ADA CE Program ARTICLE 3

Assessing the standards of online oral hygiene instructions for patients with fixed orthodontic appliances

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ABSTRACT

Background. The authors conducted this study to assess the quality of the information available on the Web about oral hygiene for patients with fixed orthodontic appliances.

Methods. The authors entered the search terms "cleaning braces," "brushing braces," and "oral hygiene and braces" into Google, Yahoo, and Bing search engines. They analyzed Web sites satisfying the inclusion criteria from the first 20 hits of each search for accessibility, usability, and reliability by using the LIDA instrument; for readability by using the Flesch Reading Ease (FRE) score; and for the completeness of oral hygiene instructions.

Results. Sixty-two Web sites met the inclusion criteria. The mean total LIDA score of 71.2 indicated the moderate quality of the design of the reviewed Web sites. The mean (standard deviation [SD]) values of LIDA scores for accessibility, usability, and reliability were 85.9 (7.0), 63.4 (16.1), and 48.0 (10.4), respectively. The mean (SD) FRE Score of 68.6 (9.7) applied to standard reading skills. The completeness of information (mean [SD] = 67.1 [27.8]) presented the highest variability.

Conclusions. Overall, the authors found that the standards of online oral hygiene materials for orthodontic patients with fixed appliances exhibited modest scores. Readability appeared to be appropriate for young adolescents, whereas the comprehensiveness of the displayed information was highly variable. Further improvement of the infrastructure of electronic health information (that is, e-health) in orthodontics is necessary to meet patients' needs.

Practical Implications. Given the moderate quality of oral hygiene instruction available on the Web for patients with fixed appliances, orthodontic patients and caregivers should be cautious when browsing the Internet for relevant information. Dental professionals should refer patients to valid Web-based educational materials.

Key Words. Oral hygiene; orthodontic appliances; patient education; Internet.

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The availability of "e-health," defined as the application of emerging information and communications technology (ICT), especially the Internet, to advance or enable health and health care,[1] has grown exponentially over the last 2 decades. The results of the 2009 National Health Interview Survey on the penetration of health information technology in the United States revealed that 51% of adult users had sought health information on the Web within the past 12 months.[2] According to the Eurostat report on ICT usage in households and by people living in member states of the European Union, 54% of Internet users looked for health topics in the first quarter of 2011.[3] In this context, an online survey of e-health seekers from 42 countries around the world rated the Internet as the second favorite source of health information, following consultation by health care professionals.[4]

Oral health consumers also increasingly tend to retrieve and share online available health care information. Research results indicate that 34.5% of patients attending university dental clinