:

1. Pulpal floor, four canals
2. Post-obturation
3. BC Liner Orifice barrier placement over each canal orifice
4. 2mm BC Liner placement complete to seal canals from coronal leakage

Part 3 – Additional Information

5. Supporting documentation or literature:
   • “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   • If protected by copyright, written authorization to reprint and distribute must be provided
   • All material must be submitted in electronic format.

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6. Additional Comment or Explanation:

None

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: American Association of Endodontists |
| No > ☐  |                                                   |

**Part 2 – Submission Details**

1. Action (Mark one only)

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   Affected Code (Revise or Delete only) | D3427 |

2. Full nomenclature and descriptor (For "Revise" mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   - Nomenclature Required for all "New": periradicular surgery without apicoectomy
   - Descriptor Optional for "New"; enter "None" if no descriptor

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

   D3427 is presently used for surgical repair of root resorption as well as for exploratory surgeries, which are vastly different procedures with different intended outcomes [see companion requests to add separate codes for surgical repair of root resorption and for exploratory surgery, illustrating the significant procedural distinction between repair and mere exploration]. Accordingly, deletion of D3427 is respectfully requested, along with addition of new separate codes for surgical repair of root resorption and for exploratory surgeries (surgical exposure of the root surface without surgical repair of root resorption or apicoectomy).

4. Complete a) – c) only if Action Request is for a New CDT Code

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<th>Mark if Revise or Delete [&quot;a) - c)&quot; are not applicable]</th>
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   a) CDT Code currently used to report the procedure

**NOTICE TO PREPARER AND SUBMITTER:**

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CDT CODE ACTION REQUEST

b) Procedure technical description

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C) Clinical scenario

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**Part 3 – Additional Information**

5. Supporting documentation or literature:
   - "5.a)" **must** be completed for all requested actions; "b)" and "c)" are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

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6. Additional Comment or Explanation:

None

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### Part B – Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

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If Yes, Name: American Association of Endodontists

### Part 2 – Submission Details

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2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature:
- surgical repair of root resorption - anterior
- surgical repair of root resorption – premolar
- surgical repair of root resorption – molar

Descriptor:
- For surgery on root of anterior tooth. Does not include placement of restoration.
- For surgery on root of premolar tooth. Does not include placement of restoration.
- For surgery on root of molar tooth. Does not include placement of restoration.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The current code prescribed to be used for resorption repair is D3427. However, D3427 has such broad applicability that it is used not only for resorption repair but also for exploratory surgeries, that are vastly procedurally different from each other, and have vastly different expected outcomes. Moreover, the apicoectomy codes cannot be used as surgical repair of root resorption as it is periradicular surgery but not an apicoectomy, and the apicoectomy codes are expressly limited to apicoectomies. Accordingly, the current code fails to have a unique code for surgical repair of root resorption. For further discussion of procedural distinction, please 4 b) and 4 c) below.

In order to be consistent with the language for apicoectomies, three codes for surgical repair of root resorption are respectfully submitted, for anterior, premolar, and molar, respectively.

---

**NOTICE TO PREPARER AND SUBMITTER:**

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4. Complete a) – c) only if Action Request is for a New CDT Code

| a) CDT Code currently used to report the procedure | D3427 |
| b) Procedure technical description |

**D3427 periradicular surgery without apicoectomy** is the code prescribed for all periradicular surgeries that are not apicoectomies, including surgical repair of root resorption and exploratory surgeries. D3427 is insufficient and inappropriate because the procedures it presently encompasses are vastly procedurally different from each other. Specifically, surgical repair of root resorption is procedurally distinct from exploratory surgery because:

- Surgical repair of root resorption involves surgical exposure of the affected resorptive defect and root surface, excavation of the tooth structure and root surface affected by the resorption, application of 90% Trichloroacetic Acid to the excavated resorptive defect, and placement of a biological and esthetic restoration on the root surface which is partially or fully subgingival and many times approximating the osseous crest, and surgical closure of the exposed area.

- On the other hand, exploratory surgery usually only involves surgical exposure of the root surface followed by observation and surgical closure of the exposed area.

This is not merely a difference in technique, but rather a significant difference in the procedure itself, from the desired result to action performed to outcome expected.

Moreover, surgical repair of root resorption is also procedurally distinct from apicoectomies because an apicoectomy does not involve excavation of a resorptive defect, application of 90% TCA to the resorptive defect, or placement of a subgingival restoration on the root surface, but does involve surgical exposure of the affected root apex (or apices), curettage of the infected periapical tissues, resection of 2-3+ mm of the root end, ultrasonic root end preparation 2-4mm into the canal space, placement of a biocompatible root end filling material, and surgical closure of the exposed area. Again, this is not a difference in technique, but rather a significant different in the procedure itself, from the desired result to action performed to outcome expected.

---

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**CDT CODE ACTION REQUEST**

**Part 3 – Additional Information**

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6. Additional Comment or Explanation:

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# CDT Code Action Request

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## Part 2 – Submission Details

1. **Action** (Mark one only)
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   - Revise ☐
   - Delete ☐
   - Affected Code (Revise or Delete only) D

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   **Nomenclature**
   - surgical exposure of root surface without apicoectomy or repair of root resorption

   **Descriptor**
   - Exposure of root surface followed by observation and surgical closure of the exposed area. Not to be used for or in conjunction with apicoectomy or repair of root resorption.

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)

   The current code prescribed to be used for exploratory surgery (surgical exposure of root surface without apicoectomy or repair of root resorption) is D3427. However, D3427 is also presently used for surgical repair of root resorption, which is vastly procedurally different and has vastly different expected outcomes. Accordingly, the current code fails to have unique codes for the distinct procedures of exploratory surgery and for surgical repair of root resorption. For further discussion of procedural distinction, please 4 b) and 4 c) below.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - Mark if Revise or Delete ["a) - c") are not applicable] ☐
   - a) CDT Code currently used to report the procedure D3427
b) Procedure technical description

D3427 periradicular surgery without apicoectomy is the code prescribed for all periradicular surgeries that are not apicoectomies, including surgical repair of root resorption and exploratory surgeries. D3427 is insufficient and inappropriate because the procedures it presently encompasses are vastly procedurally different from each other. Specifically, surgical repair of root resorption is procedurally distinct from exploratory surgery because:

- Surgical repair of root resorption involves surgical exposure of the affected resorptive defect and root surface, excavation of the tooth structure and root surface affected by the resorption, application of 90% Trichloroacetic Acid to the excavated resorptive defect, and placement of a biological and esthetic restoration on the root surface which is partially or fully subgingival and many times approximating the osseous crest, and surgical closure of the exposed area.

- On the other hand, exploratory surgery usually only involves surgical exposure of the root surface followed by observation and surgical closure of the exposed area.

This is not merely a difference in technique, but rather a significant different in the procedure itself, from the desired result to action performed to outcome expected.

c) Clinical scenario

Patient appears with symptoms of discomfort or swelling associated with the periapical region of previously endodontically treated tooth. Radiograph shows a periapical lucrency, area of resorption or perforation, extrusion of endodontic filling, or possible sign of root fracture. Clinician surgically exposes the periradicular structures to determine if apicoectomy, root resorption repair, or perforation repair is possible, to examine the extrusion, and to examine for potential root fracture or other structural compromise. The surgical exposure for observation provides the clinician with the determination of the presence vertical fracture of the root with or without dehiscence of bone over the fracture, or the significance of the compromise of the root, or extruded root filling for which the clinician can then treatment plan including, for example extraction or periapical curettage. No apicoectomy, repair of resorptive or perforative defect, or extraction is performed at this time.

The following image is provided as an example. In the below scenario, patient had a sinus tract at the apex of tooth #8 and an apical radiolucency. The probing depths were normal (2-3mm). Apical surgery was initiated, however, upon reflection of the flap a vertical root fracture extending from the apex to the mid root was noted. The surgical exposure was closed and the patient was referred for extraction.

![Image](image_url)
### Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th></th>
<th>b) Protected by copyright? (If “a)” is “Yes”)</th>
<th></th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Yes &gt;</td>
<td>☐</td>
<td>Yes &gt;</td>
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<td>☐</td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

None

---

**NOTICE TO PREPARER AND SUBMITTER:**

- **All requested information in Parts 1-3 is required;** limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
- Completed Request **must** be submitted in **unprotected MSWord format** via email to dentalcode@ada.org.
- A submission will be returned for correction if it is: a) **not** an unprotected MS Word document; b) **not** on the current Action Request format; or c) it is missing “Required” information.
Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: 10/7/2019
---|---
Name: John Y. Kwan, DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > | ☐ | No > | ☒ |

If Yes, Name:

Part 2 – Submission Details

1. Action (Mark one only) | New | ☒ | Revise | ☐ | Delete | ☐ | Affected Code (Revise or Delete only) | D
---|---|---|---|---|---|---|---|---

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>periodontal endoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor</td>
<td>Endoscopic debridement of diseased tooth roots utilizing instruments to micro visually remove subgingival plaque and calculus attendant to periodontal disease.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Webster’s Medical Dictionary: Endoscopy: A procedure that uses an endoscope to diagnose or treat a condition. Periodontal Endoscopy allows for micro visual debridement of subgingival calculus typically with standard ultrasonic tooth cleaning instruments. This procedure is indicated for patients with periodontal disease and is therapeutic, not prophylactic, in nature. It is known that scaling and root planing cannot be predictably achieved without visualization. Whereas non-surgical subgingival scaling and root planing is essentially a blind procedure, Periodontal Endoscopy is a non-surgical procedure that is very DIFFERENT. Endoscopic visualization provides an opportunity for VISUAL scaling and root planing significantly increasing the predictability of pocket reduction and stability of healing via a closed procedure. This procedure is a Superior Method compared to what we rely on for initial periodontal therapy and even surgical therapy. This procedure can be provided by dentists and hygienists. This procedure is being taught at the UCSF School of Dentistry, Division of Periodontology, USC Herman Ostrow School of Dentistry, Dental Hygiene Program, Idaho State University, Dental Hygiene Masters Program, Shoreline College Dental Hygiene Program and LSU School of Dentistry, Department of Periodontics.

Notice to Preparer and Submitter:

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### CDT Code Action Request

**Part 1**

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>a) CDT Code currently used to report the procedure</th>
<th>b) Procedure technical description</th>
<th>c) Clinical scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td><strong>Periodontal Endoscopic Debridement, full or partial quadrant. This procedure involves endoscopic visualization of the crown and root surfaces of teeth to remove plaque and calculus from these surfaces. It is indicated for patients with periodontal disease and is therapeutic, not prophylactic, in nature.</strong> <strong>Endoscopic Debridement is a procedure designed for the removal of plaque and calculus that are present on roots effected by periodontal disease. This procedure is used for the definitive treatment of most stages of periodontal disease.</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Patients presenting with diagnosis of periodontal disease typically have subgingival calculus which if removed completely will result in attachment gain and periodontal health. Treatment plans include periodontal scaling and root planing in a partial or full quadrant. Billing for the endoscopic procedure is billed under either no code, hence no covered benefit or 4999 unspecified periodontal procedure which is typically denied and patient pays. Unless the patient has Delta Dental as they state in their handbook that the endoscopic procedure should be included. This is a problem as the cost for the equipment, consumables and procedure should be paid for separately.</strong> <strong>The procedure can be billed under gingival flap procedure as this allows for visual root debridement however this is more expensive and a doctor procedure. Whereas the periodontal scaling and root planing with endoscopic procedure can be done by a dentist or hygienist.</strong></td>
<td></td>
</tr>
</tbody>
</table>

**Part 2 – Additional Information**

5. Supporting documentation or literature:

- “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
- If protected by copyright, written authorization to reprint and distribute **must** be provided
- All material **must** be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>Yes &gt; ☒</th>
<th>No &gt; ☐</th>
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</thead>
<tbody>
<tr>
<td>b) Protected by copyright?</td>
<td>Yes &gt; ☒</td>
<td>No &gt; ☐</td>
</tr>
<tr>
<td>(If “a)” is “Yes”)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Permission to reprint?</td>
<td>Yes &gt; ☒</td>
<td>No &gt; ☐</td>
</tr>
<tr>
<td>(If “b)” is “Yes”)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

None

---

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<table>
<thead>
<tr>
<th>CPT Code</th>
<th>Code Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>43235</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; diagnostic, including collection of specimen(s) by brushing or washing, when performed</td>
</tr>
<tr>
<td>43236</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with directed submucosal injection(s), any substance</td>
</tr>
<tr>
<td>43237</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with endoscopic ultrasound examination limited to the esophagus, stomach or duodenum, and adjacent structures</td>
</tr>
<tr>
<td>43238</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with transendoscopic ultrasound-guided intramural or transmural fine-needle aspiration/biopsy(s), (includes endoscopic ultrasound examination limited to the esophagus, stomach or duodenum, and adjacent structures)</td>
</tr>
<tr>
<td>43239</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; biopsy; single or multiple</td>
</tr>
<tr>
<td>43240</td>
<td>Esophagogastroduodenoscopy, with transmural drainage of pseudocyst (includes placement of transmural drainage catheter[s]/stent[s], when performed, and endoscopic ultrasound, when performed)</td>
</tr>
<tr>
<td>43241</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; insertion of intraluminal tube or catheter</td>
</tr>
<tr>
<td>43242</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with transendoscopic ultrasound-guided intramural or transmural fine-needle aspiration/biopsy(s) (includes endoscopic ultrasound examination of the esophagus, stomach, and either the duodenum or a surgically altered stomach where the jejunum is examined distal to the anastomosis)</td>
</tr>
<tr>
<td>43243</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; injection sclerosis of esophageal/gastric varices</td>
</tr>
<tr>
<td>43244</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; band ligation of esophageal/gastric varices</td>
</tr>
<tr>
<td>43245</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with dilation of gastric/duodenal stricture(s) (eg, balloon, bougie)</td>
</tr>
<tr>
<td>43246</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with directed placement of percutaneous gastrostomy tube</td>
</tr>
<tr>
<td>43247</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with removal of foreign body(s)</td>
</tr>
<tr>
<td>43248</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; insertion of guide wire followed by passage of dilator(s) through esophagus over guide</td>
</tr>
<tr>
<td>43249</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; transendoscopic balloon dilation of esophagus (&lt;30 mm)</td>
</tr>
<tr>
<td>43233</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with dilation of esophagus with balloon (30 mm diameter or larger) (includes fluoroscopic guidance, when performed)</td>
</tr>
<tr>
<td>43250</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with removal of tumor(s), polyp(s), or other lesion(s) by hot biopsy forceps</td>
</tr>
<tr>
<td>43251</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with removal of tumor(s), polyp(s), or other lesion(s) by snare technique</td>
</tr>
<tr>
<td>43252</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with optical endomicroscopy</td>
</tr>
<tr>
<td>CPT Code</td>
<td>Code Descriptor</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>43253</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with transendoscopic ultrasound-guided transmural injection of diagnostic or therapeutic substance(s) (eg, anesthetic, neurolytic agent) or fiducial marker(s) (includes endoscopic ultrasound examination of the esophagus, stomach, and either the duodenum or a surgically altered stomach where the jejunum is examined distal to the anastomosis)</td>
</tr>
<tr>
<td>43254</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with EMR (endoscopic mucosal resection)</td>
</tr>
<tr>
<td>43255</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with control of bleeding, any method</td>
</tr>
<tr>
<td>43256</td>
<td>43256 has been deleted. To report, use 43266</td>
</tr>
<tr>
<td>43266</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with placement of endoscopic stent (includes pre- and postdilation and guide wire passage, when performed)</td>
</tr>
<tr>
<td>43257</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with delivery of thermal energy to the muscle of lower esophageal sphincter and/or gastric cardia, for treatment of gastroesophageal reflux disease</td>
</tr>
<tr>
<td>43258</td>
<td>43258 has been deleted. To report, use 43270</td>
</tr>
<tr>
<td>43270</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with ablation of tumor(s), polyp(s), or other lesion(s) (includes pre- and post-dilation and guide wire passage, when performed)</td>
</tr>
<tr>
<td>43259</td>
<td>Esophagogastroduodenoscopy, flexible, transoral; with endoscopic ultrasound examination, including the esophagus, stomach, and either the duodenum or a surgically altered stomach where the jejunum is examined distal to the anastomosis</td>
</tr>
</tbody>
</table>
COPYRIGHT ASSIGNMENT AGREEMENT CONCERNING PROPOSED DENTAL
PROCEDURE CODE SUBMISSIONS

The undersigned, JOHN Y. KWAN DDS ("Submitter"),

whose address is 6383 Telegraph Ave Suite 101
Oakland CA 94609

representing SELF

(Please print full name)
(Please print full mailing address)

(Please print full organization name or "self," as appropriate)

is submitting one or more proposed dental procedure code(s) or is proposing the amendment of
a proposed or existing dental procedure code or codes for consideration by the American Dental
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transfers all copyrights and any other rights to any proposed code or amendment submitted by
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Submitter hereby acknowledges and agrees that with respect to such proposed code or proposed
amendment as described above: ADA will own all right, title and interest, including the entire
e exclusive copyright and all other intellectual property and proprietary rights and that Submitter will
retain no such rights. Submitter represents and warrants that: (1) he/she has full power and
authority to enter into this Agreement and to grant any and all rights, interest and title granted
herein; (2) any and all contributions he/she makes to such materials are original; Participant
further agrees that he/she will execute any additional documents necessary to effect this
assignment to ADA.

Signature

John Y. Kwan, DDS

Name (Please print)

Date

10/7/19
Clinical Studies Supporting the Perioscopy System

Subgingival Identification study. SEM evaluation

- 42 teeth, 210 sites
- 4 hygienists
95% accuracy in identifying topographical landmarks and features

Extraction Study: SEM evaluation

- 42 teeth, 210 sites
- Teeth cleaned with aid of dental endoscope (Perioscopy)
- Teeth extracted and SEM evaluated
1.2% of Endoscope aided SRP had residual calculus – mostly at CEJ
Similar study designs in literature showed 10 – 50% residual calculus remaining following traditional SRP w/out endoscope

Endoscopic SRP (Perioscopy)

- 46 patients, 73 quadrants
  - Sites treatment planned for surgery
  - Used endoscope and non surgical therapy first
  - 1 year follow-up at 3 month intervals
- Treated by 1 hygienist
At 1 year, 71 – 73 quadrants required no flap surgery
Mean attachment gain of 2.06mm

Retrospective look at Perioscopy treatment outcomes after three years (626 sites)

In pockets 4 - 6mm

PD reduction of 1.94mm with endoscope as compared with traditional SRP reported in literature of 1.0mm
Attachment gain of 1.92mm as compared with traditional SRP reported in literature of 0.38mm

In pockets over 6mm

PD reduction of 4.4mm with endoscope as compared with traditional SRP reported in literature of 2.18mm
Attachment gain 4.1mm as compared with traditional SRP reported in literature 0.97mm

Clinical Data Supporting use of Perioscopy System
In Press or In Progress

Clinical Data Supporting use of Perioscopy System
In Press or In Progress

**Harrell SK, Wilson TG.** Minimally invasive surgical technique utilizing Enamel Matrix Protein and Dental Endoscope
- Accepted for publication Journal Periodontology
- Excellent clinical results
  - Average **CAL** 3.57 as compared to traditional surgical techniques found in the literature averaging 1.8mm
  - Average **PD reduction** 3.56 as compared to traditional surgical techniques found in the literature averaging 2.7
  - Average **recession** following procedure 0.01mm as compared to traditional surgical techniques found in the literature averaging 0.9mm

**Wilson TG, et al.** Histology non-surgical applications
**Wilson TG, et al.** Histology surgical applications
The Relationship Between the Presence of Tooth-Borne Subgingival Deposits and Inflammation Found With a Dental Endoscope

Thomas G. Wilson Jr.,* Stephen K. Harrel,* Martha E. Nunn,† Bonnie Francis,* and Kara Webb*

**Background:** Inflammatory periodontal diseases are found in many dentate individuals, but therapists and researchers who assess disease activity have had to rely on external clinical signs and symptoms to ascertain the health of the subgingival periodontal tissues. However, by using an endoscope in the subgingival environment, the therapist can see the relationship of subgingival tooth-borne accretions to signs of inflammation in the pocket wall. This study explored those relationships via the endoscope.

**Methods:** Twenty-six patients with moderate to severe periodontitis were chosen. The study visit involved a standardized, masked examiner who gathered data on the external gingival index, probing depth, gingival recession, and clinical attachment level. A second standardized examiner, masked to the findings of the first, used a dental endoscope. A set of indices (endoscopic biofilm index, endoscopic calculus index, and endoscopic gingival index) specifically developed for subgingival parameters was used. A fixation stent ensured that the periodontal probe and the endoscopic explorer traveled along the same path.

**Results:** A statistically significant relationship was found between deposits of subgingival calculus covered with biofilm and inflammation of the pocket wall, as measured by color change. In >60% of the cases, this inflammation was associated only with biofilm over deposits of calculus, not biofilm alone. Only subgingival calculus was statistically significant in relation to the positive traditional gingival index.

**Conclusions:** Deposits of subgingival calculus covered with biofilm were directly related to >60% of pocket wall inflammation as measured by increased redness of the pocket epithelium. This was in comparison to biofilm alone. J Periodontol 2008;79:2029-2035.

**KEY WORDS**
Biofilm; calculus; endoscope; inflammation.

---

Inflammatory periodontal diseases affect a significant portion of the dentate adult population and are the primary cause of tooth loss in this group. Subgingival tooth-borne accretions, including calculus and biofilm, are commonly found in the chronic forms of these diseases. However, once bacterial plaque was declared the primary, extrinsic etiologic factor in the inflammatory forms of these diseases, subgingival calculus (SCI) was relegated to a minor role, and the need for its complete removal became dubious.

Until recently, information about the subgingival environment was dependent on surgical or histologic observations. Both are disruptive to the subgingival structures, which eliminates the opportunity to accurately observe the subgingival environment. Real-time observation of the subgingival area has been made possible through development of the dental endoscope. The device operator can clearly see the environment at up to ×48 magnification during an initial visit and the results of therapy over an extended response time, allowing routine diagnostic observation and therapy.

The relationship between inflammation of the pocket wall, as delineated by increased redness and the presence of SCI, and biofilm deposits can also be observed using the endoscope. The goals of this study were to explore the relationship between SCI and biofilm and the
presence of endoscopically visible signs of inflammation (redness) on the pocket wall and the relationship of these deposits to traditional periodontal indices.

MATERIALS AND METHODS
Twenty-six patients with moderate to severe periodontitis were selected, and written informed consent was obtained before therapy began. Patients were enrolled in the study from 2004 to 2006 and seen in a private practice in Dallas, Texas. The study was conducted in accordance with the Helsinki Declaration of 1975, as revised in 2000.

At the initial study visit, traditional clinical findings, including the gingival index (GI), bleeding on probing (BOP), probing depth (PD), and clinical attachment level (CAL), were gathered at six sites on all study teeth. Gingival recession was measured at four sites on each study tooth. The parameters were set by a calibrated examiner who was initially masked to the endoscopic findings and trained and calibrated for reliability. Interproximal sites with and without clinical signs of disease (e.g., BOP and increased PD) were chosen in each

Table 1. Definitions of Indices

<table>
<thead>
<tr>
<th>Endoscopic biofilm index (EBI)*</th>
<th>0 = No endoscopically observable biofilm present on root surface</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = Separate flecks of biofilm present on &lt;1/3 of the surface visualized endoscopically</td>
</tr>
<tr>
<td></td>
<td>2 = A thin, continuous band of biofilm present on two-thirds of the surface visualized endoscopically</td>
</tr>
<tr>
<td></td>
<td>3 = A continuous band of biofilm present on the entire surface visualized endoscopically</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Endoscopic calculus index (ECI)*</th>
<th>0 = No endoscopically observable calculus on the root surface</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = Separate, discrete flecks of calculus present on the surface visualized endoscopically; generally considered embedded accretions</td>
</tr>
<tr>
<td></td>
<td>2 = A coalition of deposits of calculus present on the surface visualized endoscopically covering &lt;50% of the visual field</td>
</tr>
<tr>
<td></td>
<td>3 = A thick, diffuse accumulation of calculus present on the surface visualized endoscopically covering &gt;50% of the visual field</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Endoscopic inflammation index (EII)†</th>
<th>0 = Normal gingiva: no inflammation, no discoloration, and no bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 = Mild inflammation, slight color change, mild alteration of gingival surface, and no bleeding</td>
</tr>
<tr>
<td></td>
<td>2 = Moderate inflammation, erythema, swelling, and BOP or pressure</td>
</tr>
<tr>
<td></td>
<td>3 = Severe, diffuse inflammation, severe erythema and swelling, tendency to spontaneous hemorrhage, and some ulceration</td>
</tr>
</tbody>
</table>

* Modified from Greene and Vermillion.6
† Modified from Löe and Silness.5

Figure 1. A) The gray/blue area surrounding the white area seen in the left side of this figure was easily disturbed by the endoscopic explorer and was termed biofilm. B) A schematic drawing of the endoscopic field seen in A. Calculus (C) is observed on the root surface (R) and is directly associated with the increase in red seen in the pocket wall (I), whereas the biofilm alone is not. S = endoscope shield.

Figure 2. A) The white area (arrowhead) in the top center of the field is calculus. B) Inflammation of the pocket wall (I) is seen directly adjacent to calculus (C). R = root surface; S = endoscope shield.
patient. A second examiner masked to the findings of the first examiner used the dental endoscope to observe the subgingival environment. A position stent ensured that the probe used by the first examiner and the endoscopic explorer used by the second examiner traveled the same path. The endoscopic findings were quantified using three traditional indices modified for this study and based on common clinical findings seen with the endoscope: the endoscopic biofilm index (EBI), the endoscopic inflammation index (EII), and the endoscopic calculus index (ECI) (Table 1). EBI is a modification of the Greene and Vermillion index originally designed to describe supragingival plaque. When the endoscope is used subgingivally in a periodontal pocket, a material film adhering to the tooth is frequently observed. This material, considered a biofilm in this study, is easily disturbed by the shield on the endoscope. During scaling of the subgingival root surface, this film loses adherence and is washed away by irrigation water flowing from the endoscope probe. EBI measures the amount of film occupying the endoscopic track, which is 3 mm wide and runs from the coronal to the apical extent of the pocket (Fig. 1).

Figure 3. Inflammation of the pocket wall was seen more frequently associated with calculus covered with biofilm than with biofilm alone.

Table 2. Distribution of Subgingival Inflammation (%) by Clinical and Endoscopic (subgingival) Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subgingival (endoscopic) Inflammation</th>
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<tbody>
<tr>
<td></td>
<td>None</td>
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<tr>
<td>PD (mm)</td>
<td></td>
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<tr>
<td>≤3</td>
<td>22.5</td>
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<tr>
<td>4 to 5</td>
<td>6.2</td>
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<tr>
<td>≥6</td>
<td>0.7</td>
</tr>
<tr>
<td>BOP</td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>21.5</td>
</tr>
<tr>
<td>Present</td>
<td>4.7</td>
</tr>
<tr>
<td>Gingival inflammation5</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>25.6</td>
</tr>
<tr>
<td>Mild</td>
<td>21.8</td>
</tr>
<tr>
<td>Moderate</td>
<td>4.8</td>
</tr>
<tr>
<td>Severe</td>
<td>0.0</td>
</tr>
<tr>
<td>Subgingival (endoscopic) biofilm</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>82.6</td>
</tr>
<tr>
<td>Mild</td>
<td>25.3</td>
</tr>
<tr>
<td>Moderate</td>
<td>1.9</td>
</tr>
<tr>
<td>Severe</td>
<td>0.0</td>
</tr>
<tr>
<td>Subgingival (endoscopic) calculus</td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>53.5</td>
</tr>
<tr>
<td>Mild</td>
<td>3.9</td>
</tr>
<tr>
<td>Moderate</td>
<td>0.0</td>
</tr>
<tr>
<td>Severe</td>
<td>0.0</td>
</tr>
</tbody>
</table>

* Based on weighted χ² test.
subgingival wall of the pocket is easily observed with the endoscope. Typically, the gingival wall of the sulcus is a light pink color indicating health. In disease, islands of dark red color blotch the pocket wall. These areas vary from a slight color change to deep red with an erythematous appearance and may be discrete or diffuse. Additionally, these red areas may bleed from the movement of the endoscopic probe.

SCI can easily be observed through the endoscope as hard accretions firmly attached to the root surface. In addition, they are distinguished by their brilliant reflection of light and, thus, corroborate initial evidence. Calculus deposits may range from small isolated flecks, or islands, to thick, continuous layers. ECI, a variation of the Greene and Vermillion index, measures the amount of SCI observed through the endoscope (Fig. 2).

All endoscopic procedures were recorded with digital video to further ensure accuracy and consistency. Video taken during the initial readings made by the endoscopic operator was watched and evaluated by three calibrated operators.

RESULTS
Endoscopic Results
Findings indicated that the endoscopy explorer followed the path previously traveled by the periodontal probe, as a result of the stent. Subgingival biofilm (SBI) and calculus were routinely observed, with deeper PDs generally related to increased deposits of both accretions. Biofilm and calculus often coexisted in the same track; however, in a large percentage of cases, increased inflammation (as measured by increased redness of the pocket wall) was associated with deposits of calculus covered with biofilm. Less than 30% of subgingival inflammation was associated with biofilm alone (Fig. 3). The association between calculus and subgingival inflammation is a routine observation of experienced endoscope clinicians, who use the device to find small areas of residual calculus during therapeutic scaling and root planing and minimally invasive periodontal surgery.

Statistical Methods
Descriptive statistics and frequency distributions were calculated for patient characteristics, clinical measures, and endoscopic measures. Weighted χ² tests of independence were conducted for clinical and endoscopic measures to adjust for correlated observations within subjects. Single-factor mixed models were fit to test the association of clinical and endoscopic variables with PD and to test the association of clinical and endoscopic variables with subgingival inflammation. Adjusted means and corresponding 95% confidence intervals for PDs and subgingival inflammation by clinical and endoscopic variables were also calculated. A multifactor mixed model was fit to test the simultaneous association of subject characteristics and clinical and endoscopic variables with subgingival (endoscopic) inflammation with age group, smoking status, gender, BOP, supra- gingival inflammation, SBI, and SCI included as predictors in the model. Similarly, a multifactor mixed model was fit to test the simultaneous association of subject characteristics and clinical and endoscopic variables with PD.

Statistical Results
Twenty-six subjects were enrolled in the study at baseline; 50% (13/26) were male, and 46.2% (12/26) were smokers. The mean baseline age of subjects enrolled in

### Table 3.
**Adjusted Means and 95% Confidence Intervals (CI) for PD by Clinical and Endoscopic (subgingival) Variables: Based on Mixed Modeling**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean PD (mm)</th>
<th>95% CI</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gingival inflammation&lt;sup&gt;5&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2.96</td>
<td>2.54 to 3.37</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mild</td>
<td>3.49</td>
<td>3.29 to 3.69</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4.28</td>
<td>4.06 to 4.49</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>7.13</td>
<td>6.41 to 7.86</td>
<td></td>
</tr>
<tr>
<td>BOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>3.56</td>
<td>3.36 to 3.76</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Present</td>
<td>4.29</td>
<td>4.07 to 4.52</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) inflammation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2.95</td>
<td>2.69 to 3.21</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mild</td>
<td>3.30</td>
<td>3.08 to 3.51</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>4.14</td>
<td>3.92 to 4.35</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>5.26</td>
<td>4.98 to 5.53</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) biofilm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>2.76</td>
<td>2.40 to 3.12</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Slight accumulation on &lt;1/3 of surface</td>
<td>3.29</td>
<td>3.09 to 3.49</td>
<td></td>
</tr>
<tr>
<td>Accumulation on &lt;2/3 of surface</td>
<td>3.90</td>
<td>3.69 to 4.11</td>
<td></td>
</tr>
<tr>
<td>Accumulation on entire surface</td>
<td>5.06</td>
<td>4.82 to 5.30</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) calculus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None on root surface</td>
<td>2.99</td>
<td>2.77 to 3.21</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Flecks on root surface</td>
<td>3.51</td>
<td>3.30 to 3.72</td>
<td></td>
</tr>
<tr>
<td>Thin layer on root surface</td>
<td>4.42</td>
<td>4.19 to 4.65</td>
<td></td>
</tr>
<tr>
<td>Thick layer on root surface</td>
<td>5.34</td>
<td>5.02 to 5.68</td>
<td></td>
</tr>
</tbody>
</table>

* Based on a mixed model assuming a compound symmetry correlation structure.
the study was 57.3 ± 8.97 years (median = 58.1 years; range: 37 to 70.4 years). Of the 26 subjects enrolled, 12 subjects (46.2%) returned for a follow-up visit in ~1 month.

The distribution of subgingival (endoscopic) inflammation by clinical and endoscopic variables is shown in Table 2. Distributions and χ² tests of independence were calculated using weighting to adjust for correlated observations within subjects. SBI, SCI, and PD were significantly associated with subgingival inflammation (P < 0.001, P < 0.001, and P = 0.021, respectively).

Single-factor mixed models were fit to test the association of clinical and endoscopic variables with PD individually. Adjusted means and corresponding 95% confidence intervals are provided for PDs by clinical and endoscopic variables in Table 3. All clinical and endoscopic variables (supragingival inflammation, BOP, subgingival inflammation, SBI, and SCI) were significantly related to PD (P < 0.001 for all variables).

Single-factor mixed models were fit to test the association of clinical and endoscopic variables to subgingival inflammation individually. Adjusted means and corresponding 95% confidence intervals are provided for subgingival inflammation by clinical and endoscopic variables in Table 4. All clinical and endoscopic variables (supragingival inflammation, BOP, SBI, and SCI) were significantly related to subgingival inflammation (P < 0.001 for all variables).

A multifactor mixed model was fit to test the simultaneous association of subject characteristics and clinical and endoscopic variables with subgingival (endoscopic) inflammation. The mixed model is shown in Table 5. Age group, smoking status, gender, BOP, gingival inflammation, SBI, and SCI were included in the model. When these variables were considered simultaneously, gingival inflammation, subgingival inflammation, SBI, and SCI were significantly associated with PD (P < 0.001, P = 0.003, P < 0.001, and P < 0.001, respectively).

**DISCUSSION**

A color shift toward red is among the cardinal signs of inflammation and a standard component of virtually all clinical indices used to assess the severity of gingival inflammation.7-10 However, this parameter measured supragingivally did not have a high predictive value for the progression of periodontitis.11

Data from the use of the dental endoscope established a statistically significant relationship between SCI, SBI, and subgingival inflammation, as measured by color change (increased redness) on the pocket wall. A combination of SCI and a biofilm coating associated with subgingival inflammation was seen more frequently than inflammation associated with SBI alone, i.e., although a statistically significant relationship existed between subgingival inflammation and biofilm and SCI, subgingival inflammation observed with the endoscope was much more prevalent when biofilm and calculus were present.

Figure 3 shows the prevalence of inflammation in relationship to biofilm and calculus. Biofilm and

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean Subgingival Inflammation</th>
<th>95% CI</th>
<th>P Value*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supragingival inflammation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>1.26</td>
<td>0.95 to 1.58</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Mild</td>
<td>1.24</td>
<td>1.05 to 1.42</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>1.89</td>
<td>1.70 to 2.08</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>2.44</td>
<td>1.91 to 2.96</td>
<td></td>
</tr>
<tr>
<td>BOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Absent</td>
<td>1.28</td>
<td>1.10 to 1.46</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Present</td>
<td>1.88</td>
<td>1.69 to 2.07</td>
<td></td>
</tr>
<tr>
<td>SBI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>0.26</td>
<td>0.05 to 0.47</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Slight accumulation on &lt;1/3 of surface</td>
<td>0.93</td>
<td>0.80 to 1.07</td>
<td></td>
</tr>
<tr>
<td>Accumulation on &lt;2/3 of surface</td>
<td>1.77</td>
<td>1.63 to 1.90</td>
<td></td>
</tr>
<tr>
<td>Accumulation on entire surface</td>
<td>2.48</td>
<td>2.33 to 2.63</td>
<td></td>
</tr>
<tr>
<td>SCI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None on root surface</td>
<td>0.51</td>
<td>0.35 to 0.68</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Flecks on root surface</td>
<td>1.42</td>
<td>1.26 to 1.57</td>
<td></td>
</tr>
<tr>
<td>Thin layer on root surface</td>
<td>2.05</td>
<td>1.89 to 2.22</td>
<td></td>
</tr>
<tr>
<td>Thick layer on root surface</td>
<td>2.70</td>
<td>2.50 to 2.89</td>
<td></td>
</tr>
</tbody>
</table>

* Based on a mixed model assuming a compound symmetry correlation structure.
calculus were observed in >60% of the sites in which inflammation was detected. This compares to slightly >30% of the sites in which inflammation was observed without calculus, which indicates that calculus may be a factor in subgingival inflammation. Because sterilized calculus does not create inflammation, \(^1\) it can be hypothesized that calculus, in some way, enhances the inflammatory efficacy of the biofilm observed.

**CONCLUSIONS**

The current study found that subgingival inflammation was unrelated to any of the traditional measures of inflammation, including gingival inflammation (traditional gingival index) and the presence of BOP. However, deeper PDs were related to subgingival inflammatory changes.

In a companion study\(^{13}\) in humans, calculus was removed with the aid of an endoscope. That study showed no histologic signs of chronic inflammation at 6 months following a single episode of closed, subgingival scaling and root planing using the endoscope. Thus, complete removal of SCI, as defined by the use of an endoscope, may be appropriate if chronic inflammation is a problem.

**ACKNOWLEDGMENTS**

This study was funded completely by the senior author, Dr. Thomas G. Wilson Jr. No outside funds were used. The body of this article was written by the senior author;

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**Table 5.**

**Mixed Model for Predicting Subgingival (endoscopic) Inflammation**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>SE</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.220</td>
<td>0.176</td>
<td>0.226</td>
</tr>
<tr>
<td>Age group (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 to &lt;55</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55 to &lt;65</td>
<td>−0.076</td>
<td>0.154</td>
<td>0.629</td>
</tr>
<tr>
<td>≥65</td>
<td>0.090</td>
<td>0.171</td>
<td></td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-smoker</td>
<td></td>
<td></td>
<td>0.448</td>
</tr>
<tr>
<td>Smoker</td>
<td>−0.097</td>
<td>0.128</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.688</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>−0.055</td>
<td>0.136</td>
<td></td>
</tr>
<tr>
<td>BOP</td>
<td></td>
<td></td>
<td>0.202</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>0.109</td>
<td>0.085</td>
<td></td>
</tr>
<tr>
<td>Gingival inflammation(^5)</td>
<td></td>
<td></td>
<td>0.363</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>−0.021</td>
<td>0.094</td>
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</tr>
<tr>
<td>Moderate</td>
<td>0.025</td>
<td>0.121</td>
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</tr>
<tr>
<td>Severe</td>
<td>0.307</td>
<td>0.203</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) biofilm</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1/3 of surface</td>
<td>0.434</td>
<td>0.087</td>
<td></td>
</tr>
<tr>
<td>1/3 to &lt;2/3 of surface</td>
<td>0.879</td>
<td>0.098</td>
<td></td>
</tr>
<tr>
<td>Entire surface</td>
<td>1.222</td>
<td>0.115</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) calculus</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flecks</td>
<td>0.558</td>
<td>0.060</td>
<td></td>
</tr>
<tr>
<td>&lt;50%</td>
<td>0.880</td>
<td>0.081</td>
<td></td>
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<tr>
<td>&gt;50%</td>
<td>1.339</td>
<td>0.108</td>
<td></td>
</tr>
</tbody>
</table>

\(=\) reference category for each factor.

---

**Table 6.**

**Mixed Model for Predicting PD**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Estimate</th>
<th>SE</th>
<th>( P ) Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>2.127</td>
<td>0.287</td>
<td>&lt;0.001</td>
</tr>
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<td>Age group (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37 to &lt;55</td>
<td></td>
<td></td>
<td>0.436</td>
</tr>
<tr>
<td>55 to &lt;65</td>
<td>−0.115</td>
<td>0.221</td>
<td></td>
</tr>
<tr>
<td>≥65</td>
<td>−0.317</td>
<td>0.246</td>
<td></td>
</tr>
<tr>
<td>Smoking status</td>
<td></td>
<td></td>
<td>0.340</td>
</tr>
<tr>
<td>Non-smoker</td>
<td></td>
<td></td>
<td>0.176</td>
</tr>
<tr>
<td>Smoker</td>
<td>0.056</td>
<td>0.194</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td>0.775</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.056</td>
<td>0.194</td>
<td></td>
</tr>
<tr>
<td>BOP</td>
<td></td>
<td></td>
<td>0.116</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>−0.250</td>
<td>0.159</td>
<td></td>
</tr>
<tr>
<td>Gingival inflammation(^5)</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>0.534</td>
<td>0.174</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>0.990</td>
<td>0.225</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>3.461</td>
<td>0.375</td>
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</tr>
<tr>
<td>Subgingival (endoscopic) inflammation</td>
<td></td>
<td></td>
<td>0.003</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mild</td>
<td>0.081</td>
<td>0.132</td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>0.371</td>
<td>0.173</td>
<td></td>
</tr>
<tr>
<td>Severe</td>
<td>0.756</td>
<td>0.223</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) biofilm</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1/3 of surface</td>
<td>0.298</td>
<td>0.168</td>
<td></td>
</tr>
<tr>
<td>1/3 to &lt;2/3 of surface</td>
<td>0.470</td>
<td>0.198</td>
<td></td>
</tr>
<tr>
<td>Entire surface</td>
<td>1.014</td>
<td>0.233</td>
<td></td>
</tr>
<tr>
<td>Subgingival (endoscopic) calculus</td>
<td></td>
<td></td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>None</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flecks</td>
<td>0.117</td>
<td>0.121</td>
<td></td>
</tr>
<tr>
<td>Thin layer</td>
<td>0.527</td>
<td>0.164</td>
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</tr>
<tr>
<td>Thick layer</td>
<td>0.842</td>
<td>0.221</td>
<td></td>
</tr>
</tbody>
</table>

\(=\) reference category for each factor.
the statistical section was written by Dr. Martha Nunn. The authors thank Dr. Terry Rees, Department of Periodontics and director of the Stomatology Center, Texas A&M Health Science Center, Baylor College of Dentistry, Dallas, Texas, for reviewing the article. The authors thank Lauren Ardoin, surgical/administrative assistant, Dallas, Texas, for her invaluable assistance in the preparation of this manuscript. The authors report no conflicts of interest related to this study.

REFERENCES

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The Relationship Between Bleeding on Probing and Subgingival Deposits. An Endoscopical Evaluation

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³Department of Pediatrics, School of Medicine, Alma Mater Studiorum - University of Bologna, Bologna, Italy

Abstract: Background: Bleeding on probing (BOP) is an indicator of tissue inflammatory response to bacterial pathogens. Due to anatomical limitations, the entity and physical state of microbial aggregations located under the gingival margin and their relations to BOP have been hardly investigated till now. The recent introduction of the endoscopy has allowed clinicians to observe the subgingival environment in a non-traumatic way. The aim of this study is to evaluate the correlation between BOP and subgingival deposits by using this new technology.

Methods: 107 teeth (642 individual sites) from 16 periodontal patients, treated with scaling and root planing, were evaluated for plaque index (PI), gingival index (GI), probing pocket depth (PPD), bleeding on probing (BOP), endoscopic biofilm index (EBI), and endoscopic calculus index (ECI) at one-month revaluation.

Results: A linear association between BOP and PD, EBI, and ECI was detected. The BOP provided a high level of specificity but quite low sensitivity values both for ECI (sensitivity 40%, specificity 86%) and EBI (sensitivity 37%, specificity 89%). The BOP sensitivity was directly linked to the amount of subgingival deposits.

Conclusions: This study demonstrates a direct relationship between BOP and presence/amount of subgingival deposits. More investigations on larger samples are, however, needed.

Keywords: Endoscopy, bleeding on probing, pocket depth, root planing, biofilm, calculus.

INTRODUCTION

Customary diagnosis of periodontal disease features the gathering of certain clinical and radiographical parameters. By using these observations, the clinician attempts to determine the patient’s periodontal status, and identify clinical signs that allow predicting the disease course.

The bleeding on probing (BOP) is a widely used clinical sign as indicator of the periodontal condition and disease progression [1].

Its clinical relevance has been shown and supported by several studies. A study on this topic, published in 1990 by Lang and colleagues, demonstrates how the absence of BOP represents a reliable indicator of periodontal stability [2]. Some years later Albandar and colleagues reported that, in individuals with early-onset periodontitis, existing lesions show more disease progression in sites with overt gingival inflammation than in sites where it was absent [3]. Recently, it has been demonstrated how a persistent presence of gingivitis in a periodontal site all over a long period of observation (26 years), is responsible for future periodontal breakdown [4]. Besides, the value of BOP as predictor of future periodontal deterioration seems to significantly increase when associated with periodontal pocket depth greater than or equal to 6 mm [5].

Even though all these findings point out the important role of BOP on present and future periodontal conditions, many are the variables that can play a confounding role on it. For instance it has been clearly shown how the smoke habit reduces the bleeding response to the periodontal probing [6]. As well, the fact that BOP could appear either from a deep periodontal tissue inflammation or to a superficial one could have important implications that shouldn’t be underestimated. Additionally, in spite of a quite clear connection between gingival bleeding and inflammation state, very few are known about the entity and physical state of subgingival bacterial deposits and BOP.

To date the anatomical peculiarities of the area have undeniably limited the investigation on this topic. The recent introduction of the endoscopy in periodontology (DV2, Dental View, Irvine, CA) has given for the first time a non-traumatic visual access to the subgingival area, conse-
The aim of this study is to verify, by using this innovative tool, the presence of subgingival deposits and evaluate their correlation with BOP and other periodontal clinical parameters.

MATERIALS AND METHODS

From the beginning of February 2008, sixteen consecutive subjects attending the Periodontal Department of the University of Bologna were selected for the study. The inclusion criteria were: presence of generalized moderate to severe periodontitis [8], non-smoker, no drug consumption for at least one month, no systemic pathologies, and no prosthetic dental treatments. Informed consents were obtained and the tenets of the Declaration of Helsinki were followed.

Patients were treated with closed subgingival scaling and root-planing under local anesthesia. Oral hygiene instruction and motivation were included. After a healing period of 1 month, re-evaluation was carried out and the endoscopic data collected. The endoscopical observation was performed on a randomly selected quadrant for each patient. The random allocation was obtained drowning from a box containing 16 tickets reporting the four oral quadrants all equally represented. The chosen ticket was automatically thrown away, consequently, at the final observation, an automatic assignment was resulted.

The same general dentist with special postgraduate training in periodontics performed the initial preparations. The operator was unacquainted with the aim of the clinical trial.

Two examiners (A and B) collected the data; both were experienced dentists with graduate training in periodontics. Both the examiners were blinded to the findings obtained by the other and both had been calibrated for reproducibility prior to the study. Six sites for each tooth were evaluated: mesiofacial, midfacial, distofacial, distolingual, midlingual, and mesiolingual. All sites of third molars were disregarded.

Examiner A using a standardized periodontal probe (CP11 Hu Friedy, Europe) detected: Plaque Index (PI) [9], Gingival Index (GI) [10], Probing Pocket Depth (PPD), and BOP (Fig. 2). The BOP was considered positive if bleeding occurred between 30 seconds after probing. Examiner B under endoscopic vision recorded the Endoscopic Biofilm Index (EBI) and the Endoscopic Calculus Index (ECI) at least 15 minutes later the preceding examination (Fig. 3) [11]. A time interval of 15 minutes was used in order to limit the possibility that the first exam, especially when bleeding was present, could affect the subsequent evaluation. The two endoscopic indices, reported on Table 1, have been recently purposed with the aim to distinguish different degrees and physical state of subgingival deposits.

The statistical analysis, performed on tooth sites, was made using the simple and multiple Chi Square tests ($\chi^2$), the Mantel-Haenszel test for linear association and the Relative Risk with a 95% confidence interval. The Kruskal-Wallis test was used to study the correlations between both tooth type or tooth site and the three variables BOP, EBI, ECI. The SPSS program was utilized for our data analysis.

Relative risk analysis for EBI and ECI was carried out using all values greater than or equal to 1 as a common variable.
RESULTS

None of the selected patients dropped the study or was disqualified. The 16 subjects examined were 9 females and 7 males with an average age of 50 years (45-54). PI percentage was between 22% and 46%. PPD at the time of the analysis was between 1 and 9 mm with a median value of 3 mm. The study sample consisted of 107 teeth corresponding to 642 sites.

33% of the sites had GI=0, 55% had GI=1, and the remaining 12% had GI=2.

The BOP resulted correlated to the tooth type ($\chi^2=114.9$ $p<0.0001$), while either EBI or ECI correlated to tooth site too (EBI-tooth type $\chi^2=81.9$ $p<0.0001$, EBI-tooth site $\chi^2=124.7$ $p<0.0001$; ECI-tooth type $\chi^2=60.1$ $p<0.0001$, ECI-tooth site $\chi^2=110.1$ $p<0.0001$). The BOP as the subgingival deposits was more frequently observed on molars and premolars than on anterior teeth.

Figs. (4) and (5) show the distributions of EBI and ECI, respectively. The presence of subgingival residual deposits tended to be higher in the lingual area relative to the vestibular surfaces. This difference is statistically significant (EBI $\chi^2=36.95$ $p=0.0001$; ECI $\chi^2=27.89$ $p=0.0001$).

The analysis of linear association between BOP and GI, PI, PD, EBI, and ECI is reported in Table 2.

The analysis of the data shows a strong significance of the linear association to PD, EBI, and ECI in every site examined, but not the same for GI and PI. In particular, PI has a weak significant correlation with BOP only in 2 of the 6 areas analyzed.

### Table 1. Endoscopic Biofilm Index and Endoscopic Calculus Index: Characteristics and Definitions [11]

<table>
<thead>
<tr>
<th>Endoscopic Biofilm Index</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No observable biofilm on root surface</td>
</tr>
<tr>
<td>1</td>
<td>Separate flecks of biofilm on less than 1/3 of the surface</td>
</tr>
<tr>
<td>2</td>
<td>A thin continuous band of biofilm on 2/3 of the surface</td>
</tr>
<tr>
<td>3</td>
<td>A continuous band of biofilm on the entire surface</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Endoscopic Calculus Index</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No observable calculus on root surface</td>
</tr>
<tr>
<td>1</td>
<td>Separate flecks of calculus</td>
</tr>
<tr>
<td>2</td>
<td>A coalition of calculus deposits covering &lt; 50% of the visual field</td>
</tr>
<tr>
<td>3</td>
<td>A thick, diffuse accumulation of calculus covering &gt;50% of the visual field</td>
</tr>
</tbody>
</table>

**Fig. (4).** Incidence of the Endoscopic Biofilm Index (EBI) degrees in the 6 studied sites.
Table 3 shows the analysis of the linear association between PD and EBI, and between PD and ECI. A significant correlation was found in all sites with the exception of the disto-vestibular one.

The analysis of the relative risk between the presence of BOP and the presence of subgingival deposits (ECI and EBI) is seen in Table 4. From such analysis, there is a significant relative risk in almost all examined sites. Only one site resulted not significant for both ECI and EBI, however, the obtained values were very close to the limits.

The diagnostic sensitivity and specificity of BOP in sites exhibiting subgingival residual deposits under endoscopic observation are, respectively, 37% and 89% for EBI [sensitivity: 119/(119+206); specificity: 283/(34+283)] and 40% and 86% for ECI [sensitivity: 98/(98+147); specificity: 342/(55+342)]. The BOP provided a very high level of specificity but low sensitivity values both for ECI and EBI.

In order to better understand the sensitivity of BOP, a detailed analysis on the different classes of ECI and EBI was performed. As a result, the BOP sensitivity was directly linked to the dimension of the subgingival deposits, as reported on Table 5.

**DISCUSSION**

Nowadays it is commonly accepted that bacterial deposits are the key factor in the onset of periodontal disease [12]. As a consequence the primary aim of periodontal treatment is to recreate a healthy periodontal state by the removal of microorganism and their derivations from the tooth surfaces [13]. The evaluation of the efficacy of removal of bacterial deposits from the subgingival root surface has been, there-
fore, an important topic of many scientific studies on the periodontal treatments efficiency [14-19]. Unfortunately, all of these studies evaluated the presence of residual deposits on extracted teeth, condition that undoubtedly limits clinical considerations.

The association between BOP, important sign of clinical inflammation, and periodontal destruction has been studied [2,4,5]. Though a direct association between them has been demonstrated, it has also been shown that a high percentage of sites with gingival inflammation and/or calculus could not develop attachment loss [3].

These observations derive the consciousness that a deeper knowledge on this topic is still needed.

The recent introduction of the endoscopy in periodontology has open new research possibilities in this field. The use of this new high tech instrument seems to give additional and interesting information, rather than just using traditional clinical parameters. Actually, it is the first time that it is given the possibility to atraumatically observe the root deposits beneath the gingival margin and their effect on the surrounding periodontal soft tissues [7].

The present study is based on this innovation.

Our endoscopic observations of subgingival residues after scaling and root-planing gave results in line with those found by previous studies on extracted teeth [15,16,18]. The plaque and calculus residues were detected, respectively, in 55% and 38% of the examined sites. The residues, both calcified and not, were mostly found on the lingual side (Fig. 4, Fig. 5) emphasizing the difficulty of access to this area, both for the clinician and for personal oral hygiene.

The low correlation detected between GI and BOP is probably due to the study design (Table 2). The scaling and root planing together with the patients’ oral hygiene have undoubtedly contributed to a general state of health of the periodontal soft tissue as measured by the GI. This result demonstrates how the clinical parameters of the gingival tissues do not always reflect the state of the deeper portion of the periodontal soft tissues.

The absence of correlation between PI and BOP can be explained by variations in personal oral hygiene (Table 2). We know, from the work by Löe et al. (1965), that the onset of gingivitis requires a presence of bacterial plaque for some length of time [20].

Another explanation of the absence of correlation detected could be the plaque index used in this study [9]. It does not allow a distinction in degree of plaque deposits quantity, therefore, a small deposit was counted equal to a much larger one. Thus, it is difficult to show the specific

### Table 3. Linear Association Analysis Between Probing Depth and Respectively Endoscopic Biofilm Index and Endoscopic Calculus Index

<table>
<thead>
<tr>
<th></th>
<th>PD - EBI</th>
<th></th>
<th>PD - ECI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>P</td>
<td>(\chi^2)</td>
<td>P</td>
</tr>
<tr>
<td>Mesio-Vestibular</td>
<td>0.0001</td>
<td>15.9</td>
<td>0.0007</td>
</tr>
<tr>
<td>Medio-Vestibular</td>
<td>0.0001</td>
<td>38.4</td>
<td>0.0001</td>
</tr>
<tr>
<td>Distal-Vestibular</td>
<td>NS</td>
<td>NS</td>
<td>0.002</td>
</tr>
<tr>
<td>Mesio-Lingual</td>
<td>0.0001</td>
<td>15.4</td>
<td>0.024</td>
</tr>
<tr>
<td>Medio-Lingual</td>
<td>0.0001</td>
<td>19.3</td>
<td>0.005</td>
</tr>
<tr>
<td>Distal-Lingual</td>
<td>0.0005</td>
<td>11.9</td>
<td>0.047</td>
</tr>
</tbody>
</table>

PD: probing depth; EBI: endoscopic biofilm index; ECI: endoscopic calculus Index; NS: statistically not significant.

### Table 4. Relative Risk Analysis between Bleeding on Probing and, Respectively, Endoscopic Biofilm Index and Endoscopic Calculus Index

<table>
<thead>
<tr>
<th></th>
<th>EBI-BOP</th>
<th></th>
<th>ECI-BOP</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>Confidence Limits 95 %</td>
<td>RR</td>
</tr>
<tr>
<td>Mesio-Vestibular</td>
<td>4.34</td>
<td>1.91 - 9.84</td>
<td>3.27</td>
</tr>
<tr>
<td>Medio-Vestibular</td>
<td>5.44</td>
<td>2.46 - 12.01</td>
<td>6.13</td>
</tr>
<tr>
<td>Disto-Vestibular</td>
<td>4.35</td>
<td>1.79 - 10.60</td>
<td>3.41</td>
</tr>
<tr>
<td>Mesio-Lingual</td>
<td>1.59 NS</td>
<td>0.74 - 3.38</td>
<td>2.28</td>
</tr>
<tr>
<td>Medio-Lingual</td>
<td>2.71</td>
<td>1.21 - 6.04</td>
<td>1.97 NS</td>
</tr>
<tr>
<td>Disto-Lingual</td>
<td>8.23</td>
<td>1.18 - 57.60</td>
<td>2.37</td>
</tr>
</tbody>
</table>

BOP: bleeding on probing; EBI: endoscopic biofilm index; ECI: endoscopic calculus index; RR: relative risk; NS: statistically not significant.
Bleeding on Probing and Subgingival Deposits

The Open Dentistry Journal, 2009, Volume 3

Table 5. Diagnostic Sensitivity of Bleeding on Probing to the Degree of Subgingival Deposits

<table>
<thead>
<tr>
<th>EBI &amp; ECI Degree</th>
<th>EBI N</th>
<th>BOP N</th>
<th>Sensitivity %</th>
<th>ECI N</th>
<th>BOP N</th>
<th>Sensitivity %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>224</td>
<td>54</td>
<td>24</td>
<td>163</td>
<td>170</td>
<td>29</td>
</tr>
<tr>
<td>2</td>
<td>81</td>
<td>36</td>
<td>44</td>
<td>62</td>
<td>45</td>
<td>56</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
<td>32</td>
<td>67</td>
<td>20</td>
<td>16</td>
<td>75</td>
</tr>
</tbody>
</table>

EBI: endoscopic biofilm index; ECI: endoscopic calculus index; BOP: bleeding on probing.

deduce that the presence of bleeding upon probing could be a quite good indicator of important amounts of residual deposits in the subgingival area.

These results show that either soft or hard deposits are associated to the presence of BOP underlying their insight virulence.

However, further studies are recommended to determine if the present observations are true for a larger number of periodontal patients, since the sites within a mouth behave more alike than surfaces from different mouths [24, 25].

Finally, the results of this study suggest that the measurements obtained using the endoscope should be considered reliable in better predicting the disease establishment and progression, therefore, future studies investigating this hypothesis are required.

CONCLUSION

In conclusion, the obtained results confirm and corroborate the importance of BOP as indicator of subgingival deposits. However, though a correlation between BOP and amount of deposits has been observed in the present study, an exact level of the assumed tolerance of the periodontal tissues is still not clearly defined.

Until this level will not be identified, the total removal of tooth-borne subgingival deposits remain a reasonable goal to reach. According to this consideration the BOP can be judged as a concrete, suitable, and useful aid for the clinician interested in this task.

CONFLICTS OF INTEREST

The authors report no financial relationships related to any products involved in this study and declare that no funding has been available other than that of the author's institution.

REFERENCES


influence of supragingival soft deposits on periodontal tissues.

ECI and EBI resulted correlated either to tooth type or site. Higher values of these indices were reported for molar teeth and inter-proximal areas. This result confirms the challenge these areas represent for the clinician to obtain, during scaling and root planing, an exhaustive debridement of the root surfaces.

Regarding the relationship between subgingival deposits and the surrounding soft tissues, a recent endoscopical publication has interestingly described a pathological connection. In that study, both calculus and biofilm were in fact directly related to pocket wall inflammation as measured by increased redness of the pocket epithelium [11].

Our findings disclose that a linear association between BOP and the presence of subgingival deposits is not particularly strong for each examined sites, anyway the data show how the amount of subgingival deposits rise with the incidence of BOP (Table 2). Relative Risk analysis further demonstrates that the incidence of BOP could be up to 6 times with calculus and up to 8 times with plaque (Table 4).

The present research shows a linear association between the increase in quantity of subgingival deposits and increase of PPD (Table 3), a result in accordance with previous findings [14-16]. The disto-vestibular site was the only area where it was not possible to observe a linear association between subgingival deposits and PPD. The anatomical features of this area, that undeniably limit the endoscope handling, could be the reason of this finding. In spite of its flexibility, the fiber of the endoscope finds few limitations in anatomical conditions like fairly small mouths and distal portion of the molar teeth. This hypothesis is supported by the observation that among the other sites studied is the disto-lingual, the one with the lower significance (Table 3).

Overall, it is possible to conclude that, when BOP is present especially in deep periodontal pockets after an adequate non-surgical therapy, a higher probability of residual deposits can be assumed.

Bleeding on probing was found to have high levels of specificity of residual deposits but low sensitivity values. These findings are in accordance with those reported by Sherman et al in 1990 on subgingival calculus [21].

The BOP’s sensitivity interestingly changes if the classes either of EBI or ECI are considered singularly. As reported on Table 5, the sensitivity values increase with the index classes. This observation confirms the previous statements of a possible level of periodontal soft tissues tolerance of subgingival calculus [22, 23]. At the same time, it is possible to


3 Ultrasonic Endoscopic Periodontal Debridement

John Y. Kwan and Suzanne M. Newkirk

The purpose of this chapter is to identify the benefits of minimally invasive periodontal therapy utilizing endoscopic technology that provides real-time video magnification, enabling clinicians to diagnose and treat periodontal disease subgingivally and nonsurgically under direct visualization (Figure 3.1).

Introduction

The use of the endoscope has become accepted in most medical surgical disciplines. Today, minimally invasive procedures routinely result in rapid wound healing, fewer complications, and shorter recovery times [1]. The periodontal endoscope consists of a 1 mm diameter, 1 m long, flexible endoscope/camera attached to a dental instrument referred to as an endoscopic “explorer,” which carries a lens attached to a fiber-optic cable that can be placed subgingivally and provides the clinician with visualization of the subgingival environment.

The images are immediately displayed on a chairside monitor (real-time video) and magnified 24–48 times, disclosing minute details, such as caries, root fractures, perforations, resorption, biofilm, and calculus, that previously may have been undetectable. The authors call this illumination and magnification of the subgingival environment a “microvisual” approach.
Dental endoscopy has been shown to reveal deposits so small that they cannot be seen during traditional periodontal surgery, even with a surgical microscope or dental magnifying loupes [2]. Dental microscopes have magnifications from 2 x to 20 x. At the highest magnifications, the slightest movement can affect the image. This is because of the long distance between the objective lens of the microscope and the actual image in the mouth. In addition, visualization on the internal aspects of the dentition as well as on the distal of posterior teeth is limited. The periodontal endoscope is intimately close to the root surface; therefore, the image easily stays within the focal depth of field. With fiber-optic illumination and high magnification the dental endoscope allows for visualization of root surfaces, the inner aspects of most furcations, and into bony defects that cannot be seen with any other device except surgically with the dental video scope [2]. Endoscopic periodontal debridement is the only nonsurgical minimally invasive, real-time video technology available for the treatment of periodontal disease.
Indications for the use of the endoscopic technique

Candidates for endoscopy include patients being treated for the following:

- initial periodontal therapy;
- sites that have not responded to traditional nonsurgical debridement;
- maintenance patients with chronically inflamed, or increasing probing depths;
- residual probing depths in maintenance patients who refuse surgical therapy and/or where surgery is contraindicated for medical, or esthetic reasons;
- suspected subgingival pathology such as caries, root fractures, perforations, or resorption.

There are several endoscopic systems available for dental use. The ones described here—the DV2 Perioscopy System and the Perioscopy System—are used for providing nonsurgical periodontal therapy and minimally invasive diagnosis. These systems have six main features:

**Components**

<table>
<thead>
<tr>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Camera light source</td>
<td>Monitor fiber</td>
<td>Endoscope sheath</td>
<td>Explorer</td>
<td>Water delivery device</td>
<td></td>
</tr>
</tbody>
</table>

1. The DV2 Perioscopy System master control unit (MCU) camera and light source provide real-time video images. The light source is an arc lamp that creates intense, focused light fiber optically delivered to the working field.

The Perioscopy System utilizes a CCD/LED camera and light coupling to provide imaging and illumination from the endoscope fiber to the monitor through a controller. The controller has window, gain control, white balance, and illumination settings that are optimized for dental endoscopy. A “handpiece” contains the camera and LED along with a focus knob (Figure 3.2).

2. The DV2 Perioscopy System color LCD video monitor provides real-time, detailed color images of the procedure site as viewed by the attached endoscope (Figure 3.3).

The Perioscopy System medical grade monitor provides high definition, real-time video imaging received from the dental endoscope. The image is 25% larger, and the resolution is a significant improvement over the DV2 System (Figure 3.4).
3. The dental endoscope (or fiber) is a device for use with the dental endoscope family of dental instruments. The fiber consists of a very slender, flexible shaft containing both imaging and illumination capabilities. When inserted into the dental endoscopic sheath and then the endoscopic explorers, the endoscope fiber provides detailed and highly magnified images of the diagnostic and/or treatment site (Figure 3.5).

The microscope lens system enlarges the image obtained by the fiber-optic probe and creates intense, focused light that is fiber optically delivered to
the working field. This reusable fiber-optic endoscope is 1 mm in diameter and 1 m long with containing 20 different fibers. The quartz sleeve encased fiber-optic probe is made of 19, 125 μm light guides that deliver light to the working field. They surround a 10,000-pixel image guide made up of fused 2 μm fibers to capture the image. The end of the probe has a hand micropolished gradient index lens and provides a 3-mm-wide field of view. The
working depth of field allows for focus from 2 to 6mm from the tip, with 4.5mm being optimum. The magnification is 24×–48× depending on the closeness to the lens.

The fiber does not require routine sterilization when used with the endoscopic sheath.

4. The sheath: A single-use disposable endoscopic sheath is designed to deliver water irrigation to keep the endoscope lens clear, eliminate the need to sterilize or disinfect the fiber between cases, and to provide a significantly longer fiber life. Bilumen construction consist of clear tubing that completely covers the endoscopic fiber and blue tubing that carries water irrigation to the working site (Figure 3.6).

Each sterile sheath has a sapphire window, a window cell (a stainless steel tube with sapphire lens), a precision tip seal, and dual Luer-Lock connectors for water and fiber connections. These elements create a fluid-tight seal that ensures accurate positioning to the working tip of the endoscopic explorer (Figure 3.7).

![Figure 3.6 Sterilized endoscopic sheath. Source: Reproduced with permission of Perioscopy Incorporated.](image1)

![Figure 3.7 Sterilized endoscopic sheath highlighting the precision tip seal and window cell. Source: Reproduced with permission of Perioscopy Incorporated.](image2)
Figure 3.8  Endoscopic explorer tissue retraction shield. Source: Reproduced with permission of Perioscopy Incorporated.

5. The fiber is placed into a sterile sheath and is then placed into an endoscopic explorer. The fiber–sheath–explorer complex is then placed into the sulcus by the clinician for subgingival viewing.

Dental endoscopic explorers are sterilizable dental instruments that hold the sheath/fiber complex, allowing for intraoral use.

The endoscopic explorer has a shield that deflects the pocket soft tissue away from the camera lens, creating visual access space to the root surface (Figure 3.8).

6. A pressurized, self-contained water delivery device is attached to the cart of the dental endoscopic system, and it not only provides a constant source of lavage into the pocket during an endoscopic procedure but also keeps the lens free from debris such as blood and tissue, providing a clear video image. The water delivery device connects to a standard in-office air line and operates by a rheostat pedal through an air-operated valve (Figure 3.9).

Exploring the subgingival environment

When the dental endoscope is used subgingivally in a periodontal pocket, a loose film adhering to the tooth is frequently observed. This material is easily disturbed by the shield on the endoscopic explorer. During scaling of the subgingival root surface, this film loses adherence and is washed away by irrigation water flowing from the endoscope probe [3]. It is assumed to be biofilm (Figure 3.10).

Typically, the gingival wall of the healthy sulcus is light pink in color, indicating health. In disease, islands of dark red color blotch the pocket wall. These areas vary from a slight color change to deep red with an erythematous
appearance and may be discrete or diffuse. In addition, these red areas have been shown to be primarily associated with calculus covered with biofilm, not biofilm alone, which emphasizes the role of calculus in the pathophysiology of this chronic inflammatory periodontal disease [3]. This also argues strongly for removal of all calculus deposits seen subgingivally reduce or eliminate inflammation.

Because of bright fiber-optic illumination, calculus found on the dental root structure commonly shows up as gold, yellow, or white. Calculus deposits may range from small isolated flecks, or islands, to thick, continuous layers [3]. Prior to periodontal endoscopy, visualization and more thorough debridement of the subgingival environment were only accomplished through surgical intervention via open-flap debridement. Even after traditional surgery, deposits of subgingival calculus have been shown to remain [4]. The ability to clearly visualize and remove calculus with nonsurgical therapy is a major advantage of periodontal endoscopy.

Figure 3.9 Endoscopic water delivery device. Source: Reproduced with permission of Perioscopy Incorporated.
**Figure 3.10** The dental endoscopic explorer shield retracting tissue from the pocket wall to expose the root surface for viewing. Source: Reproduced with permission of Perioscopy Incorporated.

Factors affecting instrumentation in non-surgical debridement include:

<table>
<thead>
<tr>
<th>Deposit/calculus</th>
<th>Instrument access</th>
<th>Root morphology considerations</th>
<th>Anatomical considerations/other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount</td>
<td>Narrow deep pockets</td>
<td>Bi and tri-furcated teeth</td>
<td>Small mouth</td>
</tr>
<tr>
<td>Tenacity</td>
<td>Curved roots</td>
<td>Concavities</td>
<td>Muscular tongues</td>
</tr>
<tr>
<td>Location</td>
<td>Close root proximity</td>
<td>Line angles</td>
<td>Tight cheeks and lips</td>
</tr>
<tr>
<td></td>
<td>Over contoured restorations</td>
<td>Depressions</td>
<td>Gaggers</td>
</tr>
<tr>
<td>Distal aspects of second or third molars</td>
<td>Developmental grooves</td>
<td>Patient cooperation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Operator experience</td>
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The primary goal of periodontal therapy is the reduction or elimination of inflammation. Traditionally, this is accomplished through removal of subgingival tooth-borne accretions using non-surgical and/or surgical treatment modalities [5]. Because periodontal pathogens reside in deep subgingival sites and also colonize supragingival plaque on the tongue dorsum and other oral sites, the control of destructive periodontal diseases may warrant a comprehensive antimicrobial approach that targets periodontal pathogens in various ecological niches of the oral cavity [5]. Scaling and root planing (with or without periodontal surgery) along with proper personal oral hygiene constitute the primary approach to controlling periodontopathogens [5].

However, traditional nonsurgical periodontal therapy provided in a closed environment utilizing a combination of hand instrumentation and ultrasonics has been shown to be both time consuming and technically difficult to perform [4]. Even very experienced clinicians may be deceived by tactilely smooth surfaces achieved by instrumentation and assume the root surfaces are free of deposits. Endoscopic evaluation of root surfaces that have undergone scaling in a closed manner with various ultrasonic tips, especially under low power, consistently reveals retained burnished calculus on the root surface ranging in size from large, smooth, and flat sheets, to small, flat “islands.” These residual deposits are usually located in furcations, developmental depressions, at line angles and around the cementoenamel junction [2].

In an evaluation of the effectiveness of traditional subgingival scaling and root planing related to depth of pocket and type of teeth, results demonstrated a high correlation between the percentage of residual calculus and probing depth. It was shown that probing depths less than 3 mm were the easiest sites for effective scaling and root planing, probing depths between 3 and 5 mm were more difficult to completely remove calculus and biofilm, and probing depths deeper than 5 mm were the most difficult sites. Tooth type did not influence the results [6]. Endoscopic examination revealed residual burnished calculus in 100% of pockets and furcations that bleed upon probing and that whenever even the smallest speck of calculus (0.5 mm in diameter or less) is seen on the tooth surface there is a corresponding inflamed, bleeding and ulcerated site in the pocket lining exactly opposite that piece of calculus [2].

Nevertheless, closed scaling and root planing without endoscopy can give good short-term clinical results with shrinkage of probing depths and a decrease in gingival inflammation, but probing depths in deeper areas often slowly return [5]. A review of studies evaluating the effectiveness of various subgingival debridement procedures showed that 5–80% of treated roots harbor residual plaque or calculus, and the deeper the pockets and furcation involvements, the more deposits are left behind [7]. Up to 30% of the total
surface area of treated roots may be covered with residual calculus, following subgingival scaling [7]. These deposits may serve as the basis for reinfection of the pocket.

Traditional blind scaling and root planing, especially if performed by inexperienced operators, can result in patient discomfort, unwarranted removal of cementum and dentin, and an increase in tooth sensitivity [8]. By contrast, a pilot study evaluating endoscopic subgingival scaling and root planing reported minimal negative sequelae. The study also reported elimination of histologic signs of chronic inflammation at 6 months following a single course of endoscopic periodontal debridement. Also observed was bone repair and growth of a long junctional epithelium on previously diseased root surfaces [5].

In a large unpublished case series performed in the office of one of the authors, John Kwan, a retrospective analysis of patients who received endoscopic ultrasonic periodontal debridement was performed.

After routine periodontal examination, these patients were diagnosed with generalized and or localized moderate-to-advanced chronic inflammatory periodontal disease. When the patients were evaluated at 1 year or more following treatment, a dramatic reduction in probing depths was noted. The greatest improvement was noted on posterior teeth with initial deep pocket probing depths.

**Study design**

This was a nonblinded prospective outcomes study. Patients with moderate-to-advanced periodontal disease were examined and pocket probing depths were recorded in a computerized charting program. All probing measurements were performed using a manual periodontal probe. The examiner was calibrated for consistent recordings.

During the first 2 years' practicing with the periodontal endoscope (2002–2004), 270 consecutively treated patients were evaluated. All treated patients were given a course of systemic antibiotics; either metronidazole 500 mg bid x 7 days, or metronidazole and amoxicillin both 500 mg bid x 7 days, or azithromycin 500 mg qd x 3 days. Antibiotics were taken either before or immediately following treatment. All treatment was completed in one visit: full-mouth ultrasonic debridement with probing depths ≥4 mm endoscopically debrided.

Patients were seen for reevaluation and periodontal maintenance every 3 months, which included full-mouth periodontal charting, periodontal instrumentation, selective polish, and oral hygiene instruction. Final comparison probing was performed at 1 year or more.
71% reduced to 6–9 mm
20% reduced to ≤5 mm
n = 45 teeth

55% reduced to ≤5 mm
n = 284 teeth

Starting at 5–6 mm:
69% reduced to ≤4 mm
n = 478 teeth
38% reduced to ≤5 mm  
\( n = 8 \) teeth

57% reduced to ≤5 mm  
\( n = 30 \) teeth

78% reduced to ≤4 mm  
\( n = 266 \) teeth
71% reduced to ≤5 mm
n = 7 teeth

89% reduced to ≤5 mm
n = 57 teeth

92% reduced to ≤4 mm
n = 246 teeth

Conclusions

Reductions in probing depths were noted in all types of teeth, particularly in deeply pocketed posterior teeth. Proportionally, more teeth that began with deeper probing depths were reduced to ≤5 mm PD at reevaluation. Ultrasonic endoscopic subgingival debridement in conjunction with systemic antibiotic
Figure 3.11  Initial periodontal charting; pocket depths from 4 to 12 mm. Source: Reproduced with permission of John Y. Kwan, DDS.

uses reduced 7–9 mm PD in more than 50% of the teeth treated this way regardless of tooth type.

This subgingival microvisual debridement is a minimally invasive, nonsurgical option for patients with periodontal disease. The following is an example of a full-mouth ultrasonic dental endoscopic debridement treatment and follow-up (Figures 3.11, 3.12, 3.13, 3.14, 3.15, and 3.16).

Description of dental endoscopic technique

Periodontal endoscopy utilizes a two-handed technique: (i) the endoscope in the nondominant hand (similar to holding a dental mirror) and (ii) the ultrasonic instrument in the dominant hand, moving together around the tooth while cleaning. Rarely, a “view, instrument and view” technique is used when both the endoscope and explorer are unable to simultaneously access the area being scaled. Four explorer designs are used to visually access all surfaces of the teeth.
Figure 3.12 Fifteen months post micro-ultrasonic endoscopic periodontal debridement, the deepest pockets now probe 4–5 mm. Source: Reproduced with permission of John Y. Kwan, DDS.

Figure 3.13 Pretreatment X-ray. Source: Reproduced with permission of John Y. Kwan, DDS.
Figure 3.14  Fifteen months post treatment X-ray. Source: Reproduced with permission of John Y. Kwan, DDS.

Figure 3.15  Pretreatment X-ray. Source: Reproduced with permission of John Y. Kwan, DDS.

It is the author’s opinion that following a systematic approach, experienced dental endoscope clinicians may provide microvisual full-mouth debridement as quickly as, and possibly more efficiently than traditional periodontal debridement (Figure 3.17).
Beginning and finishing with one explorer in each segment before starting with another explorer is an integral part of the systematic approach to endoscopic debridement. This method is similar to that taught for blind closed pocket instrumentation.

Ultrasonic powered instruments are the first choice for use with the periodontal endoscope. Typical ultrasonic inserts used are small and probe like. Endoscopically, they provide efficient root debridement, requiring only a small array of instruments. A full-mouth debridement typically requires only a straight probe-like universal ultrasonic tip with an occasional need for curved or angled tips. These nonbladed ultrasonic tips are also less likely to remove healthy root structure. Just
Figure 3.18  Dental endoscopy explorers: Right/right, right, left, left/left. Source: Reproduced with permission of Perioscopy Incorporated.

Figure 3.19  Magnetostrictive diamond-coated ultrasonic inserts. (Reproduced with permission of Perioscopy Incorporated.)

as most providers develop preferences and proficiencies with certain instruments, their use with the dental endoscope should prove useful. Efficiency is enhanced by fewer instrument changes and more instrument adaptation (Figure 3.18).

Diamond-coated ultrasonic instruments are used for advanced instrumentation in the removal of rough (globular) cementum, tenacious calculus, overhanging restorations, and subgingival enamel anomalies. Because of their cutting power, advanced skill is required in the use of diamond-coated ultrasonic tips. This is not only true with the cutting function, but also to avoid damage to the explorer shield, sheath over the endoscope fiber, or the fiber itself (Figure 3.19).
Although bacterial plaque is the primary extrinsic etiologic factor for the initiation and progression of periodontal disease, anatomic factors such as cervical enamel projections (CEPs), enamel pearls, and developmental grooves are often associated with localized periodontal destruction because they may predispose the affected area to plaque accumulation, making personal oral hygiene and professional scaling more difficult, thereby increasing a patient's chance of periodontal breakdown. Enamel projections found in furcation areas of molars have been found to be highly susceptible to the creation of periodontal pockets because there is no connective tissue attachment to the enamel. As a result, a close association has been reported between enamel projections and furcation involvement [9,10].

Masters and Hoskins were the first to suggest the association of the CEP with periodontal disease and classified the projections into three grades based on the location of adjacent CEJs and furcations: Grade I indicates a short but distinct change in the contour of the CEJ extending toward the furcation, Grade II designates when the CEP approaches the furcation without making contact with it, and Grade III denotes that the CEP extends into the furcation.

Ectopic enamel removal is a common recommendation because it allows new attachment to form [9].

Figure 3.20 and corresponding video link available on the book companion website show cervical enamel projections found during endoscopic treatment on molar teeth that have developed periodontal infection. Using dental endoscopy, enamel projections may be removed quickly and efficiently in a minimally invasive, nonsurgical manner. Prior to dental endoscopy, these areas would have required surgical intervention to view and/or treat.

Grade I CEP appears as a small, flat projection that extends toward the furcation (Figure 3.20).
Grade II CEP begins just under the CEJ and extends toward the entrance of the furcation, but does not enter. Depending on the size and thickness of an enamel projection, Grade-I and Grade-II CEPs may be removed with an ultrasonic insert on medium-to-high power using firm pressure; or if required, a more aggressive diamond-tipped insert may be used. It is recommended that these methods only be used with visualization because of their aggressive nature (Figure 3.21).

Figure 3.22 shows a Grade-III CEP entering into the furcation.

The video “Cervical enamel projections found in molar teeth with furcation involvement” can be viewed at http://www.youtube.com/watch?v=FRxBYSfYHgk.
Enamel pearls

Although bacterial plaque is a primary cause of the initiation and progression of periodontal disease, anatomic factors such as enamel pearls are often associated with advanced localized periodontal destruction [11]. Ectopic enamel removal is generally recommended during periodontal surgeries to allow new attachment to form [12]. With the advent of the dental endoscope, a diamond-tipped ultrasonic insert can remove enamel pearls nonsurgically. Figures 3.23 and 3.24 and corresponding video available on the book companion website show an endoscopic enameloplasty.

To view the video "enameloplasty visualized with the perioscope," see: http://www.youtube.com/watch?v=S1IKT2KoVj4.

Figure 3.23 Enamel pearl MB #3 pre-Tx.

Figure 3.24 Post enameloplasty.
Dental endoscopic instruction

After training in the use of the dental endoscope, the initial learning curve typically takes about 10 patients. A practitioner usually enters the comfort zone after treating between 20 and 30 patients. Recommended training usually consists of an online video review, bench training, and patient hands-on training. This type of instruction is usually provided in-office and can also be provided as part of dental, dental hygiene, and periodontal clinical training (Figure 3.25).

Proper positioning of the patient is critical to allow for effective water evacuation. A low-volume suction device or saliva ejector, again properly positioned, is adequate to allow for treatment without an assistant. During treatment without the benefit of a mirror to retract, the sides of the endoscope explorer and ultrasonic instrument can be used to retract (tongue and cheek).

Instruments are positioned looking in the mouth, and then the operator focuses on the screen to govern movements. Medium-to-medium plus power is used with ultrasonic instrumentation, using lateral pressure for more power (which is contrary to most teaching, but the benefit is very evident when cleaning endoscopically). The more tenacious the deposit, the more amplitude or power is used, utilizing smaller movements over deposits until the area is completely clean (Figure 3.26).

Subgingival visualization has shown that instrument access is far more predictable and efficient when the root surface and instrument can be simultaneously viewed.

Figure 3.25  Dental endoscopic tray setup. Source: Reproduced with permission of Perioscopy Incorporated.
Decisions in selecting nonsurgical endoscopic treatment

When initiating any nonsurgical periodontal therapy, clinicians must be aware of the following aspects:

- the objective of treatment;
- limitations of treatment (i.e., tooth anatomy, pocket depth, and operator error);
- whether treatment recommendations are in line with the severity of the disease.

Objectives of treatment include

- ameliorating or arrest the disease process;
- attempting to maintain or possibly regenerate periodontal/peri-implant support;
- reducing the periodontal/peri-implant inflammatory process.

Peri-implant diseases present in two forms: (i) peri-implant mucositis and (ii) peri-implantitis. Both are characterized by an inflammatory reaction in the tissues surrounding an implant [13]. It is accepted by some that peri-implant mucositis is the precursor of peri-implantitis, as it is accepted that gingivitis is the precursor of periodontitis. However, similar to the causal relationship between gingivitis and periodontitis, peri-implant mucositis does not necessarily progress to peri-implantitis [14].

Prevalence of peri-implantitis has been widely reported [15]. Peri-implantitis has been characterized by some as an inflammatory process around an implant, which includes both soft tissue inflammation and progressive loss of supporting bone beyond biological bone remodeling [13]. Some believe that peri-implantitis, like periodontitis, occurs primarily as a result of an overwhelming bacterial insult.
and subsequent host immune response. For this group, the primary objective for treating peri-implantitis is similar to that for treating peri-implant mucositis, which is the elimination of the biofilm from the implant surface [14].

Although sharing similarities with periodontitis in both the bacterial initiators and key immune components to those insults, the rate of disease progression and the severity of inflammatory signs for peri-implantitis may be different [14]. The microbiology of peri-implantitis is more diverse than that of periodontitis [16]. Histologically, peri-implantitis is much more infiltrative near the alveolar crest and often lacks a protective layer of tissue over the bone as we typically see in periodontitis [17,18].

Data have shown that peri-implant infections are often responsible for late failures [19]. Treatment of peri-implant disease may be found in Chapter 5.

Peri-implantitis is an infection of the tissue around an implant, resulting in the loss of supporting bone. Risk factors for peri-implantitis consist of a history of periodontitis, dental plaque, poor oral hygiene, smoking, alcohol consumption, and diabetes. A clinical diagnosis indicates inflammatory signs including bleeding on probing with or without suppuration and a peri-implant pocket depth of ≥5 mm [20]. Aggressive treatment of the underlying cause of these negative clinical findings is indicated when this diagnosis is made. The endoscope is extremely valuable in both the diagnosis and treatment of peri-implantitis and should be employed as soon as feasible on these individuals.

Endoscopic examination for patients with peri-implant diseases often reveals foreign material attached to the implant surface or to the prosthetic superstructure. White highly reflective material is often seen attached to the implant or its superstructure. The best evidence available at this time indicates that this material may be dental cement.

Utilizing the periodontal endoscope, subgingival residual cement associated with peri-implant disease may be diagnosed and removed. Endoscopically, cement removal may be accomplished utilizing either ultrasonic and or hand instruments.

Although dental endoscopy affords clinicians the opportunity to provide meticulous instrumentation, appropriate treatment recommendations should be based on the level of disease to be treated and operator experience (Figure 3.27).

Areas where periodontal endoscopic debridement is difficult include

- very inflamed pockets;
- abscesses;
- distal furcations of maxillary molars;
- narrow furcations and class III furcations;
- curved roots;
- close root proximity;
- grossly overcontoured restorations.

Although mechanical debridement is essential in removing the bacterial bio-burden from root surfaces in nonsurgical periodontal therapy, endoscopic debridement may also incorporate adjuncts. These are the same adjuncts that many clinicians use with closed and open debridement, and these may include
Figure 3.27 Periodontal disease treatment protocol.

Systemic antibiotics, low-dose doxycycline hyclate 20 mg, local delivery antibiotics such as 1.0 mg minocycline HCl, biologics such as enamel matrix derivatives, or rhPDGF, dental lasers for nonsurgical sulcular debridement (sometimes referred to as laser curettage, pocket sterilization, or laser pocket disinfection) and various chemical disinfection options.

In the opinion of the authors, actively progressing periodontitis is almost always associated with specific bacterial infections and may require the adjunctive use of systemic antibiotic therapy. By entering periodontal tissues and the periodontal pocket via serum, systemic antibiotics can affect organisms outside the reach of instruments, or topical anti-infective chemotherapeutics. Systemic antibiotic therapy also has the potential to suppress periodontal pathogens residing on the tongue or other oral surfaces, thereby delaying subgingival recolonization of pathogens [21]. Since periodontal lesions often harbor a mixture of pathogenic bacteria, drug combination therapies have gained increasing importance and may even be required for eradication and prevention of periodontal infections by known periodontal pathogens that invade subepithelial periodontal tissue or colonize extradental domains from which they may translocate to periodontal sites [21]. Many clinicians prescribe antibiotics empirically, based on clinical experience and/or the patient's medical history and sensitivity to the desired antibiotics. The rationale supporting this approach is that most pathogens are susceptible to the same antibiotics, and identification of specific bacteria is reserved for those situations where there is no or minimal clinical improvement after a course of systemic antibiotics or to ensure the elimination of the target bacteria [22].

Adjunctive antimicrobial agents such as systemic antibiotics, locally delivered antibiotics, and antimicrobial irrigation have been shown to improve treatment outcomes in patients presenting with destructive periodontal disease [23].

The following cases utilize varying adjuncts, but the emphasis and commonality is the ability to endoscopically visualize and thoroughly debride diseased root surfaces.
The following example case reports demonstrate positive clinical and radiographic healing when thorough root debridement is accomplished through minimally invasive endoscopic debridement.

Case 1—Robert Gottlieb, DDS, and Suzanne Newkirk, RDH, Richland, WA

This 47-year-old female had a history of yearly cleanings, orthognathic surgery, orthodontics, and gingival tissue grafting in the mandibular anterior teeth. She was referred for periodontal evaluation and for upper left and lower left discomfort. Clinical and radiographic examination revealed periodontal probing depths of 4–5 mm, bleeding on probing, and a significant amount of calculus throughout her mouth.

The patient presented with a class III bilateral Angles classification, with signs and symptoms of bruxism and an anterior open bite. A diagnosis of the American Academy of Periodontology (AAP) case type II–III (early-to-moderate) periodontal disease was made (Figures 3.28, 3.29, 3.30, and 3.31).

A nonsurgical treatment plan was developed consisting of ultrasonic endoscopic debridement that was completed in two appointments. Post-treatment instructions were provided to the patient for the care of her mouth post-endoscopic debridement, and the patient was scheduled for reevaluation 8 weeks post treatment to assess tissue response of endoscopic therapy. Periodontal recharting was performed indicating that healing had taken place, and the patient was scheduled for periodontal maintenance every 3 months to include periodontal charting, instrumentation, and polish.

Two years post endoscopic debridement, the patient has remained stable and is maintaining a favorable clinical outcome with an overall improved dentition and probing depths no greater than 3 mm (Figure 3.32, 3.33, 3.34).

Figure 3.28  Pretreatment panographic radiograph. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.
Figure 3.29  Pre-Tx periodontal charting. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.
Figure 3.30  Pre-Tx photo facials. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.

Figure 3.31  Pre-Tx photo mandibular lingual. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.

Figure 3.32  Post-Tx photo, facials 9 months’ post treatment. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.
Figure 3.33  Nine months post-Tx mandibular linguals. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.

Figure 3.34  Periodontal charting 30 months post endoscopic debridement. Source: Courtesy of Robert Gottlieb, DDS and Suzanne Newkirk, RDH.
Case 2—David Trylovich, DDS, MS, and Shelly Andreoli, RDH, Las Vegas, NV

This 67-year-old male patient had been consulting his general dentist for 20 years prior to being referred to a periodontist for periodontal evaluation. The referring dentist expected extraction of #26 and implant placement into the edentulous area.

Clinical and radiographic examination revealed a periodontal probing depth of 12 mm on the distal surface of #26 with associated bleeding on probing, Class I mobility on the Miller scale on #25 and Class II mobility on #26. Localized recession of 1–2 mm was present in the lower anterior teeth.

A diagnosis of localized AAP case type IV (advanced or severe) periodontal disease was made (Figure 3.35 and 3.36).

Full-mouth nonsurgical endoscopic debridement was provided under local anesthesia and completed in three visits. In addition, application of 1.0 mg minocycline HCl was provided subgingivally to the distal surface on #26. A prescription for doxycycline hyclate 20 mg was given to the patient to take two times per day for 90 days.

Eight weeks post periodontal treatment, the patient returned for reevaluation to assess tissue response. Full-mouth periodontal charting was performed; periodontal maintenance and an additional application of 1.0 mg minocycline HCl was placed subgingivally into the distal surface of #26 (Figure 3.37 and 3.38).

![Figure 3.35 Pre-treatment periodontal charting showing extensive pocketing of 12 mm. Source: Courtesy of David Trylovich, DDS, MS and Shelly Andreoli, RDH.](image-url)
Figure 3.36  Pre-Tx radiograph showing bone loss to the apex on the distal of #26. Source: Courtesy of David Trylovich, DDS, MS and Shelly Andreoli, RDH.

Figure 3.37  Three years post dental endoscopic treatment and placement of minocycline HCl, probing depths have reduced dramatically. Source: Courtesy of David Trylovich, DDS, MS and Shelly Andreoli, RDH.

Eight years post endoscopic debridement and application of locally applied minocycline, the patient is maintaining a favorable clinical outcome with an overall improved dentition; #26 shows decreased pocketing from 12 to 2 mm and radiographic bone repair.
Figure 3.38 The post treatment X-ray showing evidence of radiographic bone repair. Source: Courtesy of David Trylovich, DDS, MS and Shelly Andreoli, RDH.

Case 3—Richard Longbottom, DDS, and Wendy Williams, RDH, Auckland, NZ

This 62-year-old Asian Female had no history of previous periodontal treatment and received twice-yearly cleanings provided by her general practitioner. The patient lost the maxillary left second molar (#15) and was referred to the periodontist for periodontal evaluation.

A comprehensive periodontal evaluation revealed probing depths of 4–10 mm, with generalized bleeding on probing, localized gingival recession of 1–3 mm was noted throughout the dentition, and a generalized AAP case type III–IV (moderate-to-severe) periodontal diagnosis was made.

Because of financial constraints, a nonsurgical treatment plan was developed, consisting of ultrasonic scaling under local anesthetic, which was as completed in two visits. In addition, amoxicillin 500 mg and metronidazole 400 mg, both three times a day for 6 days was prescribed concurrent with initial therapy. Fourteen months later, the patient underwent ultrasonic endoscopic debridement, which was completed in two visits under local anesthesia. Povidone-iodine was irrigated into the periodontal pockets (Figure 3.39 and 3.40).

A periapical (PA) radiograph was taken of #30 (first image), and a probing depth of 10 mm was recorded on the distal buccal surface of #30. Three months post endoscopic debridement, periodontal maintenance was provided, which included full-mouth periodontal charting, instrumentation, and polish. Another PA radiograph of #30 was taken and a probing depth of 5 mm was recorded on the distal buccal surface of #30 (Figure 3.41 and 3.42).

Twenty-four months post endoscopic debridement, the final periapical radiograph was taken (see Figure 3.41) and a probing depth of 2 mm was recorded on
Figure 3.39  Pretreatment periodontal charting. Source: Courtesy of Richard Longbottom, DDS and Wendy Williams, RDH.

Figure 3.40  Radiograph showing a 10 mm pocket on the DB #30 and associated radiographic bone loss. Source: Courtesy of Richard Longbottom, DDS and Wendy Williams, RDH.
Figure 3.41  Periodontal charting. Source: Courtesy of Richard Longbottom, DDS and Wendy Williams, RDH.

Figure 3.42  Radiograph 24 months post treatment. Source: Courtesy of Richard Longbottom, DDS and Wendy Williams, RDH.
the distal buccal surface of #30. The patient has maintained a 3-month periodontal maintenance schedule. Periodontal indicates a reduction in pocket depths and #30 shows evidence of radiographic bone repair.

Case 4—Dr Robert Gottlieb and Suzanne Newkirk, RDH, Richland, WA

This 59-year-old patient received twice-yearly cleanings by her general practitioner, and no history of previous periodontal treatment. Her chief complaint was that her fixed partial denture (#’s 9–11) “keeps losing gum tissue,” and the patient “felt it was ugly.” This was the third fixed partial denture that had been placed. A comprehensive periodontal examination revealed periodontal probing depths of 4–9 mm, with associated generalized bleeding on probing. Localized Class I mobility and gingival recession of 1–3 mm was noted throughout the dentition. Radiographic bone loss around the fixed partial denture was noted, and a diagnosis of AAP case type III–IV (moderate-to-severe) periodontal disease was made (Figure 3.43, 3.44, and 3.45).

The patient was initially recommended full-mouth laser surgery (Laser-assisted new attachment procedure), implant placement in the edentulous area #10 and crown lengthening, but the patient declined all surgical options. A nonsurgical treatment plan of ultrasonic endoscopic debridement was made, and the patient was prescribed azithromycin (250 mg x 6), two to be taken the day of treatment, and then one per day until gone. Endoscopic debridement with adjunctive nonsurgical laser pocket disinfection was completed in two visits under local anesthesia. Periodontal maintenance was provided every 3 months to include full-mouth periodontal charting, instrumentation, and polish. The replacement of #’s 7–9 fixed partial denture was coordinated with the referring general dentist (Figure 3.46, 3.47, 3.48, 3.49, and 3.50)

Figure 3.43 Pre-Tx photo, upper anterior bridge. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.
**Figure 3.44** Pre-Tx perio charting. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.

**Figure 3.45** Pre-Tx X-rays upper anterior bridge 9–11. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.
Figure 3.46  Laser tip viewed using the dental endoscope. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.

Figure 3.47  Post restorative bridge upper anterior 9–11. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.

Figure 3.48  Periodontal probing depths 15 months post endoscopic debridement. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.
Figure 3.49 Radiograph of upper anterior bridge 3 years post endoscopic debridement. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.

Figure 3.50 Radiograph of upper anterior bridge 3 years post endoscopic debridement. Source: Courtesy of Dr. Robert Gottlieb and Suzanne Newkirk, RDH.

Three years post ultrasonic endoscopic debridement, the patient is maintaining a generalized favorable clinical outcome. Periodontal charting reveals overall improvement with generalized decreased probing depths, and radiographic bone repair is evident on the fixed partial denture abutments.

As the above case reports demonstrate, meticulous instrumentation provided by dental endoscopic treatment can render superior clinical outcomes. Clinicians
have discovered the benefits of this technology and are providing nonsurgical endoscopic diagnosis and treatment in all parts of the world and using varied approaches to therapy.

Summary

Ultrasonic endoscopic periodontal debridement is a minimally invasive microvisual technology utilized for the nonsurgical treatment of periodontal disease. The dental endoscope is also a valuable diagnostic tool for evaluation of caries, root fractures, root resorption/perforations, residual cement around teeth and implant restorations, and subgingival anomalies. As with any advanced dental instrumentation and skill, this technology requires focused attention, a desire to learn, training, practice, and patience. This skill set combined with the microvisual capacity of dental and periodontal endoscopy is providing dentistry, dental hygiene, and periodontics with a valuable and very different “vision” toward dental and periodontal health.

References

CDT Code Action Request

Part 1 – Submitter Information

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

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Part 2 – Submission Details

1. Action (Mark one only)

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Affected Code (Revise or Delete only) D4346

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

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<th>Nomenclature</th>
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<td>Descriptor</td>
<td>Optional for “New”; enter “None” if no descriptor</td>
<td>The removal of plaque, calculus, and stains and the disruption of dental biofilm from supra- and subgingival tooth surfaces when there is generalized moderate or severe and prosthetic structures in the presence of gingival inflammation and in the absence of periodontitis. It is indicated for patients who have swollen, inflamed gingiva, generalized suprabony pockets, and moderate to severe bleeding on probing. May assist in the reduction of inflammation in relation to systemic disease. Should not be reported in conjunction with prophylaxis, scaling and root planing, or debridement procedures.</td>
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3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Simplifying the current descriptor of D4346 to gingival inflammation with no qualifiers will help to eliminate the confusion surrounding the selection of this procedure code. It is important to retain “in the absence of periodontitis” so it is clear this procedure is meant for patients who present with no clinical attachment/bone loss.

The addition of ‘prosthetic’ structures would more accurately describe those cases where patients present with prosthetics, such as, but not limited to fixed bridges, dental implants, space maintainers, orthodontic brackets and wires, etc.

The intent of performing ‘scaling in the presence of gingival inflammation’ is to assist in the reduction of gingival inflammation and the promotion of a healthy dental biofilm. As D4346 is not a well understood procedure code, these changes would not be disruptive, but rather they would provide more

Notice to Preparer and Submitter:

- All requested information in Parts 1-3 is required; limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
- Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.
- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
Clarity for dental and medical professionals alike. The last statement was struck as it's unnecessary and goes without saying based on the nomenclature- 'full mouth.'

The requested nomenclature change would allow for more accurate metrics on the population presenting with gingival inflammation. **Inflammation is indeed the common thread tying multiple disease processes together.** Rising concerns regarding the possibility that events in the oral cavity can influence systemic disease are sites in the U.S. Department of Health and Human Services. Oral health in America: A report of the surgeon general. U.S. Department of Health and Human Services, National Institute of Dental and Craniofacial Research, National Institutes of Health, Rockville, Md.; 2000.

Highlighted by the U.S. surgeon general’s report in 2000 sites numerous reports of investigations into associations and interactions between oral disease—particularly periodontal disease—and coronary heart disease, stroke, adverse pregnancy outcomes, diabetes and bacterial pneumonia.

Referenced from the 2017 World Workshop: Caton JG et al. A new classification scheme for periodontal and peri-implant diseases and conditions – Introduction and key changes from the 1999 classification. J Periodontol. 2018;89(Suppl 1): S1–S8. DOI: 10.1002/JPER.18-0157 is the language being mirrored in this action request form: “If the biofilm is not disrupted/removed, frank dysbiosis results and perpetuates a chronic non-resolving and destructive inflammation.” Also sited is “gingival inflammation in response to bacterial plaque accumulation (microbial biofilms) is considered the key risk factor for the onset of periodontitis.”

The suggested descriptor includes current language as it applies to the purpose of the procedure itself (what is being removed/disrupted). See Figure 1 below for reference.

![Diagram](image)

Figure 1

Overall, the requested changes allow for more accurate tracking related to evidence-based treatment protocols and patient care outcome for individuals presenting with gingival inflammation. The revision will provide for a more accurate description of the procedure.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>Mark if Revise or Delete</th>
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<tr>
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</table>

| a) CDT Code currently used to report the procedure | D4346 |

<table>
<thead>
<tr>
<th>b) Procedure technical description</th>
</tr>
</thead>
</table>

The removal of plaque, calculus, stains and the disruption of dental biofilm from supra- and subgingival tooth and prosthetic structures in the presence of gingival inflammation and the absence of periodontitis by mechanical means. Includes coronal polishing when indicated.

**NOTICE TO PREPARER AND SUBMITTER:**

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c) Clinical scenario

A specific clinical scenario would be a patient who presents with dental biofilm-induced gingivitis (as recently defined by the 2018 AAP Classifications of Periodontal and Peri-Implant Diseases). The patient is currently under the care of an Orthodontist and has brackets and wires on the maxillary arch. As D1110 is intended to be ‘preventative’ in nature, as listed under the ‘preventive’ section in the CDT manual, and this patient has gingival disease requiring therapeutic care, it would be best represented as a D4346 (as requested in the above nomenclature and descriptor changes). Our revisions would more accurately describe the procedure being rendered on individuals exhibiting gingival inflammation, whether localized or generalized.

Part 3 – Additional Information

5. Supporting documentation or literature:
   • “5.a)” **must** be completed for all requested actions; “(b)" and “(c)” are completed when indicated.
   • If protected by copyright, written authorization to reprint and distribute **must** be provided
   • All material **must** be submitted in electronic format.

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6. Additional Comment or Explanation:

**Currently there is a gap in coding between the D1120/1110 and the D4346.** A revision to this code would allow for more accurate diagnosis of gingival inflammation, patient education and clinical care outcomes.

Patients with gingival diseases are currently being lumped into ‘prophylaxis’ coding which is intended to prevent disease and preserve health; such patients are better served with therapeutic care. Tradition continues to encourage use of D1110 in patients with gingival inflammation, unless a patient requires non-surgical periodontal scaling and root planing, which negatively impacts the true metrics of the population we serve. Improved patient education, with respect to inflammation, will positively impact the overall welfare of our patients we love and serve.

**Slight changes in the nomenclature and descriptor will bring more clarity to dental and medical professionals alike.** There is currently no mention of prosthetic structures in the D4346 procedure code. Prosthetic structures may include, but are not limited to, space maintainers, fixed bridges, dental implants, palatal obturators, orthodontic brackets and wires and partial and complete dentures.

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<td>Name: Council on Dental Benefit Programs</td>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: American Dental Association / Council on Dental Benefit Programs |
| No > ☐ |

**Part 2 – Submission Details**

1. **Action** (Mark one only)

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</table>

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   **Nomenclature Required for all “New”**
   - full mouth debridement to enable a comprehensive evaluation and diagnosis on a subsequent visit

   **Descriptor Optional for “New”; enter “None” if no descriptor**
   - Full mouth debridement involves the preliminary removal of plaque and calculus that interferes with the ability of the dentist to perform a comprehensive oral evaluation. Not to be completed on the same day as D0150, D0160, or D0180.

3. **Rationale for this request; your persuasive argument for CMC acceptance** (Required for any type of requested action – New; Revise; Delete)

   The nomenclature and descriptor text marked for deletion is not pertinent to the manner in which the full mouth debridement procedure is delivered. The reason why a procedure is delivered is best documented by the appropriate diagnosis code. What subsequent procedure is part of a patient’s treatment plan and when that procedure will be delivered is immaterial to the dentist’s clinical determination that a full mouth debridement is necessary for a patient’s oral health. Specification of a time interval between the debridement and specific subsequent treatment sets a standard of care, which is not the CDT Code’s purpose.

4. **Complete a) – c) only if Action Request is for a New CDT Code**

   **Mark if Revise or Delete [“a) - c”] are not applicable**

   a) CDT Code currently used to report the procedure ☒
b) Procedure technical description


c) Clinical scenario


Part 3 – Additional Information

5. Supporting documentation or literature:
   • “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

None

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<td>Name: Mark Hawn</td>
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<th>B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?</th>
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3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

Most of our patients are hopeful to complete their examination and cleaning the same day because of their busy schedule. If we are unable to screen the patient prior to the scheduled appointment, we need to be able to perform a debridement on our patients if necessary. Then following the debridement, the patient still expects to see the doctor and would be upset to have to cancel and reschedule the appointment. I believe that we should be able to complete a comprehensive examination on the same day as a debridement as long as the debridement is completed before so the doctor can visualize the dentition and periodontium.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>a) CDT Code currently used to report the procedure</th>
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<td>c) Clinical scenario</td>
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**Part 3 – Additional Information**

5. Supporting documentation or literature:
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6. Additional Comment or Explanation:
No additional.
Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/28/2019

| Name: | Matthew Hall, DDS |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: | Solvay Dental 360, a division of Solvay Specialty Polymers USA, LLC |
| No > ☐ |

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)  D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature  Required for all “New” | mandibular partial denture – polyaryletherketone (PAEK) framework with resin denture bases (including retentive/clasping materials, rests, and teeth) |

| Descriptor  Optional for “New”; enter “None” if no descriptor | None |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

- Over the past few years new polymer materials have been brought to the market for use with removable partial dentures.
- Most of these products can be classified as polyaryletherketone (PAEK) polymers, which are defined by the ACP as; a family of semi-crystalline thermoplastic polymers exhibiting high strength and shape stability over a wide range of temperatures; [ACP Glossary of Prosthodontics Terms]
- Examples of PAEK products on the market for partial denture use are; Ultaire™ AKP (Solvay Dental 360), Juvora™ PEEK (Juvora Dental), DD peek Med (Dental Direkt), Pekkton® (Cendres+Metaux), BioHPP®(Bredent)
- This group of denture materials is distinctly different (in function and production) then what CDT Procedure Codes are available for partial dentures and a new code to classify the use of these materials is needed.

Codes Currently Available for RPDs:
- Resin Partial Codes (D5211 & D5212)
  - The PAEK materials can not be classified as resin, since that is defined as; any resin-based composite, including fiber or ceramic reinforced polymer compounds, and glass

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ionomers; and PEAK materials are not a composite nor are they reinforced polymer compounds. Also, since PAEK materials are not used for the denture base (as the resin code states), but rather PAEK is used as the framework structure of the denture (similar to metal), these codes do not apply.

- Flexible Partial Codes (D5225 & D5226)
  - Not applicable because PAEK are not “flexible” materials, they are rigid structures that provide a framework for denture based resins to be applied to. Also, since PAEK materials are not used for the denture base (as the flexible code states), but rather PAEK is used as the framework structure of the denture (similar to metal), these codes do not apply.

- Metal Partial Codes (D5213 & D5214)
  - Not applicable due to the PAEK materials not having any metal component.

Technical Details:

- Comparison of material properties with common RPD materials, including Metal (CoCr), PAEK (PEKK, PEEK, Ultaire™ AKP), Resin (Acetal), and Flexibles (Valplast).

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**Technical Details:**

- **Comparison of material properties with common RPD materials, including Metal (CoCr), PAEK (PEKK, PEEK, Ultaire™ AKP), Resin (Acetal), and Flexibles (Valplast).**

---

- **Material fatigue data for an RPD clasp using one of the PAEK materials mentioned above (Ultaire™ AKP (Solvay Dental 360)).**
  - Objective: To compare the retention force of individual clasps made from cobalt chromium (CoCr) or new aryl ketone polymer (AKP) material, Ultaire™ AKP, following prolonged fatigue testing along ideal and non-ideal paths of removal and to assess 3D deformation of the active and passive clasp tips.
  - “Unlike CoCr, the Ultaire™ AKP clasps did not work harden, nor had as large a reduction in retentive force and accompanying permanent deformation; the retentive force for the Ultaire™ AKP clasps was consistent over 15,000 cycles of fatigue mimicking prolonged clinical use. The AKP material was more robust; showing minimal deformation even in non-ideal paths of removal, as many patients would routinely use.”

---

4. Complete a) – c) **only** if Action Request is for a New CDT Code

a) CDT Code currently used to report the procedure

| D5211, D5213, D5225, D5899 |

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b) Procedure technical description

Cylindrical milling discs comprised of PAEK materials are machined into partial removable denture frameworks using a CAD/CAM system. The improved process to manufacture the prosthesis removes opportunities for error and improves the precision of fit, allowing the clinicians to remove up to 2 patient visits (compared to metal and resin RPD procedures) and get the final denture to the patient faster.

**PAEK RPD Workflow (2-4 visits for the patient):**

- **Doctor (Visit 0):**
  - Meets with patient to decide if partial denture is the right solution
    - This could be visit 1 if the patient decides to choose the RPD today
- **Doctor (Visit 1):**
  - Prep patients teeth (if needed), takes an impression, and sends to dental lab
    - Impression can be analog or digital, but should include both maxillary and mandibular jaws with a bite registration
- **Lab (Visit 1):**
  - Creates a master stone model from the analog impression and scans into CAD software
    - Digital impression transfer directly into CAD software from Doctor’s office
  - Design framework in CAD software
    - Can design teeth in this step to avoid additional patient visits
  - Send final CAD design file to a milling machine and mill frame with a PAEK milling blank
  - Remove frame from milling blank, remove sprues, and polish framework
  - Process teeth in a resin base (that were digital designed earlier) to the PAEK framework
  - Polishes and finishes denture
  - Sends to Doctor
- **Doctor (Visit 2):**
  - Tries the frame in the patients mouth
  - Makes adjustments to frame to modify retention, fit and bite (if needed)
  - Patient takes home
- **Intermediate visits (bite block and wax try-in) can be used by the doctor if requested, but are not needed for this procedure**

c) Clinical scenario

RPDs made from a PAEK framework are used to restore missing teeth, similar to other partial dentures. They are best suited for patients missing multiple teeth and who are looking for an alternative to implants, metal frameworks, or RPDs with resin/flexible bases. PAEK materials provide non-allergenic properties not currently offered by cast-metal and resin-based partials.
Part 3 – Additional Information

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6. Additional Comment or Explanation:

Excerpts from peer-reviewed journals using High Performance Polymers, in particular PAEK, for medical and dental applications [full articles available in attached supporting documents].

“So far, the most commonly used HPP [High Performance Polymers] is polyetheretherketone (PEEK) that was first characterized in the 1990s and belongs to the polymer family of polyaryletherketone (PAEK). Soon after its synthesis, it started to be used increasingly in orthopedic, traumatic surgery and in particular as spine implants.” – Wiesli et al. Implant Dentistry (2015) vol. 24(448-457)

“... the reason for the recent enthusiasm surrounding PAEKs has been their potential for use as a metal alternative in broader indications such as removable dentures. ... In the case of customised prostheses, the upstream material or shape becomes the ‘device’ and is regulated and cleared for use for a defined set of indications. Here, the PAEKs have appeared as materials for use in injection press systems or as discs for computer aided design/manufacture (CAD/CAM). ... There are now many brands of PAEK dental devices becoming available for use in prosthetic frameworks.” – Private Dentistry (October 2015)

“Traditional RPD with Co-Cr frameworks and clasps have been an inexpensive and predictable treatment option for the rehabilitation of partially edentulous patients (16). The esthetically unacceptable display of metal clasps, increased weight of the prosthesis, potential for metallic taste, and allergic reactions to metals led to the introduction of a number of thermoplastic materials in clinical practice such as nylon and acetal resins. Nylons provide improved esthetics and reduction of rotational forces on the abutment teeth due to their low elastic modulus. The major disadvantage of a nylon RPD is the inability for a reline procedure and the lack of occlusal rests as well as rigid frameworks that could lead to occlusal instability and sinking, especially in Kennedy class I and II cases. ... Alternatively, RPDs can be constructed by using PEEK. Its elasticity can reduce stresses transferred to the abutment teeth. Furthermore, the white color of PEEK frameworks provides a different esthetic approach than the conventional metal framework display does. Additional advantages of this polymer material are elimination of allergic reactions and metallic taste, high polishing qualities, low plaque affinity, and good wear resistance (18). RPDs can be constructed more efficiently by using PEEK computer-aided design and computer-aided manufacture systems (1). The use of CAD-CAM as a manufacturing process could lead to further process simplification, providing a cost and time-saving approach and eliminating tool wear (19).” – Eltombashki et al. Alexandria Dental Journal (2019) vol. 44(93-98).

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High performance polymers - part one

In the first of a series of articles, Professor Paul Tipton gives us an introduction to high performance polymers in dentistry. Here he discusses polyether ether ketone (PEEK), a new material for framework fabrication in prosthodontics.

The high-performance polymers (HPPs) are the uppermost class of plastics, possessing better temperature and chemical stability and mechanical properties than the commodity plastics, but typically being manufactured in lower volumes and costing more.

The family of HPPs that have entered dentistry are called the Polyarletherketones (‘PAEKs’), of which there are several members with varying chemical structures. Many of us in the dental industry are inadvertently familiar with the family member called PEEK (Polyetheretherketone), through its use in healing caps, temporary abutments and scan bodies.

However, the reason for the recent enthusiasm surrounding PAEKs has been their potential for use as a metal alternative in broader indications such as removable dentures (Figures 1 and 2) and implant borne prosthetics (Figure 3). It is here that the shock absorbing characteristics of the material could be extremely interesting for immediate loading or long term frameworks (Figure 4).

In this first article of a series of six, the background to these materials will be described. This will be followed by a series of case studies describing their use in removable and implant-borne prosthetics.

The PAEK family
PEEK is the most well-known and most widely used PAEK family member. PEEK was invented in the UK in 1978 (ICI – now as Victrex plc) and was selected by aerospace, semiconductor, automotive and medical industries as a standard material of use in all these sectors. It is typically used as a metal replacement, due to its strength to weight ratio and corrosion resistance. Other family members also exist which are variations of the chemistry (eg PEK and PEKK), and these materials can also be filled with pigments or reinforcing agents. In their unaltered, unfilled state the materials are beige in colour.

PAEKs in Medical
Several of the properties of PEEK that were being exploited in industry (eg strength-to-weight ratio, chemical and wear resistance, radiolucency, and reduced stiffness versus metals) were naturally intriguing for medical use. The first published PEEK medical research came in the 1980s (Williams et al., 1987) followed by the first implantable grade from Invibio Biomaterial Solutions in the 1990s (Victrex plc./Invibio Ltd, UK). Medical grades have a much tighter specification, and increased quality control than industrial grade materials, which is important in the wake of the silicone breast implant scandal (see http://www.nhs.uk/conditions/breast-implants/pages/pip-introduction.aspx). PEEK remained the only medical PAEK for many years.

Spine surgeons particularly adopted Invibio’s PEEK, liking the reduced Young’s Modulus (stiffness) of the material and the scatter-free CT and MRI imaging. PEEK has since become the standard alternative to titanium for load bearing spinal cage devices for the spine. Today, manufacturer Invibio claims PEEK has been used in around five million implantable devices, spanning some 500 separate US FDA 510k regulatory clearances. In more recent years, additional versions of PEEK and PEKK have appeared on the medical marketplace, but have been limited in use.

PAEKs in dentistry
Short term devices such as temporary healing caps and abutments have been sold direct to dentists through the dental companies for many years. In these situations, either unfilled PEEK or PEKK with a 10% titanium dioxide pigment filler are typical and have been used in these
In the case of customised prostheses, the upstream material or shape becomes the ‘device’ and is regulated and cleared for use for a defined set of indications. Here, the PAEKs have appeared as materials for use in injection press systems or as discs for computer aided design/manufacture (CAD/CAM).

**Types of PAEKs for prosthetics**

There are now many brands of PAEK dental devices becoming available for use in prosthetic frameworks. The most common formulations of the PAEKs are:

- Unfilled, pure 100% PEEK (eg JUVORA, Invibio/JUVORA Ltd). This is a beige material.
- 80% PEEK with 20% nanoceramic filler (eg. BioHPP, Bredent GmbH). This is a white material.
- 80% PEEK with 20% titanium dioxide filler (eg Dentokeep disc, NT Trading). This is a white material.
- 80% PEKK with 20% filler including titanium dioxide (eg Pekkton Ivory, Cendres and Mettaux). This is an off-white material.

Typically the particle size of these fillers (circa. 300-500 nanometers for the nanoceramic) is not likely to give significant reinforcing properties to the material, since they are not fibres. Instead the fillers act more as a pigment and alter surface topography. These levels of 20% filler will make the material stiffness slightly higher, but consequently also slightly increase brittleness. It should also be noted that the inclusion of titanium dioxide mean that these brands - BioHPP; Dentokeep and Pekkton should not be pitched as ‘metal free’ since this could be in breach of Advertising Standards and/or Governing Bodies. The reader should also take note as to the cleared indications for use as the different materials and forms may have varying clearances.

To date, PAEKs with these specific 20% fillers only have a limited history of use in dental and actually no prior medical history in any other medical applications. Therefore it is fair to say that the jury is still out as to the effects of adding these levels of these specific fillers to the PAEKs and the author advises the use only of the pure material where there are long-term studies.

**Methods of framework manufacture**

There are two methods for laboratories to manufacture substructure frameworks from PAEKs. These are: (i) injection moulding or (ii) CAD/CAM.

(i) Industrial injection moulding machines process the polymer under very high speed and pressure (eg. 1000’s bar), which are typically two orders of magnitude higher than the typical bench top pressing machines available to the dental laboratory (eg. 10’s bar). This means that small scale injection moulding of PAEK is no mean feat, due to tight processing windows and design limitations. Also these re-melting of PAEKs can also increase the risk of unpredictable mechanical and physical properties.

(ii) The CAD/CAM process uses digital design and computerised manufacture methods. These can include cutting, milling and laser processes. The design is sent from a computer to the machine which then manufactures the device. This method is less dependent on the processing conditions and can result in more consistent mechanical properties.
Properties (e.g., brittleness, flexibility, colour, warping) if the framework has not cooled and recrystallised correctly.

Finally, re-melting of PAEK materials can also cause degradation of the polymer (e.g., generation of phenol) unless very closely controlled using the correct equipment. This polymer degradation can be accentuated by the inclusion of fillers in the materials (such as reinforcing agents or pigments). Therefore, melt processing of these materials should only be done by a competent laboratory and using the equipment recommended by the supplier.

(ii) The alternative manufacture route uses CAD/CAM technology. This manufacturing route avoids all of the risks mentioned previously for re-melting the polymer. The material properties remain consistent and the framework manufacture can also benefit from the increase precision and reproducibility of a digital workflow. Although it does require a more significant capital investment by the laboratory, many laboratories are seeing that it is necessary to align with other industries and adopt digitisation to increase efficiencies.

PAEK materials further extend these CAD/CAM efficiencies when compared to milling metal substructures, since there is typically less tool wear and faster milling times and the capital equipment necessary to mill them does not need to be as expensive as machines for milling metal frameworks.

It is the author's view that the optimum use of these materials only comes from the CAD/CAM milling process as opposed to the injection moulding process.

**Polymer properties**

When handling a prosthetic framework made from a PAEK, a striking thing is the difference in weight. When identical full arch implant prosthetic substructure frameworks were made from four different materials, the results from weighing were:

- PAEK 4.9g
- Titanium 17g
- Zirconia 23g
- Cobalt chrome 33g

However, it is the possibility to introduce shock absorption to a prosthesis that is perhaps the most exciting. This could have positive implications for patient comfort and for damage limitation. In my view, the most relevant mechanical property related to the aspect of shock absorption is not ultimately compressive strength (as is sometimes promoted), but actually flexural strength and elastic modulus.

Obtaining an increasingly stronger material becomes academic since clearly it would be simplistic to prefer the highest value.

Metals have very high compressive strengths relative to PAEKs but are not shock absorbing. Naturally, a design must also consider the influence of thickness and shape as well, but values for flexural strength and elastic modulus are more indicative of the stiffness of a material and how much it will deflect the load. Stiffer materials, like metals, have a high elastic modulus (see Table 1) meaning that metals require high loads to elastically deform them. Therefore, one can look at natural materials like bone for clues as to an ideal for stiffness. Common denture materials like PMMA have an elastic modulus range of 1.8-3.1 GPa, but limited strength. The
PAEKs have an elastic modulus closer to bone (4-5GPa) allowing the framework to be stiffer, yet still shock absorbing. However, PAEKs also additionally possess sufficient strength to be considered as a metal alternative.

**Conclusions**

The high-performance polymers called PEEK and PEKK have exciting potential in dentistry as a metal alternative for removable and implant prosthetic frameworks. Their stiffness properties confer promise as a substructure that could add an element of shock absorption. This may have benefits for patient comfort, addressing parafunction and damage limitation. In the following series of case studies, I shall describe the use of a PEEK high performance polymer as a framework for removable and implant prosthetics.

**References**

High-Performance Polymers and Their Potential Application as Medical and Oral Implant Materials: A Review

Matthias Guido Wiesli, MD, MDent Med,* and Mutlu Özcan, DDS, DMD, PhD†

Titanium (Ti) and its alloys are broadly used as dental and orthopedic implant materials due to a combination of favorable properties, such as high corrosion resistance, biocompatibility, repassivation, and adequate mechanical properties.1,2 Electrochemically, it is classified as base metal and has a high affinity to oxygen. The corrosion resistance of Ti and its alloys is a result of spontaneously formed passive oxide films (TiO₂) when in contact with oxygen.3 The Ti surface will be then covered with an oxide film within nanoseconds, yielding to passivation of the metal, protecting the device made of Ti against aggressive attacks and making the surface less reactive.4 TiO₂ is a stable and dense layer, which acts as a protective barrier to continuous metallic oxidation. This means titanium reveals a high resistance to corrosion. In the event of damage, TiO₂ has the ability to spontaneously reform under normal physiological conditions. However, events, such as cyclic loading, implant micromotion, acidic environments, and their combined effects, can result in permanent breakdown of the oxide film, which may consequently lead to exposure of the bulk metal to an electrolyte. During this process, a large amount of metal ions and debris are generated, of which their accumulation may lead to adverse tissue reactions in the oral environment.5 Ti and its alloys as dental implant material is commonly used and seems to be safe referred to its application. In conjunction with other metals and in an aqueous environment such as the mouth cavity, the passive surface may be impaired and as a consequence lead to osteolyses and healing problems and no scattering in radiation was observed. Some animal studies showed direct contact between PEEK and the bone with high biocompatibility and no evidence for cytotoxicity, mutagenicity, carcinogenicity, and immunogenicity to the present day.

Conclusion: The HPPs (i.e., PEEK) may carry some potential to be an alternative material for titanium as medical and dental implants. Yet, clinical and animal studies are limited in the field of implantology with such materials. (Implant Dent 2015;24:448–457)

Key Words: biocompatibility, high-performance polymer, implantology, oral implants, osseointegration, polyetheretherketone, titanium, Young modulus
infections is the development of biofilm on the Ti surface where the surface texture and physicochemical surface properties of the implant and the diminished immune-mediated response at the implant-tissue interface are held responsible. The surface protein layer, formed under physiological conditions, is essential for the biocompatibility of Ti. However, this protein layer may also facilitate the colonization of microorganisms. A biofilm is a cell aggregate where bacteria are adhered to each other and produce extracellular polymers. These extracellular polymers protect the microorganisms against body defense. Furthermore, antibiotics could hardly destroy the biofilm, meaning that an implant may need to be removed in most cases to destroy the biofilm and heal the infection.

Even though Ti and its alloys acquire many encouraging properties, corrosion happens pathophysiologically when the implant is in contact with the oral fluids. Due to this condition, Ti releases ions (ie, Ti [IV], V, and Al) and trigger an immune reaction that is potentially directed toward the implant. The reported immune reaction is part of the type IV reaction. Another important issue related to the metallic implants is that their presence evokes considerable scattering rays in the field of irradiation.

Currently, there are more than 1300 dental implant systems available on the dental market that differ in size, shape, and surface characteristics. Yet, during the last 2 decades, efforts are being made to develop metal-free implants, abutments, and restorative materials. One such example is zirconium dioxide. Acrylic as spine implants. The spectrum of applied implant materials in medicine, especially in orthopedic and traumatic surgery relied mainly on the use of cobalt-chrome alloy, stainless steel, or Ti materials by large size for pins, plates, screws, or total joints. Alternatively, individualized cobalt-chrome implants with titanium plasma spray coatings for talar and tibial or total ankle replacement were tried. However, orthopedic implants presented similar problems associated with the released metal ions as experienced with oral implants. Osteolysis is a result of wear-induced particles that diffuse within the effective joint space. The second-generation metal-on-metal bearing couple implants were expected to reduce the osteolysis due to wear of the implants. Opposite to the expectations, metal-on-metal bearing couple implants generated higher number of smaller particles (up to 13,500 times) than a metal-on-polyethylene (PE) couple as a result of wear, corrosion, and a combination of both. To date, there is no strong evidence of a risk for carcinogenesis or teratogenesis according to the level of metal ions measured in plasma using spectrometry.

Nonetheless, for the above stated reasons related to the disadvantages of Ti, cobalt-chromium, and even zirconium dioxide, metal-free materials, namely high-performance polymers (HPPs), are being proposed as implant materials in medicine. So far, the most commonly used HPP is polyetheretherketone (PEEK) that was first characterized in the 1990s and belongs to the polymer family of polyaryletherketone (PAEK). Soon after its synthesis, it started to be used increasingly in orthopedic, traumatic surgery and in particular as spine implants. From the biomechanical point of view, reinforced version of PEEK has a similar Young modulus (18 GPa) with the human cortical bone, which makes it an “isoeleastic” implant material. The possibility of sterilization of PEEK and no scattering under irradiation presented the material as a potential alternative to metallic implants. Table 1 demonstrates an overview on the classification of commonly used polymers for medical and dental applications.

The objectives of this literature review, therefore, were to evaluate the present literature and gain insight into the newly developed HPP materials used as medical and oral implants and make comparison with the commonly used titanium. The focus in this literature review will encompass an investigation on chemical, mechanical, and biological properties of HPPs and their application particularly in medicine and dentistry as implant materials. Based on the available in vitro, animal and clinical studies, the performance of these synthetic materials will be compared with that of titanium. Finally, conclusions will be made whether HPPs could substitute titanium for clinical applications as an implant material or not.

**Materials and Methods**

**Search Strategy**

Original scientific articles published in English in MEDLINE (PubMed-NCB) and Picarta literature databases between January 01, 1995 and June 01, 2013 were included in this review. The following Medical Subject Headings (MeSH), search terms, and their combinations were used: (“Dental Implants” [MeSH]) AND (“polytetrafluoroethylene-silicone” [Supplementary Concept] OR “Polytetrafluoroethylene”), (“Polymers” [MeSH]) AND “Dental Implants, Single-Tooth” (MeSH), (“Polyetheracrylic Acids” [MeSH]) AND (“Dental Implants” [MeSH] OR “Dental Implants, Single-Tooth” [MeSH]), (“Orthopolicis” [MeSH]) AND (“Prostheses and Implants” [MeSH]) AND “Polymers” (MeSH), “Polymers and material and oral implant,” “Fiber-reinforced composite and dental implant,” “Fiber reinforced resin and oral implant.”

**Table 1. Classification of Major Conventional and HPPs Used for Medical and Dental Applications**

<table>
<thead>
<tr>
<th>Major Polymer Types</th>
<th>Conventional Polymers</th>
<th>HPPs</th>
<th>Polyether ethylene glycol (PEEG)</th>
<th>Polyethylene glycol (PEG)</th>
<th>Bioglass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methyl methacrylate (MMA)</td>
<td>2-Hydroxyethyl methacrylate (HEMA)</td>
<td>2,2-bis(2-hydroxy-3-methacryloxypropoxy) phenylene)propane (bis-GMA)</td>
<td>1,6-bis(methacryloxy-2-ethoxycarbonylamino)-2,4,4-trimethylhexane (UDMA)</td>
<td>Triethylene glycol dimethacrylate (TEGDMA)</td>
<td></td>
</tr>
</tbody>
</table>
and titanium,” “PEG and dental implant,” “Scattering effects and titanium implant,” “High performance polymers and PAEK,” “High performance polymers and PEEK,” “High performance polymers and PAEK,” “High performance polymers and titanium,” “PEEK and titanium,” “PEEK and oral implants,” “PAEK and titanium,” “PAEK and oral implants.” Additional information was derived from scientific reports, medical and chemical textbooks, handbooks, product information, manufacturers’ instructions, and Internet web sites of the manufacturers.

Inclusion/Exclusion Criteria
Publications only in English language, where full texts were available, including abstracts, were included. Due to the limited number of studies available, no restrictions were made on study designs. Thus, all experimental, animal, and clinical studies were included.

Data Extractions
Two independent reviewers (M.G.W. and M.O.) screened the material retrieved from the electronic and hand-searched articles for possible inclusion in the review. After initial elimination, based on the titles and the abstracts by both reviewers, full-text articles were obtained. In addition, hand searches were performed on bibliographies of the selected articles and identified narrative reviews to find out whether the search process has missed any relevant article.

RESULTS
Types and Chemistry of HPPs
Among HPPs, such as PEEG, PEG polysulfone, polybutylene and others, there seems to be more possibilities to create a composite with the pure PEEK biomaterial. Composite materials consist of 2 or more phases and show their own physical, bioactive, and mechanical properties. They are bonded together by an interface, and the overall mechanical properties are a combination of both materials. PEEK can be reinforced by carbon (carbon fiber–reinforced PEEK = CFR-PEEK) and glass fibers that lead to improved wear resistance and excellent mechanical properties in increased strength and stiffness.28,31-34 Also, barium sulfate, a radiopacifier, may be added to PEEK to improve visualization and contrast in imaging. This procedure is often applied in trauma surgery.35

There are many monomers that are arranged in repeating units. If 2 or more monomers are used in a material, it is called copolymer. Furthermore, a polymer may not only be linear but also branched. However, PEEK comprised a chain of 100 linear monomer units with an average molecular weight of 80,000 to 120,000 g/mol. The length and the composition of the molecular chain have a strong influence on the properties on temperature resistance and deformation. There are several possibilities to control physical properties of the material. PEEK are sometimes referred to as polyletherketone (PEK) belongs to the family of polyaryletherketone (PAEK) and is a high-performance thermoplastic polymer. PEEK is a linear homopolymer, meaning that it consists of only a single monomer (Fig. 1). There are other HPPs on the market, such as polyletherketone ketone (PEKK), but PEEK is the most commonly used polymer for implants in medical application.

PEEK is synthesized by alkylation of bisphenol salt. The reaction of 4,4'-difluorobenzophenon with hydrochinon salt is extremely frequent. The presence of the aromatic rings (benzene) gives the molecule certain stiffness. Nevertheless, the ether (–O–) bond shows another property, namely, the molecule is able to rotate in an axillary direction on this position. When the molecule is slowly cooled down from the molten state, there exist 2 different microstructure phases. On one side, the folded chain gets into ordered domains (crystalline phase), and on the other side, the amorphous phase surrounds the crystals. Thermal processing can control the amount of the crystalline content. The typical quantity in implants is between 30% and 35%. Even so, it is possible to generate a near-amorphous structure by adjusting the cooling rate.

The chemical structure of PEEK presents some outstanding properties, such as resistance to chemical and radiation damage, high stability at temperatures above 300°C, and a greater strength than many metals. The possibility to reinforce PEEK with other materials, such as glass or carbon fibers, gives this polymer a special quality. However, PEEK is used in medical and dental applications not only because of its stability, biocompatibility, and mechanical properties, but also for its radiolucency. Pure PEEK has a tan color and is available as pellets or powder. If PEEK is reinforced with carbon fibers to improve strength, the color changes into black.27-29

Production Process of PEEK
The production of this high-performance thermoplastic polymer in medical or dental implants is a difficult process. PEEK is exceptional in its being a chemical inert material, which is very important for implants. Moreover, it is insoluble in all solvents at room temperature. The production process of the major polymer PEAK from the family of HPP is related with high costs in comparison with other thermoplastics. There are 2 different ways to manufacture PEAK. One is the electrophilic reaction where aromatic ether species are linked with ketone groups. The other route is to link the aromatic ketone with an ether bond, which is called as nucleophilic displacement reaction.29

Electrophilic Reaction
PEAK cannot be synthesized in usual solvents because of its natural resistance toward solubility and tendency to crystallize at a high level. The electrophilic reaction consists of protonating a carbonyl by using anhydrous hydrogen fluoride/boron trifluoride (HF/BF3). This process leads to a high-molecular weight PEK. There are many other electrophilic reactions to produce PEAK. Later, PEAK was synthesized in a similar way.
with alkylthio-chloroformates (Raychem Ltd., Mumbai, India), and polycondensation of 4-(4’-phenoxyphenoxybenzoic acid) was achieved in trifluoromethanesulfonic acid. Benzoic acids are substances with reactive end groups of the electrophilic reaction. This means that such agents cannot be manufactured without end-capping in consequence of their thermal instability. The circumstance of high temperature processing would lead to cross-linking of polymers and producing gels.27

Nucleophilic Displacement Reaction

It is very important to use the appropriate solvent to synthesize PEEK due to its reduced solubility. Thermal stability and a resistance toward phenoxide species, such as benzophenone or diphenylsulfone, is a relevant feature. However, biphenates are instable to oxidation. For that reason, biphenates are produced in situ by using hydroquinone and sodium or potassium carbonate. A high temperature (>300°C) is necessary to obtain a high molecular mass. This can be measured by getting an excess of difluorobenzophenone, which is formed to fluorine-terminated chain. The described method is often used in the industry and presents the ability to produce many different variants of the PEAK family, such as PEK, PEEK, PEKK, PEKEKK, and so on. The often-used polymer of the PEAK family, PEEK merges into glass at a temperature of about 143°C and presents a crystalline melt transition temperature of about 343°C.27–29

Young Modulus and Yield Stress of PEEK

PEEK presents different mechanical properties than metal devices, such as Ti, its alloys, and Co-Cr, because of its structure and process of production. Unfilled PEEK has a Young modulus between 3 and 4 GPa.28,32,36 The Young modulus of PEEK can be increased from 19 to 150 GPa with additives, such as carbon fiber.24 Table 2 shows the Young modulus of different forms of titanium, PEEK, Cr-Co, and bone.

Osseointegration of PEEK

Osseointegration or biocompatibility is the interaction between the biomaterial and the ambient tissue. Each tissue of the body is different. Blood makes another interaction with PEEK in comparison with bone. Pure PEEK polymers appear in a bulk form as an inert material. There is no observed adverse effect, such as releasing ions. Bioactivity means a positive interaction with tissues and leads to a differentiation of cells. PEEK is not known as a bioactive material. Nevertheless, there results a direct contact between PEEK and the human bone. Toth et al.36 showed in their study the histologic fusion between PEEK cages packed with autograft or rhBMP-2 and bone of sheep after 6 months. There was no evidence of degradation or wear debris.36 However, there was no chemical bond between PEEK devices and bone, implying that there were only micromechanical interlocks.36 If there evolves no histological fusion between PEEK and bone, pseudoarthrosis occurs. These phenomena caused of relative motion between the device and the bone refer to debris around the implant in tissue. The result is an inflammatory response with macrophages and other immune cells, such as lymphocytes and plasma cells, which may be followed by a chronic inflammation.29

PEEK was also tried to be coated with HA in an attempt to increase the cell attachment to the implant surface. Such a coating presented promising results compared with uncoated PEEK.28,41

<table>
<thead>
<tr>
<th>Table 2. Young Modulus of Different Implant Materials</th>
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<tbody>
<tr>
<td>Material</td>
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<tr>
<td>Pure titanium</td>
</tr>
<tr>
<td>Ti6AI4V</td>
</tr>
<tr>
<td>Ti6AI4V with 23–32 vol% porosity</td>
</tr>
<tr>
<td>Chrome-cobalt</td>
</tr>
<tr>
<td>Unfilled PEEK</td>
</tr>
<tr>
<td>CFR-PEEK</td>
</tr>
</tbody>
</table>

PEEK Allergy

Katzer et al42 investigated mutagenicity and cytotoxicity of PEEK in an animal study. There was no evidence of mutagenicity and cytotoxicity on the human organism from PEEK braid, its ethanol, or chloroform extracts under the appropriate conditions in their report. Similarly, carbon fiber–reinforced PEEK did not show any adverse reactions. In another study, Wenz et al43 investigated the biocompatibility of PEEK focusing on cytotoxicity. There was also no evidence of cytotoxicity, mutagenicity, carcinogenicity, and immunogenicity of PEEK and its composites in a bulk form.29 Another research group evaluated the influence of PEEK-Optima, ultrahigh-molecular weight polyethylene (UHMWPE) and cross-linked UHMWPE (X-UHMWPE) with 3 different particle sizes (0.7, 2, and 10 μm) at the dose of 20 particles per cell on monocytes and macrophages after 24 and 48 hours. Different assays and cytokine analysis (interleukin [IL]-1b, IL-6, IL-8, monocyte chemotactic protein 1 (MCP-1), and tumor necrosis factor [TNF]-α) did not present a significant difference on viability or proliferation between the 3 different materials. PEEK-Optima showed less cytotoxicity response compared with UHMWPE and X-UHMWPE, after 24 and 48 hours. The highest reaction was observed at particle size of 0.7 μm. Particles of X-UHMWPE presented significantly more IL-1b, IL-6, MCP-1, and TNF-α at 24 hours.44 This literature review revealed 7 animal studies and 1 clinical study using HPPs.

Animal Studies With PEEK

Osseointegration and infection. Cook and Rust-Dawicki37 investigated the interface attachment strength between PEEK and the unicortical bone in 4 mongrel dogs (Table 3). They placed overall 40 titanium-coated and uncoated cylindrical implants of PEEK in unicortical site of the femurs.37 The implants were examined mechanically and histologically after killing the animals. Bone contact, porosity, bone in-growth, inflammatory response, and mode of failure after 4 and 8 weeks were the parameters of interest. The uncoated implants showed significantly higher interfacial shear strength after 4 weeks. There was no difference between the uncoated and coated implants after 8 weeks. However, the titanium-coated materials presented
<table>
<thead>
<tr>
<th>Author Group</th>
<th>Objective</th>
<th>Animal</th>
<th>Implant Material</th>
<th>Manufacturer</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cook et al&lt;sup&gt;37&lt;/sup&gt;</td>
<td>To measure attachment strength and bone contact</td>
<td>Mongrel dogs</td>
<td>Titanium-coated and titanium-uncoated PEEK</td>
<td>—</td>
<td>Significantly higher interface attachment of uncoated implants after 4 wk; no difference after 8 wk</td>
<td>After 8 wk, there was no difference in bone contact</td>
</tr>
<tr>
<td>Rohner et al&lt;sup&gt;38&lt;/sup&gt;</td>
<td>To compare the healing, mechanical and initial vascular disturbance with SP and LCP</td>
<td>Sheep</td>
<td>SP: CF reinforced PEEK (62% CF and 38% PEEK) LCP: 7-hole titanium plate (4.5)</td>
<td>SP: Icotec AG, Altstätten, Switzerland LCP: Synthes, GmbH &amp; Co KG, Umkirch, Germany</td>
<td>The strength for the SP group was −13.93% and for the LCP group −7.49%; the stiffness showed similar values in both groups (SP group: −24.44%, LCP group: −27.08%); there was initial vascular disturbance after plate insertion but no significant disturbance in periostal circulation</td>
<td>CF-PEEK seems to be a considerable replacement material for metallic implants for bone fractures</td>
</tr>
<tr>
<td>Toth et al&lt;sup&gt;36&lt;/sup&gt;</td>
<td>The radiolucent PEEK-threaded interbody cages that were filled with autograft (n = 7) or rhBMP-2 (n = 6) on an absorbable collagen sponge were evaluated</td>
<td>Sheep</td>
<td>PEEK, InFuse bone graft substitute: rhBMP-2</td>
<td>PEEK: PEEK-Optima, Invibio, Greenville, SC InFuse bone graft substitute: Medtronic Sofamor Danek, Memphis, TN rhBMP-2: Wyeth Research, Cambridge, MA</td>
<td>There was no device degradation or wear debris at the PEEK cages; mild chronic inflammation with few macrophages around the peri-implant tissue was demonstrated</td>
<td>Biomaterial PEEK was suggested to be a valuable material for interbody fusion cages in traumatic and orthopedic surgery</td>
</tr>
<tr>
<td>Nakahara et al&lt;sup&gt;46&lt;/sup&gt;</td>
<td>To compare CF-reinforced PEEK (CFR/PEEK) cups and stems with HA coatings for cementless hip prostheses and without HA for cement fixation in 16 sheep (radiographically and histologically); each animal obtained a unilateral total hip replacement</td>
<td>Sheeps</td>
<td>CFR/PEEK composites (50% and 65% volumetric fraction), PEEK compound (30% weight fraction), and Ti6Al4V</td>
<td>—</td>
<td>All cases with titanium stem and 2 cases with CFR-PEEK presented bone ongrowth fixation of the remaining animals; osteopenia was observed in 3 of 5 cases of the titanium stem but not in the CFR-PEEK cases; the results were evaluated radiographically and histologically</td>
<td>The radiolucency of CFR/PEEK gives the possibility to assay the osseointegration by using CT; bone resorption was reduced due to lower stiffness of this material</td>
</tr>
</tbody>
</table>

(continued on next page)
Table 3. (Continued)

<table>
<thead>
<tr>
<th>Author Group</th>
<th>Objective</th>
<th>Animal</th>
<th>Implant Material</th>
<th>Manufacturer</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webster et al&lt;sup&gt;39&lt;/sup&gt;</td>
<td>To investigate the occurrence of bacterial infection in silicon nitride (Si₃N₄) compared with PEEK and titanium implants</td>
<td>Wistar rats</td>
<td>Si₃N₄, ASMT grade 4 titanium and PEEK Optima</td>
<td>ASMT grade 4 titanium: Fisher Scientific, Continental Steel &amp; Tube Co., Fort Lauderdale, FL \ PEEK Optima: Invibio Thornton Cleveleys, Lancashire, United Kingdom</td>
<td>About 64% of Si₃N₄; 24% of PEEK, and 36% of titanium showed new bone formation with absence of bacteria injection 3 mo after surgery \ Bone formation with presence of bacteria was Si₃N₄: 41%, titanium: 26%, and PEEK: 21% \ Si₃N₄ presented significantly better new bone formation and resistance to bacterial infection in contrast to titanium and PEEK</td>
</tr>
<tr>
<td>Wu et al&lt;sup&gt;40&lt;/sup&gt;</td>
<td>To evaluate the bioactivity of nano-TiO₂ (n-TiO₂) and PEEK that were fabricated with amounts of n-TiO₂ and PEEK powder</td>
<td>Beagle dogs</td>
<td>PEEK powder, n-TiO₂/PEEK nanocomposites</td>
<td>PEEK powder: Victrex, Lancashire, United Kingdom \ n-TiO₂/PEEK nanocomposites: Key Laboratory for Ultrafine Material of Ministry of Education, School of Materials Science and Engineering, East China University of Science and Technology, Shanghai</td>
<td>There was more cell attachment at the rough n-TiO₂/PEEK, whereas the smooth PEEK presented the lowest optical density value; 2 implants of PEEK and n-TiO₂/PEEK were placed on each tibia of the animals; PEEK showed almost half of the percent bone volume value compared with n-TiO₂/PEEK \ n-TiO₂ improves the bioactivity of PEEK, thus it is essential; this material may be a considerable alternative to titanium</td>
</tr>
<tr>
<td>Nakahara et al&lt;sup&gt;34&lt;/sup&gt;</td>
<td>To compare the bone ongrowth fixation of CFR/PEEK cups and stems with surface coating with HA (cementless) and cups and stems without coating (cemented fixation)</td>
<td>Sheep</td>
<td>CFR/PEEK composites (50% and 65% volumetric fraction), PEEK compound (30% weight fraction), Ti6Al4V and CoCr</td>
<td>—</td>
<td>Good performance of cementless and cemented CFR/PEEK stems fixation; cup fixation (cementless and cemented) was very difficult \ Good performance of cementless fixation can be obtained with the application of the HA-coating CFR/PEEK</td>
</tr>
</tbody>
</table>
Table 4. Summary of Findings of Clinical Studies Using HPP PEEK as an Implant Material

<table>
<thead>
<tr>
<th>Author Group</th>
<th>Objective</th>
<th>Implant Material</th>
<th>Manufacturer</th>
<th>Results</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chou et al.</td>
<td>To compare the fusion rates of different implant materials</td>
<td>Nonthreaded titanium cage containing a biphasic calcium phosphate ceramic triosite, and 60% β-tricalcium phosphate containing triosite</td>
<td>Zimmer, Berlin, Germany</td>
<td>There were 2 radiographically fusion rates after 6 and 12 mo; after 6 months, group A: 37.21%, group B: 93.3%, and group C: 84.85%; after 12 mo, group A: 37.21%, group B: 78.2%, and group C: 61.07%</td>
<td>Not in the CFR-PEEK cases. Besides the osteointegration, the incidence of bacterial infection is an important aspect in implantology. Webster et al.33 investigated this aspect in silicon nitride (Si₃N₄) and the results with PEEK and titanium implants. All 3 different materials were implanted in calvarial defects of 96 rats following injection of 1 × 10⁴ Staphylococcus epidermidis and saline at the control group. Four rats were killed and examined for the quantity of bone formation and presence of bacteria after 3, 7, and 14 days and 3 months. About 64% of Si₃N₄, 24% of PEEK, and 36% of titanium showed a new bone formation with absence of bacteria injection 3 months after surgery. Si₃N₄ demonstrated 41%, titanium 26%, and PEEK 21% bone formation in the presence of bacteria. Briefly, Si₃N₄ presented a significantly better new bone formation and resistance to bacterial infection in contrast to titanium and PEEK. Wu et al.40 evaluated the bioactivity of different amounts of nano-TiO₂ (n-TiO₂) and PEEK powder. The resulting powder mixture (n-TiO₂/PEEK) was placed in a specially manufactured mould disk (15 × 2 mm) for physical and chemical characterization and in vitro testing and cylindrical implants (4 × 7 mm) for in vivo testing. PEEK acted as a control. Scanning, transmission electron microscopy, and x-ray photoelectron spectroscopy were used to analyze the surface and dispersion in the composites. There was more cell attachment at the rough n-TiO₂/PEEK, whereas the smooth PEEK presented significantly lower optical density. The authors used 3 beagle dogs for the in vivo examination. Two implants of PEEK and n-TiO₂/PEEK were placed on each tibia of the animals. The dogs were killed after 4 weeks. PEEK showed almost half of the percent bone volume value compared with n-TiO₂/PEEK (P &lt; 0.05).40</td>
</tr>
<tr>
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<td>Wu et al.</td>
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<td></td>
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</tbody>
</table>
were killed after 8 weeks, and they measured in pairs the torsion to determine strength and stiffness in the osteomized and contralateral tibiae. There was no significant difference between the osteomized and nonosteomized tibia. The authors calculated the median value for relative reduction of strength (100 × [operated – contralateral]/contralateral). The strength for the SP group was −13.93% and −7.49% for the LCP group. The stiffness showed similar values in both groups (SP group: −24.44% and LCP group: −27.08%). Rohner et al\textsuperscript{38} used the 6 remaining sheep for a second experiment. They evaluated the initial vascular disturbance after plate insertion. In this experiment, there was also no significant disturbance in periosteal circulation.

Clinical Studies

Osseointegration. Chou et al\textsuperscript{45} investigated 55 patients who received a segmental anterior discetomy with a follow-up period of up to 12 months. They formed 3 groups: group A (n = 27) received implants of a titanium cage packed with biphasic calcium phosphate ceramic, group B (n = 9) was operated with PEEK cages containing trisioite, and group C received autogenous tricortical iliac crest bone graft. There were 2 radiographically fusion rates after 6 and 12 months (after 6 months—group A: 37.21%, group B: 93.3%, and group C: 84.85%; after 12 months—group A: 46.51%, groups B and C 100% fusion rates) (Table 4). There was no randomized control clinical trial found at the time of this review.

DISCUSSION

In this review, only 7 animal studies and 1 clinical study could provide information on the question whether PEEK material could be an alternative to Ti implants. Although Ti shows many advantages and is a well-tolerated metal, investigations continue to eliminate metals from dentistry and replace them with more inert nonmetallic materials.

From the biomechanical point of view, Rohner et al\textsuperscript{38} investigated the stiffness and strength of radiolucent CFR-PEEK plate and a titanium plate for osteosynthesis in a sheep model with the outcome that both materials presented similar mechanical properties. This study also indicated that CFR-PEEK is not only an excellent osteosynthesis material but it also does not produce artifacts in radiographical examinations. PEEK having Young modulus with 10–30 GPa closer to human bone may have better implications in less marginal bone resorption and osteolysis as opposed to titanium and zirconia.

Investigation in spinal surgery using PEEK\textsuperscript{38,47} and dental implants\textsuperscript{31,57} indicated high biocompatibility and no evidence of cytotoxicity, mutagenicity, carcinogenicity, and immunogenicity.\textsuperscript{28} The animal study by Toth et al\textsuperscript{36} described a good biocompatibility without device degradation and wear debris of the PEEK cages. Although the follow-up time of the experiment was relatively short, authors claimed that there was an indication of PEEK being a substitute for titanium-based implants, considering the radiographic, biomechanical, and histological results.

Currently, bone nails that are used as osteosynthesis material for bone fractures are made of PEEK. However, this review did not find its application in dental implantology to qualify the material as an oral implant. Any releasing of ions or debris of PEEK is not known. Nanometer-sized particles generated as a consequence of wearing of the metal implant surface are potential factors for osteolysis and may influence of the implant longevity.\textsuperscript{28} These aspects need further investigation with HPPs.

According to the results of animal studies, excellent osseointegration of coated carbon fiber reinforced PEEK\textsuperscript{34,37} were comparable with titanium.\textsuperscript{60} This indicates that potential coatings may be needed for CFR/PEEK to make it a realistic alternative to titanium for medical and dental implants. Nakahara et al\textsuperscript{46} could show in their study that no osteopenia has occurred in CFR-PEEK stems compared with the titanium stems. This may be a further advantage of this HPP. In bacterial infection, PEEK has a less biofilm resistance effect compared with silicon nitride (Si₃N₄) and titanium.\textsuperscript{59} This suggests that PEEK implant with a bacterial infection would need an antibiotic therapy over a long time, which may have a negative consequence of the general health concerning of the antibiotic resistance difficulty.

It could be easily conceivable that not only implants consist of HPP but also the abutments. In a recent study, the influence of titanium and polymer abutments had favorable effect on the soft and hard tissues. They observed an effect of bone and soft tissue level.\textsuperscript{58} However, there would not be any mechanical and chemical interactions between 2 different materials if implant and its abutment consisted of the same chemical structure.

HPP could play a role not only for medical and dental implants but also in the reconstructive surgery. Von Wilmowsky et al\textsuperscript{49} examined the influence of laser sintered PEEK with incorporated nano-sized carbon black, β-tricalcium phosphate and bioactive glass 45S5 on human osteoblasts (hFOB 1.19). The highest proliferation rate of osteoblasts was observed the bioactive glass containing sintered PEEK at day 7 (OD 1.76 ± 0.22) and at day 14 (OD 3.75 ± 0.31) compared with pure PEEK as the control group. These results presented that laser sintered PEEK would be a reasonable alternative to bone substitute for reconstructive surgery.\textsuperscript{49} Another research group coated the surface of PEEK with titanium by using an electron beam with the objective of evaluating biocompatibility and adhesion to bone tissue. The study showed a considerable higher bone contact of titanium-coated PEEK compared with pure PEEK.\textsuperscript{50} Furthermore, there is need for more investigations concerning contact stress and wear of HPP materials. That would lead to a better understanding of the mechanical characterization.\textsuperscript{51} Although PEEK seemed to have excellent properties and be considered as an alternative material to titanium, cobalt-chrome and other materials, more research is required.

CONCLUSIONS

Metallic implant materials, and in particular, titanium and its alloys, continue to be the materials of choice for
medical and dental implantology because of their biocompatibility, resistance to corrosion, and mechanical properties. Despite their advantages, these materials implicate some issues such as osteolysis followed by implant failure, scattered radiation, occasional hypersensitivity, allergy, and possibly surface degradation related to peri-implantitis. A nonmetallic material such as HPP PEEK seems to have favorable properties. Yet, the numbers of experimental, animal, and clinical studies were limited to make conclusions for their medical and dental utilization.

**Disclosure**

The authors claim to have no financial interest, either directly or indirectly, in the products or information listed in the article.

**Acknowledgments**

Author contributions: M. Özcan designed the study. M. G. Wiesli and M. Özcan performed experiments and wrote the paper.

**References**


Shear Bond Strength of different resin-based materials Processed on Poly-ether-ether ketone frameworks (IN VITRO STUDY)

Mohamed A. Eltombakshy BSc1, Mohamed S. Elattar PhD2, Dawlat M. Ahmed PhD3

ABSTRACT

INTRODUCTION: Removable partial dentures (RPDs) are fabricated to replace the lost teeth of a partially edentulous individual. The serviceability of an RPD is dependent on the bond strength at the resin–framework interface. The esthetically unacceptable display of metal clasps, the increased weight of the prosthesis, the potential for metallic taste, and allergic reactions to metals led to the introduction of a number of thermoplastic materials in clinical practice such as nylon and acetal resins. An alternative restoration material (poly-ether-ether-ketone [PEEK]) has been successfully used over the last years.

OBJECTIVES: to evaluate the shear bond strength and the effect of aging on bond strength of two different resin based materials to poly-ether-ether-ketone [PEEK].

MATERIALS AND METHODS: Fifty two PEEK cylinders was prepared. Specimens was randomly assigned into two parallel groups, 26 specimens each according to the resin materials used. The bond strength and aging of resin material to poly-ether-ether-ketone [PEEK] was evaluated.

RESULTS: the initial shear bond strength of PMMA to PEEK was significantly higher than that of composite resin to PEEK. However, after aging process the shear bond strength of PMMA to PEEK decreased while that of composite resin to PEEK remained unchanged. There was no significant difference between the shear bond strength of both PMMA and composite resin to PEEK after aging.

CONCLUSIONS: PMMA can be used as a veneering material with PEEK with comparable results to traditionally used composite resin. Moreover, owing to the adequate bond strength between PEEK and PMMA, PEEK frameworks could be relined in the traditional method similar to metal frameworks.

KEYWORDS: PEEK, PMMA, Composite resin, Shear bond strength, Thermocycling, in vitro.

INTRODUCTION

Poly-ether-ether-ketone (PEEK) is a polymer from the group poly-aryl-ether-ketone (PAEK). It is a relatively new family of high-temperature thermoplastic polymers, consisting of an aromatic backbone molecular chain, interconnected by ketone and ether functional groups (1).

Historically, the availability of PEEK arrived at a time when there was growing interest in the development of “isoelastic” hip stems and fracture fixation plates with stiffness comparable with bone (2).

By the late 1990s, PEEK had emerged as the leading high-performance thermoplastic candidate for replacing metal implant components, especially in orthopedics (3) and trauma (4). Not only was the material resistant to simulated in vivo degradation, including damage caused by lipid exposure, but starting in April 1998, PEEK was offered commercially as a biomaterial for implants (Invibio Ltd., Thornton Cleveleys, United Kingdom) (5). Facilitated by a stable supply, research on PEEK biomaterials flourished and is expected to continue to advance in the future (6).

The monomer unit of ether-ether-ketone monomer (Figure 1) polymerizes via step-growth dialkylation reaction of bis-phenolates to form PEEK. A common synthesis route for PEEK is the reaction between 4,4-difluorobenzophenone and the disodium salt of hydroquinone in a polar solvent at 300 °C. It is a semi-crystalline material having a melting point around 335 °C. PEEK can modified either by the addition of functionalized monomers (pre-polymerization) or post-polymerization modifications by chemical processes such as sulfonation, amination and nitration (7).

Figure 1: Chemical Structure of PEEK

Due to its elastic modulus, similar to that of cortical bone, it plays an important role as a viable alternative to conventional implant materials such as titanium in the field of orthopedics (8) and traumatology (9). Also in the field of dentistry, where traditionally a wide range of alloplastic materials is used, the application of PEEK increases replacing those conventional dental materials (10). This can be associated with distinct problems. Besides hypersensitivities against distinct components of dental composites on the one hand, even titanium, which is known as a proven biocompatible metal, has recently been suspected to provoke inflammatory reactions on the other hand (11). Additionally, more and more patients desire metal free reconstructions (12), to avoid the risk of oral galvanism for instance (13). Due to its mechanical properties, which can be influenced by adding different compound materials (1), PEEK might represent a viable biomaterial, not only able to replace conventional polymers, but also even metals, alloys and ceramics in the field of dentistry.

ABSTRACT:

INTRODUCTION: Removable partial dentures (RPDs) are fabricated to replace the lost teeth of a partially edentulous individual. The serviceability of an RPD is dependent on the bond strength at the resin–framework interface. The esthetically unacceptable display of metal clasps, the increased weight of the prosthesis, the potential for metallic taste, and allergic reactions to metals led to the introduction of a number of thermoplastic materials in clinical practice such as nylon and acetal resins. An alternative restoration material (poly-ether-ether-ketone [PEEK]) has been successfully used over the last years.

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KEYWORDS: PEEK, PMMA, Composite resin, Shear bond strength, Thermocycling, in vitro.

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The use of RPDs in clinical practice remains a viable and predictable treatment modality. Data on future needs for RPDs indicate that the need for RPDs is actually predicted to increase as the geriatric population increases which includes a high percentage of partially edentulous patients (14). The use of alternatives to RPD such as implants may not always be practical for a number of reasons and the benefits of RPDs are well documented (15).

Traditional RPD with Co-Cr frameworks and clasps have been an inexpensive and predictable treatment option for the rehabilitation of partially edentulous patients (16). The esthetically unacceptable display of metal clasps, increased weight of the prosthesis, potential for metallic taste, and allergic reactions to metals led to the introduction of a number of thermoplastic materials in clinical practice such as nylon and acetal resins. Nylons provide improved esthetics and reduction of rotational forces on the abutment teeth due to their low elastic modulus. The major disadvantage of a nylon RPD is the inability for a reline procedure and the lack of occlusal rests as well as rigid frameworks that could lead to occlusal instability and sinking, especially in Kennedy class I and II cases. On the other hand, acetal resins present adequate mechanical strength to form a framework more rigid than nylon with retentive clasps, connectors, and supportive elements; however, the acetal resin material lacks natural translucency and vitality (17).

Alternatively, RPDs can be constructed by using PEEK. Its elasticity can reduce stresses transferred to the abutment teeth. Furthermore, the white color of PEEK frameworks provides a different aesthetic approach than the conventional metal framework display does. Additional advantages of this polymer material are elimination of allergic reactions and metallic taste, high polishing qualities, low plaque affinity, and good wear resistance (18).

RPDs can be constructed more efficiently by using PEEK computer-aided design and computer-aided manufacture systems (1). The use of CAD-CAM as a manufacturing process could lead to further process simplification, providing a cost and time-saving approach and eliminating tool wear (19).

PEEK features a white colored appearance as compared to metal reconstructions. However, from the aesthetic point of view, it still requires veneering owing to its low translucency and grayish pigmentation. Consequently, durable bonding must be achieved to ensure an adequate functional outcome and long-term stability. The latter can be established by chemical adhesion, (micro) mechanical retention, or a combination of both and depends on the composition and interaction of the materials used (20).

In this context, one disadvantage of using PEEK in prosthetic dentistry is a difficulty to achieve adequate bond strength to resin materials owing to its low surface energy and resistance to surface modification by different chemical treatments (21).

In view of the limited data available on bonding to PEEK materials and the lack of data on bonding between PEEK and acrylic resin, the purpose of this study is to evaluate the bond strength and the effect of aging on bond strength of two different resin based materials (composite resin and acrylic resin) to PEEK.

### MATERIALS AND METHODS

**Materials**

**Materials which were used in this study are:**

1. **Framework material:**
   - BioHPP; modified PEEK (BioHPP; Bredent GmbH, Senden, Germany)
2. **PMMA and composite primer for bonding** (Visio.link; Bredent GmbH, Senden, Germany)
3. **Resin materials:**
   - a. Heat cure acrylic material (Acrostone; Acrostone Dental Manufacturer, Egypt Acrostone; Acrostone Dental Manufacturer, Egypt)
   - b. Composite resin (Visio.lign; Bredent GmbH, Senden, Germany)

**Equipments**

- Universal testing machine (AG1, Shimadzu Corporation, Kyoto, Kyoto Prefecture, Japan) to test shear bond strength
- Thermocycling machine (Custom made; Dental Biomaterials Department, Faculty of Dentistry, Alexandria University, Egypt) for aging process

**Methods**

**Preparation of the framework specimens**

**Modified PEEK specimens**

Fifty two patterns were fabricated as cylinders (10 mm diameter and 10 mm height) by using hard inlay wax (Pyrax Inlay wax, Pyrax Polymars, Uttarakhand, India). The inlay wax was melted in a hot water bath and poured into a custom-made mould with the required dimensions. Then the wax patterns were invested in a specially designed dental flask and sprues were made to allow the flow of the material into the required spaces. After complete burning out of the wax, the modified PEEK material containing 20% ceramic fillers (BioHPP; Bredent GmbH, Senden, Germany) was pressed into the flask by melting and vacuum pressing. The overall burnout schedule before pressing following the manufacturer’s instructions. Each cylinder was then cleaned ultrasonically in distilled water for 60 s, and then air dried.

**Standardization of bonding area**

In order to standardize the bond area for the specimens, a Double-sided tape with a 6-mm diameter hole was attached to one flat surface of each cylinder to create fifty two specimens with a defined bond area (19.6mm2). For this purpose, a Teflon O-ring (5.0-mm internal diameter, 1mm thick) was positioned on these flat surfaces in such a way that its hole was contiguous with the hole in the double-sided tape.

**Grouping**

The specimens were divided into two groups; 26 specimens each:

- **Group I** (Control group); modified PEEK specimens bonded to composite resin (Visio.lign)
- **Group II** (Study Group); modified PEEK specimens bonded to heat cured PMMA.

After the specimens preparation, each group was further divided into 2 subgroups (13 specimens each), one subgroup was tested after initial bonding and the other subgroup was tested after thermocycling process.

**Surface treatment**

The surface of all the specimens were then sandblasted by using 110 µ aluminum oxide (Al2O3) at 0.25 MPa for 30 seconds at a distance of 1 cm, and then cleaned with water in an ultrasonic bath for 10 minutes.

**Resin Bonding**

**PMMA**
PMMA (23 g/10 mL) (Acrostone; Acrostone Dental Manufacturer, Egypt) was packed and polymerized according to the manufacturer’s instructions. Before packing, the bonding agent; Visio.Link (Bredent GmbH, Senden, Germany), was applied on the surface of the specimens according to manufacturer’s instructions. Once polymerization was complete, the specimens were stored in distilled water at room temperature for 24 hours.

**Composite Resin**

Visio.lign (Bredent GmbH, Senden, Germany) was used according to the manufacturer’s instructions. Before composite resin application, bonding agent; Visio.Link (Bredent GmbH, Senden, Germany), was applied on the surface of the specimens according to the manufacturer’s instructions. Once polymerization was complete, the specimens were stored in distilled water at room temperature for 24 hours.

**Shear bond strength testing**

Shear Bond strength of randomly selected thirteen specimens of each group was determined by placing each specimen in a universal testing machine (AG1, Shimadzu Corporation, Kyoto, Kyoto Prefecture, Japan) at a crosshead speed of 1.0mm/ min until the specimen failed.

The Shear bond strength is then determined by the equation:

\[ \tau = \frac{P_c}{A} \]

Where Pc is the critical load to debonding and A is the bonded area.

**Aging and Shear bond strength testing**

Shear Bond strength of the other thirteen specimens of each group was determined after thermocycling in distilled water for 1000 cycles between 5°C and 55°C. The specimens were then placed in a universal testing machine as previously mentioned.

**Data management & statistical analysis**

The data was processed, and analyzed using Statistical Package for Social Sciences program SPSS (15.0) software (SPSS Inc., Chicago IL, USA). The study included descriptive and analytical data. A P-value of less than 0.05 was considered statistically significant.

**RESULTS**

**Shear bond strength testing results:**

Shear Bond strength of randomly selected thirteen specimens of each group (the control and study groups) was determined by placing each specimen in a universal testing machine. Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) The Kolmogorov-Smirnov test was used to verify the normality of distribution quantitative data was described using range (minimum and maximum), mean, standard deviation and median. Mann Whitney test was used for data analysis. Significance of the obtained results was judged at the 5% level. The shear bond strength values are presented in (Table 1) and (Figure 2).

**Table 1: Comparison of the shear bond strength between the Control group and Study group**

<table>
<thead>
<tr>
<th></th>
<th>Control group Bonded to visiolign (n=13)</th>
<th>Study group Bonded to PMMA (n=13)</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. – Max.</td>
<td>0.10 – 0.35</td>
<td>0.41 – 0.59</td>
<td>0.0’</td>
<td>&lt;0.001’</td>
</tr>
<tr>
<td>Mean ± SD.</td>
<td>0.26 ± 0.08</td>
<td>0.50 ± 0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>0.30</td>
<td>0.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Figure 2: Comparison of the shear bond strength between the control group and study group**

The mean value for shear bond strength was found to be higher for the study group (Group II) than control group (Group I). The statistical analysis revealed significant difference between the two groups where (p≤0.05).

**Shear bond strength testing results after aging:**

Shear Bond strength of the other thirteen specimens of each group (the control and study groups) was determined, after thermocycling in distilled water for 1000 cycles between 5°C and 55°C. The specimens were then placed in a universal testing machine. Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) The Kolmogorov-Smirnov test was used to verify the normality of distribution quantitative data was described using range (minimum and maximum), mean, standard deviation and median. Mann Whitney test was used for data analysis. Significance of the obtained results was judged at the 5% level. The shear bond strength values are presented in (Table 2) and (Figure 3).

**Table 2: Comparison between the shear bond strength of the control and study groups after aging**

<table>
<thead>
<tr>
<th></th>
<th>Control group Bonded to visiolign (n=13)</th>
<th>Study group Bonded to PMMA (n=13)</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.50 ± 0.07</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>0.30</td>
<td>0.47</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The mean value of shear bond strength was found to be the same for the control and study groups. The statistical analysis revealed no significant difference between the two groups where (p≤0.05).

Effect of Thermocycling:
A comparison between the results of each study group before and after thermocycling were performed. Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp) The Kolmogorov-Smirnov test was used to verify the normality of distribution quantitative data was described using range (minimum and maximum), mean, standard deviation and median. Mann Whitney test was used for data analysis. Significance of the obtained results was judged at the 5% level. The shear bond strength values are presented in (Table 3) and (Figure 4).

Table 3: Comparison of the effect of aging for the control and study groups

<table>
<thead>
<tr>
<th>Control group</th>
<th>Before Aging (n=13)</th>
<th>After Aging (n=13)</th>
<th>U</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Min. – Max.</td>
<td>Mean ± SD.</td>
<td>Median</td>
<td></td>
</tr>
<tr>
<td>Bonded to visio-link</td>
<td>0.10 – 0.35</td>
<td>0.26 ± 0.08</td>
<td>0.30</td>
<td>0.662</td>
</tr>
<tr>
<td>Study group</td>
<td>Before Aging (n=13)</td>
<td>After Aging (n=13)</td>
<td>U</td>
<td>p</td>
</tr>
<tr>
<td>Group II</td>
<td>Min. – Max.</td>
<td>Mean ± SD.</td>
<td>Median</td>
<td></td>
</tr>
<tr>
<td>Bonded to PMMA</td>
<td>0.41 – 0.59</td>
<td>0.50 ± 0.07</td>
<td>0.47</td>
<td>0.01</td>
</tr>
</tbody>
</table>

For group I, the mean shear bond strength was found to be higher after aging. The statistical analysis revealed no significant difference where (p≤0.05), while in group II, the mean shear bond strength was found to be higher before aging. The statistical analysis revealed significant difference where (p≤0.05).

DISCUSSION
A new restoration material (poly-ether-ether-ketone [PEEK]) has been successfully used over the last few years in the medical field, and specially in orthopedics (22).

Although PEEK in general has been successfully used for years in orthopedics and medical technology, it has only recently been used in dentistry. Thus, studies evaluating the properties of this material are limited. The existing reports on this material are generally in vitro, emphasizing the need for further studies.

The grayish and opaque color of PEEK limits the application as a sole restoration. Therefore, PEEK needs to combine with esthetic resin material. However, the bond strength of the material is low when combined with resin materials because of the inert chemical performance, low surface energy, and surface modification resistance of PEEK. Thus, improving the surface properties of PEEK has become a research hotspot (21).

The choice of the tested adhesives was based on recommendations of the PEEK manufacturer. The user’s manual suggests primarily the use of Visio-link to create a sufficient bond strength between the PEEK surface and different resins (23).

The normal low surface energy of polymers leads to adhesive problems, especially concerning the wetting and interaction between two polymers (24). The bonding improved simultaneously with the wetting, which meant that the surface energy increased (24). In this study, the increase in surface energy was achieved by air-abrasion performed before the bonding process.

Shear bond strength (SBS) test was employed because it can easily and rapidly reflect the clinical situation. SBS tests are more appropriate for evaluating adhesive capabilities of luting cements to composites. Any change in the surface treatment of the material may affect the shear strength, which is related to mechanical and chemical adhesion (25).

Studies showed that treatment using silica coating and using multifunctional acrylates containing primer resulted in durable bonding to PEEK surfaces (26). In the current study, no further pretreatment was performed after airborne-particle abrasion and adhesive treatments using Visio.link.

In another study the air-abraded (50 μm, 0.2 MPa) PEEK surfaces conditioned with adhesive systems Visio-link (40.0–69.0 MPa) or Signum PEEK Bond I +II (41.3–57.5 MPa) showed similar or higher TBS results compared to those obtained with other framework materials tested in previous studies (23).

Although the airborne-particle abrasion increases the surface area and allows a better infiltration of the adhesive material, the bonding is still predominantly characterized by mechanical interactions between the PEEK surface and the adhesive material. In contrast to this, the veneering material is additionally bonded by chemical means to the adhesive Visio.link layer and therefore creates a stronger bond (24).

It seems that MMA monomers are important contributors of increased bond strength between PEEK and veneering resins. This was also supported by the study of
Kern & Lehmann, which showed that a durable bonding to PEEK could only be achieved using the multifunctional methacrylate containing resin varnish (Luxatemp Glaze & Bond) on air-abraded surfaces to create substantial chemical bonding to PEEK (26). That study also concluded that the use of phosphate monomer containing primer on air abraded PEEK did not result in any adhesion.

It is generally accepted that, for MMA/PMMA denture base materials, grinding the surface of the denture tooth and wetting it with monomer is a pre-requisite to obtain a clinically reliable bond strength (27). The bonding mechanism is believed to be based on an interpenetrating network or a covalent bond (27).

The results of this study showed that the initial shear bond strength of PMMA to PEEK was higher than that of composite resin to PEEK. The difference in shear bond strength values was statistically significant.

A previous study tested the bond strength of resin composite cements after conditioning using Visio-link and diffusion process resulting in dissolving the PMMA surface and also increasing the TBS (29). This could explain the results in the current study.

Furthermore, Previous investigations have stated that because of the process of post-polymerization of the adhesive system and the veneering composite resin, higher bond strength values could be observed with thermal changes (23). This also could be an explanation to the increased initial SBS of PMMA to PEEK due to the elevation of temperature during PMMA heat curing process.

Storage and thermocycling are the most often used artificial aging methods for simulating oral conditions in laboratory testing of bonding durability (26). This minimal requirement of simulating oral conditions seems necessary before clinical recommendations can be provided, even with caution. Artificial aging by the procedure of thermocycling may act in two different ways on the SBS; on one side it may lead to an increase of the bond strength, caused by the post-polymerization in the contact area of the PEEK surface, the adhesive and the veneering cement, while on the other side, the thermal stress may lead to mechanical stress of the bonding area caused by different volumetric changes of the concerned materials (23).

In the current study, after the aging process, the shear bond strength of PMMA to PEEK decreased while that of composite resin to PEEK remained unchanged. There was no significant difference between the shear bond strength of both PMMA and composite resin to PEEK.

In a study evaluating the strengthening of PMMA with preimpregnated fibers, it has been reported that the strengthening effect of preimpregnated fibers is more evident in auto- rather than in heat-polymerized acrylic resins (30). These authors suggested that the lower properties found with heat-polymerized acrylics could be due to decreased adhesive strength at the impregnating resin-PMMA interface, potentially caused by insufficient monomer wetting or differences in the thermal expansions between the reinforcement and the acrylic resin. These suggestions may be applicable to the results of the current study where the SBS of PMMA to PEEK decreased after thermocycling process.

One of the negative properties of PMMA is water absorption (31). This can be explained by the fact that a higher amount of resin matrix in combination with a lower content of filler particles results in higher water absorption (32). This phenomenon explains the decrease in SBS of PMMA to PEEK after thermocycling.

Up to date, there are no studies evaluating the bond between PEEK and PMMA, hence the importance of this study to evaluate the possibility of PEEK denture base relining with PMMA.

CONCLUSION

Within the limitation of an in vitro study, the following could be concluded:
1. PMMA can be used as a veneering material with PEEK with comparable results to traditionally used composite resin.
2. Owing to the adequate bond strength between PEEK and PMMA, PEEK frameworks could be relined in the traditional method similar to metal frameworks.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

REFERENCES


CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A.  Contact Information (Action Requestor)  Date Submitted: 10/28/2019

| Name: | Matthew Hall, DDS |

B.  Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: Solvay Dental 360, a division of Solvay Specialty Polymers USA, LLC |
| No > ☐ |

Part 2 – Submission Details

1.  Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)  D

2.  Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature Required for all “New” | maxillary partial denture – polyaryletherketone (PAEK) framework with resin denture bases (including retentive/clasping materials, rests, and teeth) |
| Descriptor Optional for “New”; enter “None” if no descriptor | None |

3.  Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

- Over the past few years new polymer materials have been brought to the market for use with removable partial dentures.
- Most of these products can be classified as polyaryletherketone (PAEK) polymers, which are defined by the ACP as; a family of semi-crystalline thermoplastic polymers exhibiting high strength and shape stability over a wide range of temperatures; [ACP Glossary of Prosthodontics Terms]
- Examples of PAEK products on the market for partial denture use are; Ultaire™ AKP (Solvay Dental 360), Juvo™ PEEK (Juvo Dental), DD peek Med (Dental Direkt), Pekkton® (Cendres+Metaux), BioHPP®(Bredent)
- This group of denture materials is distinctly different (in function and production) then what CDT Procedure Codes are available for partial dentures and a new code to classify the use of these materials is needed.

Codes Currently Available for RPDs:
- Resin Partial Codes (D5211 & D5212)
  - The PAEK materials can not be classified as resin, since that is defined as; any resin-based composite, including fiber or ceramic reinforced polymer compounds, and glass

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ionomers; and PEAK materials are not a composite nor are they reinforced polymer compounds. Also, since PAEK materials are not used for the denture base (as the resin code states), but rather PAEK is used as the framework structure of the denture (similar to metal), these codes do not apply.

- **Flexible Partial Codes (D5225 & D5226)**
  - Not applicable because PAEK are not “flexible” materials, they are rigid structures that provide a framework for denture based resins to be applied to. Also, since PAEK materials are not used for the denture base (as the flexible code states), but rather PAEK is used as the framework structure of the denture (similar to metal), these codes do not apply.

- **Metal Partial Codes (D5213 & D5214)**
  - Not applicable due to the PAEK materials not having any metal component.

**Technical Details:**

- **Comparison of material properties with common RPD materials, including Metal (CoCr), PAEK (PEKK, PEEK, Utaire™ AKP), Resin (Acetal), and Flexibles (Valplast).**

<table>
<thead>
<tr>
<th>Material</th>
<th>Elastic Modulus (GPa)</th>
<th>Flex Modulus (GPa)</th>
<th>Tensile Strength (MPa)</th>
<th>Flex Strength (MPa)</th>
<th>Density</th>
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<td>CoCr</td>
<td>200</td>
<td>1,300</td>
<td>1,050</td>
<td>240</td>
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<td>PEEK</td>
<td>1.5</td>
<td>5</td>
<td>115</td>
<td>200</td>
<td>1.28</td>
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</tr>
<tr>
<td>PEEK</td>
<td>4.7</td>
<td>4.4</td>
<td>130</td>
<td>192</td>
<td>1.11</td>
<td>105.1</td>
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<tr>
<td>Utaire™ AKP</td>
<td>3.5</td>
<td>3.5</td>
<td>55</td>
<td>348</td>
<td>1.36</td>
<td>97.2</td>
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<tr>
<td>Acetal</td>
<td>2.3</td>
<td>2.4</td>
<td>59</td>
<td>100.5</td>
<td>1.41</td>
<td>63.8</td>
</tr>
<tr>
<td>Valplast™</td>
<td>1.8</td>
<td>1.2</td>
<td>60</td>
<td>98</td>
<td>1.64</td>
<td>-</td>
</tr>
</tbody>
</table>

- **Material fatigue data for an RPD clasp using one of the PAEK materials mentioned above (Utaire™ AKP (Solvay Dental 360)).**
  - Objective: To compare the retention force of individual clasps made from cobalt chromium (CoCr) or new aryl ketone polymer (AKP) material, Utaire™ AKP, following prolonged fatigue testing along ideal and non-ideal paths of removal and to assess 3D deformation of the active and passive clasp tips.
  - “Unlike CoCr, the Utaire™ AKP clasps did not work harden, nor had as large a reduction in retentive force and accompanying permanent deformation; the retentive force for the Utaire™ AKP clasps was consistent over 15,000 cycles of fatigue mimicking prolonged clinical use. The AKP material was more robust; showing minimal deformation even in non-ideal paths of removal, as many patients would routinely use.”

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**CDT Code Action Request**

4. Complete a) – c) **only** if Action Request is for a New CDT Code

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td>D5211, D5213, D5225, D5899</td>
<td>□</td>
</tr>
</tbody>
</table>

**b) Procedure technical description**

Cylindrical milling discs comprised of PAEK materials are machined into partial removable denture frameworks using a CAD/CAM system. The improved process to manufacture the prosthesis removes opportunities for error and improves the precision of fit, allowing the clinicians to remove up to 2 patient visits (compared to metal and resin RPD procedures) and get the final denture to the patient faster.

**PAEK RPD Workflow (2-4 visits for the patient):**

- **Doctor (Visit 0):**
  - Meets with patient to decide if partial denture is the right solution
    - This could be visit 1 if the patient decides to choose the RPD today

- **Doctor (Visit 1):**
  - Preps patients teeth (if needed), takes an impression, and sends to dental lab
    - Impression can be analog or digital, but should include both maxillary and mandibular jaws with a bite registration

- **Lab (Visit 1):**
  - Creates a master stone model from the analog impression and scans into CAD software
    - Digital impression transfer directly into CAD software from Doctor’s office
  - Design framework in CAD software
    - Can design teeth in this step to avoid additional patient visits
  - Send final CAD design file to a milling machine and mill frame with a PAEK milling blank
  - Remove frame from milling blank, remove sprues, and polish framework
  - Process teeth in a resin base (that were digital designed earlier) to the PAEK framework
  - Polishes and finishes denture
  - Sends to Doctor

- **Doctor (Visit 2):**
  - Tries the frame in the patients mouth
  - Makes adjustments to frame to modify retention, fit and bite (if needed)
  - Patient takes home

- Intermediate visits (bite block and wax try-in) can be used by the doctor if requested, but are not needed for this procedure

**c) Clinical scenario**

RPDs made from a PAEK framework are used to restore missing teeth, similar to other partial dentures. They are best suited for patients missing multiple teeth and who are looking for an alternative to implants, metal frameworks, or RPDs with resin/flexible bases. PAEK materials provide non-allergenic properties not currently offered by cast-metal and resin-based partials.

---

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Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided.
   - All material **must** be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>Yes &gt; ☒</th>
<th>b) Protected by copyright? (If “a)” is “Yes”)</th>
<th>Yes &gt; ☐</th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
<th>Yes &gt; ☐</th>
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<tbody>
<tr>
<td>No &gt; ☐</td>
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</tbody>
</table>

6. Additional Comment or Explanation:

Excerpts from peer-reviewed journals using High Performance Polymers, in particular PAEK, for medical and dental applications [full articles available in attached supporting documents].

“So far, the most commonly used HPP [High Performance Polymers] is polyetheretherketone (PEEK) that was first characterized in the 1990s and belongs to the polymer family of polyaryletherketone (PAEK). Soon after its synthesis, it started to be used increasingly in orthopedic, traumatic surgery and in particular as spine implants.” – Wiesli et al. Implant Dentistry (2015) vol. 24(448-457)

“... the reason for the recent enthusiasm surrounding PAEKs has been their potential for use as a metal alternative in broader indications such as removable dentures. ... In the case of customised prostheses, the upstream material or shape becomes the ‘device’ and is regulated and cleared for use for a defined set of indications. Here, the PAEKs have appeared as materials for use in injection press systems or as discs for computer aided design/ manufacture (CAD/CAM). ... There are now many brands of PAEK dental devices becoming available for use in prosthetic frameworks.” – Private Dentistry (October 2015)

“Traditional RPD with Co-Cr frameworks and clasps have been an inexpensive and predictable treatment option for the rehabilitation of partially edentulous patients (16). The esthetically unacceptable display of metal clasps, increased weight of the prosthesis, potential for metallic taste, and allergic reactions to metals led to the introduction of a number of thermoplastic materials in clinical practice such as nylon and acetal resins. Nylons provide improved esthetics and reduction of rotational forces on the abutment teeth due to their low elastic modulus. The major disadvantage of a nylon RPD is the inability for a reline procedure and the lack of occlusal rests as well as rigid frameworks that could lead to occlusal instability and sinking, especially in Kennedy class I and II cases. ... Alternatively, RPDs can be constructed by using PEEK. Its elasticity can reduce stresses transferred to the abutment teeth. Furthermore, the white color of PEEK frameworks provides a different esthetic approach than the conventional metal framework display does. Additional advantages of this polymer material are elimination of allergic reactions and metallic taste, high polishing qualities, low plaque affinity, and good wear resistance (18). RPDs can be constructed more efficiently by using PEEK computer-aided design and computer-aided manufacture systems (1). The use of CAD-CAM as a manufacturing process could lead to further process simplification, providing a cost and time-saving approach and eliminating tool wear (19).” – Eltombashki et al. Alexandria Dental Journal (2019) vol. 44(93-98).

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 11/1/2019

Name: Betsy Davis DMD MS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

<table>
<thead>
<tr>
<th>Yes</th>
<th>☒</th>
<th>If Yes, Name: American College of Prosthodontists</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>☐</td>
<td>Name: 211 E. Chicago Avenue, Suite 1000</td>
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<tr>
<td></td>
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Part 2 – Submission Details

1. Action (Mark one only)  New ☐  Revise ☒  Delete ☐  Affected Code (Revise or Delete only) D5225

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

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<th>Nomenclature Required for all “New”</th>
<th>maxillary partial denture - flexible base (including any clasps, retentive/clasping materials, rests, and teeth)</th>
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</thead>
<tbody>
<tr>
<td>Descriptor Optional for “New”; enter “None” if no descriptor</td>
<td></td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
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<tr>
<th>Mark if Revise or Delete [“a) - c)” are not applicable]</th>
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<tr>
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<td>b) Procedure technical description</td>
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c) Clinical scenario

## Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.
CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 11/1/2019

Name: Betsy Davis DMD MS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > | ☒ | If Yes, Name: American College of Prosthodontists |
| No > | ☐ | 211 E. Chicago Avenue, Suite 1000 |
|       |   | Chicago IL 60611 |

Part 2 – Submission Details

1. Action (Mark one only) New ☐ Revise ☒ Delete ☐ Affected Code (Revise or Delete only) D5226

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature Required for all “New” mandibular partial denture – flexible base (including any clasps, retentive/clasping materials, rests and teeth)

Descriptor Optional for “New”; enter “None” if no descriptor

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] ☒

a) CDT Code currently used to report the procedure D5226

b) Procedure technical description

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c) Clinical scenario

Part 3 – Additional Information

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**Part 1 – Submitter Information**

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<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
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<tbody>
<tr>
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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes > ☒ | If Yes, Name: American College of Prosthodontists 211 E. Chicago Avenue, Suite 1000 Chicago IL 60611 |
| No > ☐  |                                                      |

**Part 2 – Submission Details**

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<th>Affected Code (Revise or Delete only)</th>
<th>D5282</th>
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<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Nomenclature Required for all “New” removable unilateral partial denture – one piece cast metal (including clasps retentive/clasping materials, rests and teeth), maxillary</td>
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</tbody>
</table>

**Descriptor Optional for “New”; enter “None” if no descriptor**

<table>
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<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
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<td>This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.</td>
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<th>4. Complete a) – c) only if Action Request is for a New CDT Code</th>
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<tbody>
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   - All material **must** be submitted in electronic format.

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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.
**Part 1 – Submitter Information**

<table>
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<tr>
<th>A. Contact Information (Action Requestor)</th>
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<tbody>
<tr>
<td>Name: Betsy Davis DMD MS</td>
<td></td>
<td></td>
</tr>
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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☒ | American College of Prosthodontists  
211 E. Chicago Avenue, Suite 1000  
Chicago IL 60611 |
| No | ☐ | |

**Part 2 – Submission Details**

<table>
<thead>
<tr>
<th>1. Action (Mark one only)</th>
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<th>Delete</th>
<th>☐</th>
<th>Affected Code</th>
<th>D5283</th>
</tr>
</thead>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

- **Nomenclature**: removable unilateral partial denture – one piece cast metal (including clasps retentive/clasping materials, rests, and teeth), mandibular

- **Descriptor**: None

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

   This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.

4. Complete a) – c) only if Action Request is for a New CDT Code  
   Mark if Revise or Delete [*“a) - c)” are not applicable] ☒

   a) CDT Code currently used to report the procedure
   b) Procedure technical description

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 11/1/2019

Name: Betsy Davis DMD MS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☒  If Yes, Name: American College of Prosthodontists
211 E. Chicago Avenue, Suite 1000
Chicago IL 60611

No ☐

Part 2 – Submission Details

1. Action (Mark one only)  New  ☐  Revise  ☒  Delete  ☐  Affected Code (Revise or Delete only)  D5284

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature  Required for all “New”
removable unilateral partial denture – one piece flexible base (including clasps retentive/clasping materials, rests, and teeth) – per quadrant

Descriptor  Optional for “New”; enter “None” if no descriptor

3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.

4. Complete a) – c) only if Action Request is for a New CDT Code  ☒  Mark if Revise or Delete [“a) - c)” are not applicable]

a) CDT Code currently used to report the procedure  D5284

b) Procedure technical description

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c) Clinical scenario

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<th>Yes</th>
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</tr>
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<tbody>
<tr>
<td>No</td>
<td>☐</td>
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<tr>
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<td><strong>If Yes, Name:</strong></td>
<td>Chicago IL 60611</td>
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### Part 2 – Submission Details

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<th><strong>1. Action (Mark one only)</strong></th>
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<th><strong>Affected Code</strong> (Revise or Delete only)</th>
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| **2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)** |

**Nomenclature**
removable unilateral partial denture – one piece resin (including clasps retentive/clasping materials, rests, and teeth) – per quadrant

**Descriptor**

| **3. Rationale for this request; your persuasive argument for CMC acceptance** |

This request is for consistency with other removable codes in the descriptor for the retentive/clasping elements. This request will bring nomenclature and descriptor wording consistency with the other removable prosthesis procedure code entries in the category of service and this requested revision does not affect the scope and manner in which the procedure is delivered to the patient.

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---

**CDT Code Action Request**

**c) Clinical scenario**

---

**Part 3 – Additional Information**

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| Yes > ☒ | If Yes, Name: American College of Prosthodontists |
| No > ☐   | 211 E. Chicago Avenue, Suite 1000 |
|          | Chicago IL 60611 |

### Part 2 – Submission Details

1. **Action**
   - (Mark one only)
   - New ☐
   - Revise ☒
   - Delete ☐

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2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

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<th>Nomenclature Required for all “New”</th>
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<td>Includes any necessary clasps and rests.</td>
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3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)

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4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - Mark if Revise or Delete ("a) - c") are not applicable]
   - ☒

   a) CDT Code currently used to report the procedure
   - D5820

   b) Procedure technical description

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### Part 2 – Submission Details

1. **Action** (Mark one only)  
   - New  
   - ☐ Revise  
   - ☒ Delete  
   - ☐  
   - Affected Code (Revise or Delete only)  
     - D5821

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)
   - Nomenclature: interim partial denture (mandibular) (including retentive/clasping materials, rests, and teeth), mandibular
   - Descriptor: Includes any necessary clasps and rests.

3. **Rationale for this request; your persuasive argument for CMC acceptance**  
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4. **Complete a) – c) only if Action Request is for a New CDT Code**  
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     - ☒
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     - D5821
   - b) Procedure technical description

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<td>Name: Alan E Friedel, DDS</td>
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<td>Yes &gt; ☒ If Yes, Name: PerioProtect LLC</td>
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<tr>
<td>No &gt; ☐</td>
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### Part 2 – Submission Details

1. **Action** (Mark one only)  
   - New ☐  
   - Revise ☐  
   - Delete ☒  

2. **Affected Code**  
   - D5994

3. **Nomenclature**  
   - Required for all “New”  
   - Periodontal medicament carrier with peripheral seal—laboratory processed

4. **Descriptor**  
   - Optional for “New”; enter “None” if no descriptor
   - A custom fabricated, laboratory processed carrier that covers the teeth and alveolar mucosa. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

5. **Rationale for this request; your persuasive argument for CMC acceptance**  
   (Required for any type of requested action – New; Revise; Delete)

   Part of a suite of three actions, recommending deletion of the current, more generic code, in favor of two codes delineating maxillary and mandibular trays which should prevent confusion within the profession. Currently most patients who use these prosthetic devices receive two trays simultaneously; one each for the maxillary and mandibular arches. At present, some insurance carriers reject one submission citing a duplication (even when the arch is noted appropriately on the ADA form). Some practitioners are confused as to whether each tray should be noted when charting and on an insurance claim form.

   This action would also be consistent with recent CMC actions which have created separate codes when similar prosthetics and devices are used with maxillary and mandibular applications.

6. Complete a) – c) only if Action Request is for a New CDT Code
   - Mark if Revise or Delete [“a) - c)” are not applicable] ☒

   a) CDT Code currently used to report the procedure

---

**NOTICE TO PREPARER AND SUBMITTER:**

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### PART 1: DENTAL CODE REVIEW

**b) Procedure technical description**

- [ ]  

**c) Clinical scenario**

- [ ]  

### PART 2: ACTION REQUEST

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### PART 3 – ADDITIONAL INFORMATION

5. Supporting documentation or literature:
   - "5.a)" must be completed for all requested actions; "b)" and "c)" are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

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6. Additional Comment or Explanation:

None
To: Members of the ADA Code Maintenance Committee  
From: Alan E Friedel, DDS  
Subject: Clarification of Multiple Submissions by Perio Protect LLC  

I am writing to provide clarification of the multiple requests made regarding CDT Code D5994 by Perio Protect. Because there are simultaneous requests: one to delete the code, adding two new codes; and one to amend the code, I hope to provide a sense of what our intended goals are.

The first submissions sent in were those requests to delete the legacy code which does not specify arch, and to replace it with two new codes one for the upper arch, and one for the lower arch.

This would be in keeping with recent CMC actions delineating which arch any prosthetic device was fabricated to treat. There have been many instances where patients having trays made for both upper and lower arches simultaneously have had one tray rejected for coverage as a duplication of coded procedure. Having maxillary and mandibular tray codes would again be consistent with other recent changes, and solve the problem.

Our final submission asks for amending D5994 to add additional language. At first glance it might appear strange to ask to amend the very code we wish to be deleted, but there is a purpose. Out of respect for the process of the CMC, we cannot presume the Committee will agree with us and bifurcate D5994 into two new codes. The added language for the amend request serves a different purpose than the intent of the deletion/addition requests. If the deletion/addition request is accepted we would like the amendment request to be considered for both new maxillary and mandibular codes. If the deletion/addition request is rejected, we would like the amend request to be considered for the retained legacy code.

The FDA Cleared Medical Device language is requested because D5994 trays are made to deliver different medications of the clinician’s choice into the dental sulcus. Unlike other delivery devices used in dentistry today D5994 trays have multiple uses and do not arrive with medication prepackaged by a pharmaceutical company. The peripheral seal performs an important function. They apply back pressure into the sulcus overcoming crevicular fluid flow, therefore getting medication into the dental sulcus as intended. Other trays which may appear to be the same, but are without a true seal will not have the same levels of success as shown by research, and may not successfully treat disease. Third party payers cannot differentiate whether trays as delivered are designed with a peripheral seal versus those that only look like they have a seal. Using the term FDA Cleared Medical Device will help ensure the public gets appropriate care, and that insurers only pay claims on prostheses that meet the criteria of a true peripheral seal.
### Part 1 – Submitter Information

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<tr>
<th>A. Contact Information (Action Requestor)</th>
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**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes > ☒ | If Yes, Name: PerioProtect LLC |
| No > ☐   |                             |

### Part 2 – Submission Details

1. **Action (Mark one only)**
   - New ☒
   - Revise ☐
   - Delete ☐

2. **Full nomenclature and descriptor**
   - For “Revise” mark-up as follows:
     - added text – blue underline;
     - deleted text – red strike-through;
     - unchanged text – black

   **Nomenclature**
   - maxillary periodontal medicament carrier with peripheral seal – laboratory processed

   **Descriptor**
   - A custom fabricated, laboratory processed carrier for the maxillary arch that covers the teeth and alveolar mucosa. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)
   
   Part of a suite of three actions, recommending deletion of the current, more generic code, in favor of two codes delineating maxillary and mandibular trays which should prevent confusion within the profession. Currently most patients who use these prosthetic devices receive two trays simultaneously; one each for the maxillary and mandibular arches. At present, some insurance carriers reject one submission citing a duplication (even when the arch is noted appropriately on the ADA form). Some practitioners are confused as to whether each tray should be noted when charting and on an insurance claim form.

   This action would also be consistent with recent CMC actions which have created separate codes when similar prosthetics and devices are used with maxillary and mandibular applications.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - Mark if Revise or Delete [“a) - c)” are not applicable] ☐
   - a) CDT Code currently used to report the procedure D5994

---

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b) Procedure technical description

Periodontal medicament carrier with peripheral seal- laboratory processed specific to the Maxillary Arch. Maxillary Impressions are taken in a dental office extending into the vestibular space. They are forwarded to a dental laboratory for fabrication of a custom fabricated, laboratory processed carrier that covers the teeth and alveolar mucosa. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

c) Clinical scenario

Patient with periodontitis requires medicament trays to be fabricated for both maxillary and mandibular arch simultaneously, or needs a tray for a single arch. This code allows clear understanding of which arch had a tray fabricated, or in the case of two trays allows for demarcation that one tray is for the maxillary arch and the second tray is for the mandibular arch.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

None
Part 1 – Submitter Information

A. Contact Information (Action Requestor) Date Submitted: 5/14/2019

Name: Alan E Friedel, DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☒

If Yes, Name: PerioProtect LLC

Part 2 – Submission Details

1. Action (Mark one only) New ☒ Revise ☐ Delete ☐ Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature

 mandibular periodontal medicament carrier with peripheral seal- laboratory processed

Descriptor

A custom fabricated, laboratory processed carrier for the mandibular arch that covers the teeth and alveolar mucosa. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

3. Rationale for this request; your persuasive argument for CMC acceptance

Part of a suite of three actions, recommending deletion of the current, more generic code, in favor of two codes delineating maxillary and mandibular trays which should prevent confusion within the profession. Currently most patients who use these prosthetic devices receive two trays simultaneously; one each for the maxillary and mandibular arches. At present, some insurance carriers reject one submission citing a duplication (even when the arch is noted appropriately on the ADA form). Some practitioners are confused as to whether each tray should be noted when charting and on an insurance claim form.

This action would also be consistent with recent CMC actions which have created separate codes when similar prosthetics and devices are used with maxillary and mandibular applications.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable] ☐

a) CDT Code currently used to report the procedure D5994

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b) Procedure technical description

**Periodontal medicament carrier with peripheral seal- laboratory processed specific to the Mandibular Arch**

Mandibular Impressions are taken in a dental office extending into the vestibular space. They are forwarded to a dental laboratory for fabrication of a custom fabricated, laboratory processed carrier that covers the teeth and alveolar mucosa. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

c) Clinical scenario

Patient with periodontitis requires medicament trays to be fabricated for both maxillary and mandibular arch simultaneously, or needs a tray for a single arch. This code allows clear understanding of which arch had a tray fabricated, or in the case of two trays allows for demarcation that one tray is for the mandibular arch and the second tray is for the maxillary arch.

**Part 3 – Additional Information**

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
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6. Additional Comment or Explanation:

None
**Part 1 – Submitter Information**

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**Part 2 – Submission Details**

1. **Action** (Mark one only) New ☐ Revise ☒ Delete ☐ Affected Code (Revise or Delete only) D5994

2. **Full nomenclature and descriptor** (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

**Nomenclature**
periodontal medicament carrier with peripheral seal-FDA cleared medical device laboratory processed

**Descriptor**
A custom fabricated, laboratory processed carrier that covers the teeth and alveolar mucosa, and which has been cleared by the US Food and Drug Administration. Used as a vehicle to deliver prescribed medicaments for sustained contact with the gingiva, alveolar mucosa, and into the periodontal sulcus or pocket.

3. **Rationale for this request; your persuasive argument for CMC acceptance**
(Required for any type of requested action – New; Revise; Delete)

The D5994 trays as currently fabricated are delivery devices which do not come with a prepackaged dose of medication included. The trays as described allow each practitioner to determine what medication is to be delivered on an individual basis. They are designed specifically to deliver medication under pressure into the gingival sulcus, which is unique because of the peripheral seal. We seek to amend the current Nomenclature and Descriptor for clarity. Any time medication is delivered there is some attending level of patient risk, and FDA clearance of the delivery device provides an impartial review and a measure of protection to prescribing practitioners who use trays as delivery devices. Please note, if the committee chooses to delete D5994 and replace it with separate codes for upper and lower arches (as part of our other request), the submitter would like this language to be considered for placement in both of the new codes.

**NOTICE TO PREPARER AND SUBMITTER:**

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CDT CODE ACTION REQUEST

4. Complete a) – c) only if Action Request is for a New CDT Code

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a) CDT Code currently used to report the procedure

b) Procedure technical description

c) Clinical scenario

Part 3 – Additional Information

5. Supporting documentation or literature:
   - "5.a)" must be completed for all requested actions; "b)" and "c)" are completed when indicated.
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6. Additional Comment or Explanation:

None

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Part 1 – Submitter Information

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☐ | If Yes, Name: |
| No > ☒ |

Part 2 – Submission Details

1. Action (Mark one only) | New ☒ Revise ☐ Delete ☐ | Affected Code (Revise or Delete only) | D |

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

- Nomenclature
  - Required for all “New” preventive maintenance of fully edentulous patients restored with maxillary fixed dental implant-borne superstructures

- Descriptor
  - Optional for “New”; enter “None” if no descriptor
  - This procedure includes the disruption of dental biofilm, removal of calculus and stains for the maintenance of healthy peri-implant mucosa and supporting peri-implant bone.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The purpose of this procedure code would be to accurately document services rendered in the prevention and maintenance of post-surgical peri-implant tissues in the absence of natural dentition and when the maxillary prosthesis is not removed for maintenance procedures.

Currently, preventative hygiene and maintenance procedure codes represent services rendered to natural teeth but the D6080 procedure code for implant maintenance only pertains to when the prosthesis is removed for debridement.

According to the American Academy of Implant Dentistry, three million Americans have dental implants, and 500,000 dental implants are being placed per year as dental implants have become the standard of care for the replacement of missing teeth. As fixed hybrid implant-borne superstructures have become more commonly accepted treatment options for patients, a new dental patient has emerged, edentulous patients with implant-borne prostheses, and this patient population is exponentially growing.

While similarities exist between methodologies for evaluation and decontamination of natural teeth and implants, there are critical elements that differ, and therefore they cannot be considered equivalent.

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Identification of signs of peri-mucositis at its earliest stages enables the practitioner to prevent progression to clinical attachment loss and peri-implantitis which can impair the long-term success of dental implants and advances more rapidly than around natural dentition. For patients with full dentition comprised of implants, peri-implantitis can be detrimental to not only their dental health but can also have a tremendous impact on their systemic health.

**Management of dental biofilm on and around fixed prostheses, implant locators attachments, and bar attachments, is imperative for peri-implant disease prevention and maintenance.**

Procedure coding that accurately reflects the treatment provided in the maintenance phase of dental implant care when the prosthesis is not removed is imperative as the use of D1110 and D4910 does not describe preventative modalities for patients comprised of an implant-borne dentition, furthermore, D6080 pertains to when the implant-borne prosthesis is removed, maintenance is preformed and then the prosthesis is reinserted.

Not all patients will have the superstructure removed at each maintenance interval as the American College of Prosthodontics states that the removal of a fixed, screw-retained implant prosthesis for evaluation is not needed unless there are signs of peri-implantitis, a demonstrated inability to maintain adequate oral hygiene, or there are mechanical complications that require removal.¹

It is important to remove calculus safely with instruments compatible with the material of the implants and superstructures. In-office implant maintenance appointments at 2- to 6-month intervals should be scheduled and based on a patient's risk profile (e.g., history of smoking, history of periodontitis, systemic conditions, patient’s limited vision and dexterity, etc.).²

4. Complete a) – c) **only** if Action Request is for a New CDT Code

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The thorough evaluation of (1) dental implant-borne fixed superstructure prostheses and peri-implant mucosa as well as (2) dental implant-borne prostheses, abutments and peri-implant mucosa will be performed through visual inspection, manual palpation of peri-implant mucosa, probing, and assessment of occlusal forces. **These assessments are performed in a different manner then that of natural dentition due to the difference in peri-implant mucosa.**

Mechanical removal of plaque and calculus on the implants, fixed implant-borne prostheses, abutments and surrounding peri-implant tissues in order to disrupt dental biofilm and promote peri-implant health is critical. Individualized oral hygiene instructions adapted to the patients’ implant-borne prostheses, abutments, and prosthetic design.
c) Clinical scenario

Preventative and/or maintenance services would be performed for patients presenting with a fixed implant-borne suprastructure exhibiting no evidence of active peri-implant disease.

Part 3 – Additional Information

5. Supporting documentation or literature:
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6. Additional Comment or Explanation:

Supportive statements are followed by the citation from which it is drawn.

**STATEMENT:** Three million Americans have dental implants, and 500,000 dental implants are being placed per year.


**STATEMENT:** Peri-implant disease is more prominent in patients without preventative maintenance.


**STATEMENT:** Peri-implant disease advances more rapidly around dental implants than around natural dentition, therefore, thorough evaluation and decontamination is critical for the long-term success of dental implants.


**STATEMENT:** Not all patients will have the superstructure removed at each maintenance interval as the American College of Prosthodontics states that the removal of a fixed, screw-retained implant prosthesis for evaluation is not needed unless there are signs of peri-implantitis, a
demonstrated inability to maintain adequate oral hygiene, or there are mechanical complications that require removal.


STATEMENT: It is important to remove calculus safely with cleaning instruments compatible with the material of the implants and superstructures. In-office implant maintenance appointments at 2- to 6-month intervals should be scheduled and based on a patient's risk profile (e.g., history of smoking, history of periodontitis, systemic conditions, patient's limited vision and dexterity, etc.).


Identification of signs of peri-mucositis at its earliest stages enables the practitioner to prevent progression to clinical attachment loss and peri-implantitis which can impair the long-term success of dental implants and advances more rapidly than around natural dentition. For patients with full dentition comprised of implants, peri-implantitis can be detrimental to not only their dental health but can also have a tremendous impact on their systemic health.

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted:  10/17/2019

Name:  DentalCodeology Consortium

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes  ☐  If Yes, Name:

No  ☒

Part 2 – Submission Details

1. Action (Mark one only)  New  ☒  Revise  ☐  Delete  ☐  Affected Code (Revise or Delete only)  D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature  Required for all “New”  preventive maintenance of fully edentulous patients restored with mandibular fixed dental implant-borne superstructures

Descriptor  Optional for “New”; enter “None” if no descriptor  This procedure includes the disruption of dental biofilm, removal of calculus and stains for the maintenance of healthy peri-implant mucosa and supporting peri-implant bone.

3. Rationale for this request; your persuasive argument for CMC acceptance  
(Required for any type of requested action – New; Revise; Delete)

The purpose of this procedure code would be to accurately document services rendered in the prevention and maintenance of post-surgical peri-implant tissues in the absence of natural dentition and when the mandibular prosthesis is not removed for maintenance procedures.

Currently, preventative hygiene and maintenance procedure codes represent services rendered to natural teeth but the D6080 procedure code for implant maintenance only pertains to when the prosthesis is removed for debridement. According to the American Academy of Implant Dentistry, three million Americans have dental implants, and 500,000 dental implants are being placed per year as dental implants have become the standard of care for the replacement of missing teeth. As fixed hybrid implant-borne suprastructures have become more commonly accepted treatment options for patients, a new dental patient has emerged, edentulous patients with implant-borne prostheses, and this patient population is exponentially growing.

While similarities exist between methodologies for evaluation and decontamination of natural teeth and implants, there are critical elements that differ, and therefore they cannot be considered equivalent.

NOTICE TO PREPARER AND SUBMITTER:

- All requested information in Parts 1-3 is required; limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
- Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.
- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
Identification of signs of peri-mucositis at its earliest stages enables the practitioner to prevent progression to clinical attachment loss and peri-implantitis which can impair the long-term success of dental implants and advances more rapidly than around natural dentition. For patients with full dentition comprised of implants, peri-implantitis can be detrimental to not only their dental health but can also have a tremendous impact on their systemic health.

Management of biofilm on and around fixed prostheses, implant locators attachments, and bar attachments, is imperative for peri-implant disease prevention and maintenance.

**Procedure coding that accurately reflects the treatment provided in the maintenance phase of dental implant care when the prosthesis is not removed is imperative as the use of D1110 and D4910 does not describe preventative modalities for patients comprised of an implant-borne dentition, furthermore, D6080 pertains to when the implant-borne prosthesis is removed, maintenance is preformed and then the prosthesis is reinserted.**

Not all patients will have the superstructure removed at each maintenance interval as the American College of Prosthodontics states that the removal of a fixed, screw-retained implant prosthesis for evaluation is not needed unless there are signs of peri-implantitis, a demonstrated inability to maintain adequate oral hygiene, or there are mechanical complications that require removal.¹

It is important to remove calculus safely with instruments compatible with the material of the implants and superstructures. In-office implant maintenance appointments at 2- to 6-month intervals should be scheduled and based on a patient’s risk profile (e.g., history of smoking, history of periodontitis, systemic conditions, patient’s limited vision and dexterity, etc.).²

<table>
<thead>
<tr>
<th>4. Complete a) – c) only if Action Request is for a New CDT Code</th>
<th>Mark if Revise or Delete ['a) - c)* are not applicable]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) CDT Code currently used to report the procedure</td>
<td>none</td>
</tr>
<tr>
<td>b) Procedure technical description</td>
<td></td>
</tr>
</tbody>
</table>

The thorough evaluation of (1) dental implant-borne fixed superstructure prostheses and peri-implant mucosa as well as (2) dental implant-borne protheses, abutments and peri-implant mucosa will be performed through visual inspection, manual palpation of peri-implant mucosa, probing, and assessment of occlusal forces. **These assessments are performed in a different manner then that of natural dentition due to the difference in peri-implant mucosa.**

Mechanical removal of plaque and calculus on the implants, fixed implant-borne prostheses, abutments and surrounding peri-implant tissues in order to disrupt dental biofilm and promote peri-implant health is critical. Individualized oral hygiene instructions adapted to the patients’ implant-borne prostheses, abutments, and prosthetic design.

**NOTICE TO PREPARER AND SUBMITTER:**

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c) Clinical scenario

Preventative and/or maintenance services would be performed for patients presenting with a fixed implant-borne suprastructure exhibiting no evidence of active peri-implant disease.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

   a) Material submitted? | Yes > | ☐ | b) Protected by copyright? (If “a)” is “Yes”) | Yes > | ☐ | c) Permission to reprint? (If “b)” is “Yes”) | Yes > | ☐
   | No > | ☒ |

6. Additional Comment or Explanation:

Supportive statements are followed by the citation from which it is drawn.

STATEMENT: Three million Americans have dental implants, and 500,000 dental implants are being placed per year.

STATEMENT: Peri-implant disease is more prominent in patients without preventative maintenance.

STATEMENT: Peri-implant disease advances more rapidly around dental implants than around natural dentition, therefore, thorough evaluation and decontamination is critical for the long-term success of dental implants.

STATEMENT: Not all patients will have the superstructure removed at each maintenance interval as the American College of Prosthodontics states that the removal of a fixed, screw-retained implant prosthesis for evaluation is not needed unless there are signs of peri-implantitis.
<table>
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<tr>
<th>demonstrated inability to maintain adequate oral hygiene, or there are mechanical complications that require removal.</th>
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<td><strong>STATEMENT:</strong> It is important to remove calculus safely with cleaning instruments compatible with the material of the implants and superstructures. In-office implant maintenance appointments at 2- to 6-month intervals should be scheduled and based on a patient's risk profile (e.g., history of smoking, history of periodontitis, systemic conditions, patient’s limited vision and dexterity, etc.).³</td>
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<tr>
<td><strong>Identification of signs of peri-mucositis at its earliest stages enables the practitioner to prevent progression to clinical attachment loss and peri-implantitis which can impair the long-term success of dental implants and advances more rapidly than around natural dentition. For patients with full dentition comprised of implants, peri-implantitis can be detrimental to not only their dental health but can also have a tremendous impact on their systemic health.</strong></td>
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**Part 1 – Submitter Information**

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<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 11/1/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Name:</strong> Betsy Davis DMD MS</td>
<td></td>
</tr>
</tbody>
</table>

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<tr>
<th>B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes &gt; ☒</strong></td>
</tr>
<tr>
<td>If Yes, Name: American College of Prosthodontists</td>
</tr>
<tr>
<td>211 E. Chicago Avenue, Suite 1000</td>
</tr>
<tr>
<td>Chicago IL 60611</td>
</tr>
<tr>
<td><strong>No &gt; ☐</strong></td>
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**Part 2 – Submission Details**

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<tbody>
<tr>
<td><strong>Nomenclature</strong></td>
</tr>
<tr>
<td>Required for all “New”</td>
</tr>
<tr>
<td>Surgical placement of craniofacial implant – extra oral</td>
</tr>
<tr>
<td><strong>Descriptor</strong></td>
</tr>
<tr>
<td>Optional for “New”; enter “None” if no descriptor</td>
</tr>
<tr>
<td>Surgical placement of a craniofacial implant to aid in retention of an auricular, nasal, or orbital prosthesis.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
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<tbody>
<tr>
<td>Code D6010 does not apply to the extra oral placement of a craniofacial implant to retain an extra oral prosthesis. It is important to distinguish between intraoral and extra oral implants. Although the technique is similar, it is a different knowledge base needed in placing extra oral implants versus intraoral implants. Currently, there is not a listed CPT code nor a listed CDT code to describe the placement of craniofacial implants. Head and neck cancer can be one of the most devastating cancers. Rehabilitation of patients with extra oral defects either due to H&amp;N cancer, H&amp;N trauma, or a craniofacial/congenital disorder helps patients return to society and enter the work force.</td>
</tr>
</tbody>
</table>

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<tr>
<th>4. Complete a) – c) only if Action Request is for a New CDT Code</th>
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b) Procedure technical description

The surgical placement of craniofacial implants requires a surgical incision with reflection of the skin to access the bone. Usually, a surgical guide is used in the proper positioning of the craniofacial implants. There are some differences in the implant design of an intraoral implant and a craniofacial implant. Hence, there are some differences in the surgical placement. After the implants are placed, closure of the skin is required via suturing. Usually, a dressing is placed.

c) Clinical scenario

Patients first have a surgical guide fabricated either through virtual planning or a conventional impression technique. The surgical guide guides the surgeon in the proper placement of craniofacial implants. After adequate osseointegration, the first stage is seen for Stage II with the placement of an abutment (if it was not done at the time of implant placement). After adequate healing, a final impression is made and the retentive apparatus is designed consisting of either individual attachments on each of the craniofacial screws or a connecting bar with use of the final contour of the prosthesis as a guide. Coloration of the prosthesis is the last step and involves chairside characterization, both intrinsic and extrinsic.

Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided.
   - All material must be submitted in electronic format.

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<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
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6. Additional Comment or Explanation:

This has been approved by the American College of Prosthodontists.

NOTICE TO PREPARER AND SUBMITTER:

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Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: October 29, 2019

Name: American Association of Oral and Maxillofacial Surgeons

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes ☒ | If Yes, Name: AAOMS |
| No ☐ |

Part 2 – Submission Details

1. Action (Mark one only) | New X Revise ☐ Delete ☐ | Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature
Required for all “New”

surgical placement: zygomatic implant

Descriptor
Optional for “New”; enter “None” if no descriptor

An implant placed in the zygomatic bone and exiting though the maxillary mucosal tissue providing support and attachment of a maxillary dental prosthesis.

3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

Currently the CDT manual describes different implants: endosteal, mini, transosteal, and eposteal. Zygomatic implants are distinctly different from other implants in terms of design and location of placement. This will facilitate accurate reporting of the procedure performed by the dentist.

NOTICE TO PREPARER AND SUBMITTER:

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<td><strong>4. Complete a) – c) only if Action Request is for a New CDT Code</strong></td>
</tr>
<tr>
<td>☐</td>
</tr>
<tr>
<td>a) CDT Code currently used to report the procedure</td>
</tr>
<tr>
<td>b) Procedure technical description</td>
</tr>
<tr>
<td>A crestal incision with two releases is made in the maxillary arch, a full thickness flap is reflected to expose the zygomatic bone. An osteotomy is created in the zygomatic bone and maxillary bone. An implant is inserted engaging the body of the zygoma.</td>
</tr>
<tr>
<td>c) Clinical scenario</td>
</tr>
<tr>
<td>Patient with severe atrophy of the maxilla that needs an implant supported prosthesis. Two implants are inserted into the zygomatic bone without the need for sinus augmentation and two implants are inserted in the anterior maxilla. A fixed maxillary implant supported restoration is attached to the four implants.</td>
</tr>
</tbody>
</table>

**Part 3 – Additional Information**

<table>
<thead>
<tr>
<th>Supporting documentation or literature:</th>
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<td>• “5.a)” <strong>must</strong> be completed for all requested actions; “b)” and “c)” are completed when indicated.</td>
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<td></td>
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<tr>
<td>No &gt;</td>
<td>☑</td>
<td></td>
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<th>c) Permission to reprint?</th>
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</thead>
<tbody>
<tr>
<td>Yes &gt;</td>
</tr>
<tr>
<td>No &gt;</td>
</tr>
</tbody>
</table>

**6. Additional Comment or Explanation:**

None
**CDT CODE ACTION REQUEST**

**Part 1 – Submitter Information**

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 10/31/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Council on Dental Benefit Programs</td>
<td></td>
</tr>
</tbody>
</table>

**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes > ☒ | If Yes, Name: American Dental Association / Council on Dental Benefit Programs |
| No > ☐ |

**Part 2 – Submission Details**

1. **Action** (Mark one only) New ☐ Revise ☐ Delete ☒ Affected Code (Revise or Delete only) D6052

2. **Nomenclature**
   - **Required for all “New”** semi-precision attachment abutment

3. **Descriptor**
   - **Optional for “New”; enter “None” if no descriptor** includes placement of keeper assembly.

4. **Rationale for this request; your persuasive argument for CMC acceptance**
   (Required for any type of requested action – New; Revise; Delete)
   
   The current CDT Code entry does neither adequately nor clearly describes either the procedure’s scope or the component parts used when the service is delivered to a patient. An “attachment” is different and separate from an “abutment”. Clinical needs may require delivery of these procedures by different practitioners on different dates of service.

   There are two action requests for CDT Code additions submitted in conjunction with this deletion request that enable comprehensive and accurate documentation of semi-precision attachment procedures. These components may be placed, or replaced, independent of each other. Comprehensive documentation of services provided on a claim submission enables accurate adjudication and reimbursement in accordance with dental benefit plan coverage provisions.

**NOTICE TO PREPARER AND SUBMITTER:**

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- **A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.**
**CDT CODE ACTION REQUEST**

| a) CDT Code currently used to report the procedure |   |
| b) Procedure technical description |   |
| c) Clinical scenario |   |

**Part 3 – Additional Information**

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

| a) Material submitted? | Yes > ☐ No > ☒ | b) Protected by copyright? (If “a)” is “Yes”) | Yes > ☐ No > ☒ | c) Permission to reprint? (If “b)” is “Yes”) | Yes > ☐ No > ☒ |

6. Additional Comment or Explanation:

None

**NOTICE TO PREPARER AND SUBMITTER:**

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# CDT Code Action Request

## Part 1 – Submitter Information

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted:</th>
<th>10/31/2019</th>
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</thead>
<tbody>
<tr>
<td>Name: Council on Dental Benefit Programs</td>
<td></td>
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</table>

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☒ | If Yes, Name: | American Dental Association / Council on Dental Benefit Programs |
| No > ☐    |              |                                                             |

## Part 2 – Submission Details

1. **Action** (Mark one only)
   - New ☒
   - Revise ☐
   - Delete ☐
   - Affected Code (Revise or Delete only) ☐

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

   **Nomenclature**: semi-precision abutment – placement

   **Descriptor**: This procedure is the initial placement, or replacement, of a semi-precision abutment on the implant body.

---

**NOTICE TO PREPARER AND SUBMITTER:**

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CDE CODE ACTION REQUEST

3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

This is one of three related CDT Code action requests that enable comprehensive and accurate
documentation of semi-precision attachment procedures.

There is a separate request to delete the current CDT Code entry “D6052 semi-precision attachment
abutment” as it neither adequately nor clearly describes either the procedure’s scope or the component
parts used when the service is delivered to a patient. This request and another that enables
documenting placement of the semi-precision attachment, fills the coding gap created by deleting
D6052.

Clinical needs may require delivery of this procedure (placement of the semi-precision abutment) and the
other related procedure (placement of the semi-precision attachment) by different practitioners on
different dates of service. Documentation of these services when provided on a claim submission
enables accurate adjudication and reimbursement in accordance with dental benefit plan coverage
provisions pertaining to semi-precision attachments used in implant cases.

The CDT Code supports uniform, consistent, and accurate documentation of services delivered, and this
information is used in several ways: to provide for the efficient processing of dental claims; to populate an
electronic health record; and to record services to be delivered in a treatment plan. These uses were
noted in ADA testimony accepted by the National Committee on Vital and Health Statistics
(NCVHS), which acknowledged that “The purpose of the CDT Code is to achieve uniformity, consistency
and specificity in accurately reporting dental treatment. One use of the CDT Code is to provide for the
efficient processing of dental claims, and another is to populate an Electronic Health Record.”
(Testimony delivered June 20, 2012; https://ncvhs.hhs.gov/ADATestimony.pdf)

4. Complete a) – c) only if Action Request is for a New CDT Code
Mark if Revise or Delete
[“a) - c) are not applicable]

a) CDT Code currently used to report the procedure

D6052

b) Procedure technical description

A semi-precision abutment fixture is placed on an osseo-integrated implant body.

c) Clinical scenario

1) Partially edentulous patient (tooth #s 4, 5 and 6 missing) presents and accepts treatment plan that
results in placement of implant bodies (D6010 procedure) and a removable denture for the partially
edentulous portion of the maxillary arch (D6112 procedure). The dentist refers the patient to an oral
surgeon for placement of the implant bodies, and upon satisfactory osseo-integration places the
semi-precision abutment. The semi-precision attachment is placed on the prosthesis when delivered
so that the D6012 procedure may be completed.

2) Patient with implant/abutment supported removable denture presents with complaint about the
prosthesis. Dentist’s oral evaluation determines that the semi-precision abutment has failed and must
be replaced with a new fixture.

Part 3 – Additional Information

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CDT Code Action Request

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<th>Yes &gt; ☐</th>
<th>b) Protected by copyright? (If “a)” is “Yes”)</th>
<th>Yes &gt; ☐</th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
<th>Yes &gt; ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>No &gt; ☒</td>
<td></td>
<td>No &gt; ☐</td>
<td></td>
<td>No &gt; ☒</td>
<td></td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

An illustration of semi-precision attachment components (Zest Dental Solutions®)

Delivery of the initial placement, or replacement, of the semi-precision abutment may be determined by the patient record and claim history (e.g., dates of service).

---

Notice to Preparer and Submitter:

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- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
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- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
# CDT Code Action Request

## Part 1 – Submitter Information

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted:</th>
<th>10/31/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Council on Dental Benefit Programs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

<table>
<thead>
<tr>
<th>Yes ☒</th>
<th>If Yes, Name: American Dental Association / Council on Dental Benefit Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ☐</td>
<td></td>
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</tbody>
</table>

## Part 2 – Submission Details

1. Action (Mark one only)

<table>
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<tr>
<th>New ☒</th>
<th>Revise ☒</th>
<th>Delete ☐</th>
<th>Affected Code (Revise or Delete only)</th>
<th>D6052</th>
</tr>
</thead>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required for all “New”</td>
<td>This procedure involves the luting of the initial, or replacement, semi-precision attachment to the removable prosthesis.</td>
</tr>
<tr>
<td>Optional for “New”; enter “None” if no descriptor</td>
<td>semi-precision attachment – placement</td>
</tr>
</tbody>
</table>

## Notice to Preparer and Submitter:

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- A submission will be returned for correction if it is: a) **not** an unprotected MS Word document; b) **not** on the current Action Request format; or c) it is missing “Required” information.
3. **Rationale for this request; your persuasive argument for CMC acceptance**  
(Required for any type of requested action – New; Revise; Delete)

This is one of three related CDT Code action requests that enable comprehensive and accurate documentation of semi-precision attachment procedures.

There is a separate request to delete the current CDT Code entry “D6052 semi-precision attachment abutment” as it neither adequately nor clearly describes either the procedure’s scope or the component parts used when the service is delivered to a patient. This request and another that enables documenting placement of the semi-precision abutment, fills the coding gap created by deleting D6052.

Clinical needs may require delivery of this procedure (placement of the semi-precision attachment) and the other related procedure (placement of the semi-precision abutment) by different practitioners on different dates of service. Documentation of these services when provided on a claim submission enables accurate adjudication and reimbursement in accordance with dental benefit plan coverage provisions pertaining to semi-precision attachments used in implant cases.

The CDT Code supports uniform, consistent, and accurate documentation of services delivered, and this information is used in several ways: to provide for the efficient processing of dental claims; to populate an electronic health record; and to record services to be delivered in a treatment plan. These uses were noted noted in ADA testimony accepted by the National Committee on Vital and Health Statistics (NCVHS), which acknowledged that “The purpose of the CDT Code is to achieve uniformity, consistency and specificity in accurately reporting dental treatment. One use of the CDT Code is to provide for the efficient processing of dental claims, and another is to populate an Electronic Health Record.” (Testimony delivered June 20, 2012; [https://ncvhs.hhs.gov/ADATestimony.pdf](https://ncvhs.hhs.gov/ADATestimony.pdf))

4. **Complete a) – c)** only if Action Request is for a New CDT Code  
Mark if Revise or Delete 
[“a) - c)” are not applicable]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>a)</td>
<td>CDT Code currently used to report the procedure</td>
<td>D6052</td>
</tr>
<tr>
<td>b)</td>
<td>Procedure technical description</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>Clinical scenario</td>
<td></td>
</tr>
</tbody>
</table>

A semi-precision attachment fixture is placed on the implant borne restorative prosthesis prior to its placement on the semi-precision abutment.

1) Partially edentulous patient (tooth #s 4, 5 and 6 missing) presents and accepts treatment plan that results in placement of implant bodies (D6010 procedure) and a removable denture for the partially edentulous portion of the maxillary arch (D6112 procedure). The dentist refers the patient to an oral surgeon for placement of the implant bodies, and upon satisfactory osseo-integration places the semi-precision abutment. The semi-precision attachment is placed on the prosthesis when delivered so that the D6012 procedure may be completed.

2) Patient with implant/abutment supported removable denture presents with complaint about the prosthesis. Dentist’s oral evaluation determines that the semi-precision abutment has failed and must be replaced with a new fixture.

---

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Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>b) Protected by copyright? (If “a)” is “Yes”)</th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
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<tbody>
<tr>
<td>Yes &gt; ☐</td>
<td>No &gt; ☒</td>
<td>No &gt; ☒</td>
</tr>
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</table>

6. Additional Comment or Explanation:

An illustration of semi-precision attachment components (Zest Dental Solutions®)

Luting of the initial, or replacement, semi-precision abutment may be determined by the patient record and claim history (e.g., dates of service).

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/31/2019

Name: Council on Dental Benefit Programs

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☒  If Yes, Name: American Dental Association / Council on Dental Benefit Programs

No ☐

Part 2 – Submission Details

1. Action (Mark one only)  New ☐  Revise ☒  Delete ☐  Affected Code (Revise or Delete only)  D6011

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature
Required for all “New”

surgical access to an implant body (second stage implant surgery)

Descriptor
Optional for “New”; enter “None” if no descriptor

Surgical access to an implant body for placement of a healing cap or to enable placement of an abutment. This procedure, also known as second stage implant surgery, involves removal of tissue that covers the implant body so that a fixture of any type can be placed, or an existing fixture be replaced with another. Examples of fixtures include but are not limited to healing caps, abutments shaped to help contour the gingival margins or the final restorative prosthesis.

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The current CDT code entry for second stage implant surgery does not clearly and fully describe the nature and scope of this procedure, nor does it acknowledge that clinical needs may prompt repeated removal of overgrown gingival tissue.

- Nomenclature wording is ambiguous and presumes the meaning is consistently understood usage across the dental community.
- The descriptor does not describe the surgical procedure, it only describes subsequent actions that would be reported separately (e.g., abutment procedure code entries state that the procedure includes placement).

The proposed D6011 nomenclature and descriptor revisions address the current CDT code entry’s deficiencies noted above.

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**CDT CODE ACTION REQUEST**

4. Complete a) – c) **only** if Action Request is for a New CDT Code

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<tr>
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<table>
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<tr>
<th>b)</th>
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<tbody>
<tr>
<td></td>
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<table>
<thead>
<tr>
<th>c)</th>
<th>Clinical scenario</th>
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<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**Part 3 – Additional Information**

5. Supporting documentation or literature:
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<table>
<thead>
<tr>
<th>a)</th>
<th>Material submitted?</th>
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<th>c)</th>
<th>Permission to reprint? (If “b)” is “Yes”)</th>
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<td>☐</td>
<td></td>
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</table>

6. Additional Comment or Explanation: None

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### Part 1 – Submitter Information

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<tr>
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</tr>
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<tbody>
<tr>
<td>Name: Council on Dental Benefit Programs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes &gt; ☒ If Yes, Name: American Dental Association / Council on Dental Benefit Programs</td>
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<tr>
<td>No &gt; ☐</td>
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### Part 2 – Submission Details

<table>
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<th>1. Action (Mark one only)</th>
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<th>Delete</th>
<th>Affected Code (Revise or Delete only)</th>
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<tr>
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<td>☐</td>
<td>D6091</td>
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<table>
<thead>
<tr>
<th>2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nomenclature Required for all “New” replacement of replaceable part of semi-precision or precision attachment (male or female component) of implant/abutment supported prosthesis, per attachment</td>
</tr>
<tr>
<td>Descriptor Optional for “New”; enter “None” if no descriptor This procedure applies to the replaceable male or female component of the attachment.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)</th>
</tr>
</thead>
</table>
| This revision clarifies nomenclature’s wording to:  
  a) specify that the procedure involves replacement of an attachment’s replaceable part(s);  
  b) bring consistency with the comparable procedure (“D5867 replacement of replaceable part of semi-precision or precision attachment (male or female component)”) within the “Prosthodontic’s, removable” category of service; and  
  c) prevent a CDT Code gap that would occur upon acceptance of three related action requests (deletion of D6052 in conjunction with addition of codes for semi-precision abutment placement and semi-precision attachment placement) also submitted by the ADA. |

<table>
<thead>
<tr>
<th>4. Complete a) – c) only if Action Request is for a New CDT Code Mark if Revise or Delete [“a) - c)” are not applicable]</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) CDT Code currently used to report the procedure ☒</td>
</tr>
</tbody>
</table>

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b) Procedure technical description


c) Clinical scenario


Part 3 – Additional Information

5. Supporting documentation or literature:
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   • If protected by copyright, written authorization to reprint and distribute **must** be provided
   • All material **must** be submitted in electronic format.

   a) Material submitted?
      Yes > ☐
      No > ☒

   b) Protected by copyright?
      Yes > ☐
      No > ☐
      (If "a)" is "Yes")

   c) Permission to reprint?
      Yes > ☐
      No > ☒
      (If "b)" is "Yes")

6. Additional Comment or Explanation:

An illustration of semi-precision attachment components, with replaceable part identified
(Zest Dental Solutions®)

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### Part 1 – Submitter Information

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted: 5/16/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Kim Kitley</td>
<td></td>
</tr>
</tbody>
</table>

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

<table>
<thead>
<tr>
<th>Yes &gt; ☐</th>
<th>No &gt; ☒</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Yes, Name:</td>
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</tr>
</tbody>
</table>

### Part 2 – Submission Details

1. Action (Mark one only) | New ☒ Revise ☐ Delete ☐ Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required for all “New”</td>
<td>Surgical revision of buccal ties.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

The ADA currently has only one code for frenectomy (D7960 – Frenulectomy Separate Procedure). When the procedure is required in more than one area of the mouth (i.e. lip and tongue) there is often confusion and ultimately rejection of the submitted claim as a duplicate. The creation of separate and distinct codes for each area of treatment can eliminate the confusion and reduce the need for appeals.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>a)</th>
<th>Mark if Revise or Delete [“a) – c)” are not applicable] ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>CDT Code currently used to report the procedure</td>
<td>D7960</td>
</tr>
<tr>
<td>Procedure technical description</td>
<td>Surgical removal of buccal mucosa</td>
</tr>
</tbody>
</table>

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c) Clinical scenario

A mother presents with an infant having difficulties breastfeeding. The doctor talks to mom about the symptoms, examines the mouth and determines that the child has buccal ties contributing to the difficulties. Dr. recommends revision of buccal ties.

Part 3 – Additional Information

5. Supporting documentation or literature:
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6. Additional Comment or Explanation:

N/A
Part 1 – Submitter Information

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B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

- Yes >> ☐
- No >> ☒

If Yes, Name:

Part 2 – Submission Details

1. Action (Mark one only) | New ☒ | Revise ☐ | Delete ☐ | Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>lingual frenectomy (frenulectomy)</td>
<td>Surgical revision of Tongue-tie/Anklyglossia.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance

   The ADA currently has only one code for frenectomy (D7960 – Frenulectomy Separate Procedure). When the procedure is required in more than one area of the mouth (i.e. lip and tongue) there is often confusion and ultimately rejection of the submitted claim as a duplicate. The creation of separate and distinct code for each area of treatment can eliminate the confusion and reduce the need for appeals.

4. Complete a) – c) only if Action Request is for a New CDT Code

   - Mark if Revise or Delete [“a) – c)” are not applicable] ☐
   - a) CDT Code currently used to report the procedure | D7960
   - b) Procedure technical description
     Surgical removal of lingual frenulum

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c) Clinical scenario

A mother presents with an infant having difficulties breastfeeding. The doctor talks to mom about the symptoms, examines the mouth and determines that the child is tongue-tied and lip-tied. Dr. recommends revision of both the lingual and labial frenula.

Part 3 – Additional Information

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<td>No &gt;</td>
<td>☒</td>
<td></td>
<td>No &gt;</td>
<td>☒</td>
<td></td>
<td>No &gt;</td>
<td>☒</td>
<td></td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

N/A

**NOTICE TO PREPARER AND SUBMITTER:**

- **All requested information in Parts 1-3 is required;** limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
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- A submission will be returned for correction if it is: a) **not** an unprotected MS Word document; b) **not** on the current Action Request format; or c) it is missing “Required” information.
# CDT Code Action Request

## Part 1 – Submitter Information

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted:</th>
<th>5/16/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Kim Kitley</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

<table>
<thead>
<tr>
<th>Yes &gt; ☐</th>
<th>No &gt; ☒</th>
</tr>
</thead>
<tbody>
<tr>
<td>If Yes, Name:</td>
<td></td>
</tr>
</tbody>
</table>

## Part 2 – Submission Details

1. **Action** (Mark one only)

<table>
<thead>
<tr>
<th>New</th>
<th>Revise</th>
<th>Delete</th>
</tr>
</thead>
<tbody>
<tr>
<td>☒</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature</th>
<th>Descriptor</th>
</tr>
</thead>
<tbody>
<tr>
<td>labial frenectomy (frenulectomy)</td>
<td>Surgical revision of lip-tie.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance

The ADA currently has only one code for frenectomy (D7960 – Frenulectomy Separate Procedure). When the procedure is required in more than one area of the mouth (i.e. lip and tongue) there is often confusion and ultimately rejection of the submitted claim as a duplicate. The creation of separate and distinct code for each area of treatment can eliminate the confusion and reduce the need for appeals.

4. Complete a) – c) **only** if Action Request is for a New CDT Code

<table>
<thead>
<tr>
<th>Mark if Revise or Delete</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a) CDT Code currently used to report the procedure</td>
<td>D7960</td>
</tr>
<tr>
<td>b) Procedure technical description</td>
<td>Surgical removal of labial frenulum</td>
</tr>
</tbody>
</table>

## Notice to Preparer and Submitter:

- **All requested information in Parts 1-3 is required**; limited exceptions are noted.
- Cells where information is entered have white backgrounds and will automatically expand as needed.
- Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.
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### c) Clinical scenario

A mother presents with an infant having difficulties breastfeeding. The doctor talks to mom about the symptoms, examines the mouth and determines that the child is tongue-tied and lip-tied. Dr. recommends revision of both the lingual and labial frenula to improve latch and relieve symptoms.

### Part 3 – Additional Information

5. Supporting documentation or literature:
   - “5.a)” **must** be completed for all requested actions; “b)” and “c)” are completed when indicated.
   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

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<td>No &gt; ☒</td>
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</tr>
</tbody>
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6. Additional Comment or Explanation:

None

---

**NOTICE TO PREPARER AND SUBMITTER:**

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: 10/31/2019
--- | ---
Name: Dr. Gregory Oppenhuizen Andrew Wiltsch

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☒ | If Yes, Name: American Association of Orthodontists |

Part 2 – Submission Details

1. Action (Mark one only) | New | ☐ | Revise | ☒ | Delete | ☐ | Affected Code (Revise or Delete only) | D8000-D8999
--- | --- | --- | --- | --- | --- | --- | --- | ---

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature Required for all "New" N/A

Descriptor Optional for "New"; enter "None" if no descriptor

D8000-D8999 XI. Orthodontics

Orthodontic Treatment
Orthodontic treatment is defined as a complex, professionally guided process which alters the structure of the dentofacial complex requiring a clinical examination; pre-treatment diagnostic records such as radiographs; diagnosis and treatment planning; informed consent; supervision of the applied therapy; remediation and re-assessment of therapy; retention; and retrospective evaluation by an appropriately trained and licensed dentist.

Dentition
Primary Dentition: Teeth developed and erupted first in order of time.
Transitional Dentition: The final phase of the transition from primary to adult teeth, in which the deciduous molars and canines are in the process of shedding and the permanent successors are emerging.
Adolescent Dentition: The dentition that is present after the normal loss of primary teeth and prior to cessation of growth that would affect orthodontic treatment.
Adult Dentition: The dentition that is present after the cessation of growth that would affect orthodontic treatment.

All of the following orthodontic treatment codes may be used more than once for the treatment of a particular patient depending on the particular circumstance. A patient may require more than one interceptive procedure or more than one limited procedure depending on their particular problem.

---

NOTICE TO PREPARRIER AND SUBMITTER:

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- **Mark cells with “check boxes” (☐) by moving the cursor over the box and making a “left-click”.**
- **Completed Request must be submitted in unprotected MSWord® format via email to dentalcode@ada.org.**
- **A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.**
3. Rationale for this request; your persuasive argument for CMC acceptance
(Required for any type of requested action – New; Revise; Delete)

The Orthodontics section of the ADA’s CDT includes codes for Limited, Interceptive, and Comprehensive Orthodontic Treatment. However, their current descriptors do not enumerate the extensive services provided during these treatments. The suggested revision provides needed clarity regarding orthodontic treatment services in the context of “dental services on claims submitted to third party payers.” The language reflects the American Association of Orthodontists’ accepted definition of orthodontic treatment.

4. Complete a) – c) only if Action Request is for a New CDT Code

| a) CDT Code currently used to report the procedure |
| b) Procedure technical description |
| c) Clinical scenario |

Mark if Revise or Delete [“a) - c)” are not applicable]

| a) CDT Code currently used to report the procedure |
| b) Procedure technical description |
| c) Clinical scenario |

Part 3 – Additional Information

5. Supporting documentation or literature:
- “5.a)” must be completed for all requested actions; “b)” and “c)” are completed when indicated.
- If protected by copyright, written authorization to reprint and distribute must be provided
- All material must be submitted in electronic format.

| a) Material submitted? Yes > ☐ No > ☒ |
| b) Protected by copyright? Yes > ☐ No > ☒ |
| c) Permission to reprint? Yes > ☐ No > ☒ |

6. Additional Comment or Explanation:

None

NOTICE TO PREPARER AND SUBMITTER:
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Part 1 – Submitter Information

A. Contact Information (Action Requestor) | Date Submitted: 10/12/2019
---|---
Name: Doyle Williams, DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

<table>
<thead>
<tr>
<th>Yes</th>
<th>☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>☒</td>
</tr>
</tbody>
</table>

If Yes, Name:

Part 2 – Submission Details

1. Action (Mark one only) | New | ☐ | Revise | ☒ | Delete | ☐ | Affected Code (Revise or Delete only) | D9630
---|---|---|---|---|---|---|---|---

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature

**drugs or medicaments dispensed in the office for home use, single dispensing**

Descriptor

**Includes, but is not limited to oral antibiotics, oral analgesics, and topical fluoride; does not include writing prescriptions.**

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

When more than one drug or medicament is dispensed it often causes software programs to mark as a duplicate causing an appeal to be filed. This revision goes with an addition for a second code describing when two or more drugs are dispensed.

4. Complete a) – c) only if Action Request is for a New CDT Code | Mark if Revise or Delete ['a) - c)” are not applicable] | ☒
---|---|---

a) CDT Code currently used to report the procedure | D

b) Procedure technical description

c) Clinical scenario

---

**NOTICE TO PREPARER AND SUBMITTER:**

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Part 3 – Additional Information

5. Supporting documentation or literature:
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   - If protected by copyright, written authorization to reprint and distribute **must** be provided
   - All material **must** be submitted in electronic format.

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<tr>
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<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
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<td>No &gt; ☒</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

This submission would go with a revision to D9630 when two or more drugs are dispensed, and follow the solution used for current codes D9610 and D9612.

**NOTICE TO PREPARER AND SUBMITTER:**

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- A submission will be returned for correction if it is: a) not an unprotected MS Word document; b) not on the current Action Request format; or c) it is missing “Required” information.
I recently submitted two code requests for a fix to existing code D9630. I consider that request to be a good fix for the problem of sending multiple products home with a patient. I am submitting more requests today that I consider to be a better solution and the best solution. To help the CMC understand my thinking, please share this short summary:

Good solution (already submitted)
D9630 is revised to say one product given to patient
Dxxxx is new request for when two or more products are given

Better solution (included here)
D9630 is revised to describe first product sent home
Dxxxx is a new request for each additional product sent home

Best solution
D9630 is left intact (included here)
Dxxxx is a new request for fluoride home use
Dxxxx is a new request for chlorhexidine home use
Dxxxx is a new request for MI paste home use

Thank you

Doyle Williams
**Part 1 – Submitter Information**

<table>
<thead>
<tr>
<th>A. Contact Information (Action Requestor)</th>
<th>Date Submitted:</th>
<th>10/12/2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: Doyle Williams, DDS</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?**

| Yes > ☐ | No > ☒ |

**Part 2 – Submission Details**

<table>
<thead>
<tr>
<th>1. Action (Mark one only)</th>
<th>New</th>
<th>Revise</th>
<th>Delete</th>
<th>Affected Code (Revise or Delete only)</th>
<th>D</th>
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</thead>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – **blue underline**; deleted text – *red strike-through*; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature Required for all “New”</th>
<th>drugs or medicaments dispensed in the office for home use, two or more drugs or medicaments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor Optional for “New”; enter “None” if no descriptor</td>
<td>Includes, but is not limited to oral antibiotics, oral analgesics, and topical fluoride; does not include writing prescriptions.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance

(Required for any type of requested action – New; Revise; Delete)

When more than one drug or medicament is dispensed it often causes software programs to mark as a duplicate causing an appeal to be filed.

4. Complete a) – c) only if Action Request is for a New CDT Code

   Mark if Revise or Delete [“a) - c)” are not applicable] ☐

   a) CDT Code currently used to report the procedure [D9630]

   b) Procedure technical description

   Often more than one medicament is dispensed.

   c) Clinical scenario

   High risk caries patient is given MI paste, chlorhexidine and fluoride

**NOTICE TO PREPARIER AND SUBMITTER:**

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Part 3 – Additional Information

5. Supporting documentation or literature:
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<th>Yes &gt; ☐</th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
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<td></td>
<td>No &gt; ☒</td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

This submission would go with a revision to D9630 and follow the solution used for current codes D9610 and D9612.

### Notice to Preparer and Submitter:

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)   Date Submitted: 10/25/2019

| Name: Doyle Williams, DDS |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☐  If Yes, Name: |
| No > ☒ |

Part 2 – Submission Details

1. Action (Mark one only)   New ☐   Revise ☒   Delete ☐

| Affected Code (Revise or Delete only) | D9630 |

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature Required for all “New” | drugs or medicaments dispensed in the office for home use, single product |
| Descriptor Optional for “New”; enter “None” if no descriptor | Includes, but is not limited to oral antibiotics, oral analgesics, and topical fluoride; does not include writing prescriptions. |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

When more than one drug or medicament is dispensed it often causes software programs to mark as a duplicate causing an appeal to be filed. This revision goes with an addition for a second code describing when an additional product is dispensed.

4. Complete a) – c) only if Action Request is for a New CDT Code

| Mark if Revise or Delete [“a) - c)” are not applicable] | ☐ |

| a) CDT Code currently used to report the procedure D |
| b) Procedure technical description |
| c) Clinical scenario |

When multiple products are given to patients for home use, this would identify the first product. An addition submission would be used for each additional product.

NOTICE TO PREPARER AND SUBMITTER:

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| a) Material submitted? | Yes > ☐ No > ☒ | b) Protected by copyright? (If “a)” is “Yes”) | Yes > ☐ No > ☐ | c) Permission to reprint? (If “b)” is “Yes”) | Yes > ☐ No > ☐ |

6. Additional Comment or Explanation:

I am submitting three scenarios for addressing when multiple products are given to patients for home use. Currently, this causes claims to be denied as a duplicate submission rather than recognizing it is an addition service. I see this scenario as better than using “two or more” but not the best which describes each product separately.

---

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted: 10/25/2019

Name: Doyle Williams, DDS

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

Yes ☐  No ☒

If Yes, Name:

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only)  D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

Nomenclature  Required for all “New”

Drugs or medicaments dispensed in the office for home use, each additional

Descriptor  Optional for “New”; enter “None” if no descriptor

Includes but is not limited to oral antibiotics, oral analgesics, and topical fluoride; does not include writing prescriptions.

3. Rationale for this request; your persuasive argument for CMC acceptance

(Required for any type of requested action – New; Revise; Delete)

When multiple products are sent home, this code will more readily identify that it is not a duplicate submission of code D9630.

4. Complete a) – c) only if Action Request is for a New CDT Code

Mark if Revise or Delete [“a) - c)” are not applicable]

a) CDT Code currently used to report the procedure

D9630

b) Procedure technical description

Sending home more than one product for a patient’s home use.

c) Clinical scenario

High caries risk patient is given MI paste and fluoride gel.

NOTICE TO PREPARER AND SUBMITTER:

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<td>☒</td>
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<td>☐</td>
<td>No</td>
<td>☒</td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

I am submitting three very similar codes or code groupings that I see as good, better and best solutions for home use drugs.

**NOTICE TO PREPARER AND SUBMITTER:**

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<tbody>
<tr>
<td><strong>Name:</strong> Doyle Williams, DDS</td>
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<td>Yes &gt; ☐</td>
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</table>

**Part 2 – Submission Details**

1. **Action** (Mark one only) New ☒ Revise ☐ Delete ☐ Affected Code (Revise or Delete only) D

2. **Full nomenclature and descriptor** *(For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)*

<table>
<thead>
<tr>
<th>Nomenclature Required for all “New”</th>
<th>drugs or medicaments dispensed in the office for home use, anti bacterial or anti microbial rinse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor Optional for “New”; enter “None” if no descriptor</td>
<td>None</td>
</tr>
</tbody>
</table>

3. **Rationale for this request; your persuasive argument for CMC acceptance** *(Required for any type of requested action – New; Revise; Delete)*

   In order to assess outcomes, it is helpful to know the exact drug being sent home.

4. **Complete a) – c) only if Action Request is for a New CDT Code** Mark if Revise or Delete [“a) - c)” are not applicable] ☐

   a) **CDT Code currently used to report the procedure** D9630

   b) **Procedure technical description**

   Chlorhexidine rinse

   c) **Clinical scenario**

   Gingivitis patient is given chlorhexidine

---

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   - If protected by copyright, written authorization to reprint and distribute must be provided
   - All material must be submitted in electronic format.

<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>Yes &gt; ☐</th>
<th>b) Protected by copyright? (If “a)” is “Yes”) Yes &gt; ☐</th>
<th>c) Permission to reprint? (If “b)” is “Yes”) Yes &gt; ☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>No &gt; ☒</td>
<td></td>
<td>No &gt; ☐</td>
<td>No &gt; ☒</td>
</tr>
</tbody>
</table>

6. Additional Comment or Explanation:

I am submitting three very similar codes or code groupings that I see as good, better and best solutions for home use drugs

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Part 1 – Submitter Information

A. Contact Information (Action Requestor)  Date Submitted:  10/25/2019

| Name: Doyle Williams, DDS |

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes > ☐ | If Yes, Name: |
| No > ☒ |

Part 2 – Submission Details

1. Action (Mark one only)  New ☒  Revise ☐  Delete ☐  Affected Code (Revise or Delete only) D

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

| Nomenclature Required for all “New” | drugs or medicaments dispensed in the office for home use, fluoride rinse or gel |
| Descriptor Optional for “New” enter “None” if no descriptor | None |

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

In order to assess outcomes, it is helpful to know the exact drug being sent home.

4. Complete a) – c) only if Action Request is for a New CDT Code  Mark if Revise or Delete [”a) - c)” are not applicable] ☐

a) CDT Code currently used to report the procedure D9630

b) Procedure technical description

Fluoride rinse or gel

c) Clinical scenario

High risk caries patient is given fluoride

NOTICE TO PREPARER AND SUBMITTER:

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<table>
<thead>
<tr>
<th>a) Material submitted?</th>
<th>Yes</th>
<th>☐</th>
<th>b) Protected by copyright? (If “a)” is “Yes”)</th>
<th>Yes</th>
<th>☐</th>
<th>c) Permission to reprint? (If “b)” is “Yes”)</th>
<th>Yes</th>
<th>☐</th>
</tr>
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<tbody>
<tr>
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<td>☑</td>
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### Part 1 – Submitter Information

#### A. Contact Information (Action Requestor) | Date Submitted: 10/25/2019

| Name: Doyle Williams, DDS |

#### B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

| Yes | ☐ |
| No | ☒ |

### Part 2 – Submission Details

1. **Action** (Mark one only)
   - New | ☒ |
   - Revise | ☐ |
   - Delete | ☐ |

2. **Affected Code** (Revise or Delete only)
   - D

3. **Nomenclature**
   - Required for all “New”
   - drugs or medicaments dispensed in the office for home use, minimal intervention paste (MI paste)

4. **Descriptor**
   - Optional for “New”; enter “None” if no descriptor
   - None

3. **Rationale for this request; your persuasive argument for CMC acceptance**
   - (Required for any type of requested action – New; Revise; Delete)

   In order to assess outcomes, it is helpful to know the exact drug being sent home.

4. **Complete a) – c) only if Action Request is for a New CDT Code**
   - Mark if Revise or Delete [“a) - c)” are not applicable]

   a) **CDT Code currently used to report the procedure**
   - D9630

   b) **Procedure technical description**
   - MI paste

   c) **Clinical scenario**
   - High caries risk patient is given MI paste

---

**NOTICE TO PREPARER AND SUBMITTER:**

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   a) Material submitted? | Yes > ☐ | No > ☒
   b) Protected by copyright? (If “a)” is “Yes”) | Yes > ☐ | No > ☐
   c) Permission to reprint? (If “b)” is “Yes”) | Yes > ☐ | No > ☒

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CDT CODE ACTION REQUEST

Part 1 – Submitter Information

A. Contact Information (Action Requestor)       Date Submitted: 10/31/2019

<table>
<thead>
<tr>
<th>Name</th>
<th>Mark Mihalo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address (Line 1)</td>
<td>1339 W State Road 2</td>
</tr>
<tr>
<td>Address (Line 2)</td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>LaPorte</td>
</tr>
<tr>
<td>State</td>
<td>IN</td>
</tr>
<tr>
<td>Zip Code</td>
<td>46350</td>
</tr>
<tr>
<td>Telephone</td>
<td>219-324-6112</td>
</tr>
<tr>
<td>Email</td>
<td><a href="mailto:drmihalo@frontier.com">drmihalo@frontier.com</a></td>
</tr>
</tbody>
</table>

B. Does this request represent the official position of either a dental organization or a recognized dental specialty, or a third-party payer or administrator, or the manufacturer/supplier of a product?

- Yes □
- No ☒

If Yes, Name:

C. Does the requestor or entity identified in item #1 or #2 receive any financial benefit?

- Yes □
- No ☒

If Yes, describe:

D. "ADA Copyright Assignment Agreement" form signed and included with this Action Request?

- Yes ☒
- No □

If No, explain:

\[\text{NOTICE TO PREPARENDER AND SUBMITTER:}\]

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<tr>
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<tbody>
<tr>
<td></td>
<td></td>
<td>☒</td>
<td></td>
<td>D9971</td>
</tr>
</tbody>
</table>

2. Full nomenclature and descriptor (For “Revise” mark-up as follows: added text – blue underline; deleted text – red strike-through; unchanged text – black)

<table>
<thead>
<tr>
<th>Nomenclature Required for all “New”</th>
<th>odontoplasty 1-2 teeth; includes removal of enamel projections -per tooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptor Optional for “New”; enter “None” if no descriptor</td>
<td>Removal/reshaping of enamel surfaces or projections for esthetics, orthodontics, or to allow proper guide planes, rest seats and retention for removable partial dentures.</td>
</tr>
</tbody>
</table>

3. Rationale for this request; your persuasive argument for CMC acceptance (Required for any type of requested action – New; Revise; Delete)

   The lack of a descriptor for odontoplasty may leave users confused and thinking that it should only be used for the removal of enamel projections such as mamelons on incisors. Odontoplasty is a frequently used procedure in orthodontics where the interproximal enamel surfaces of teeth are reduced to allow for proper alignment.

   When fabricating a removable partial denture, the enamel surfaces of some teeth may need to be recontoured to transfer the occlusal force to the retaining tooth, (rest seat) allow proper insertion, (guide plane) or to provide undercuts for retentive clasps.

   Unless procedure D9971 is interpreted and reported as a per tooth procedure, it is impossible to track individual tooth outcomes and follow-up procedures in the patient chart.

4. Complete a) – c) only if Action Request is for a New CDT Code

<table>
<thead>
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<tbody>
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<tr>
<td>b) Procedure technical description</td>
<td></td>
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<tr>
<td>c) Clinical scenario</td>
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### Notice to Preparer and Submitter:

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</tr>
</tbody>
</table>

6. Additional Comment or Explanation:
None

Part 4 – CMC Secretariat Use Only

Secretariat Notes:
1. If this submission is accepted as presented the CDT Code entry would appear as follows:

   D9971 odontoplasty -per tooth
   Removal/reshaping of enamel surfaces or projections for esthetics, orthodontics, or to allow proper guide planes, rest seats and retention for removable partial dentures.

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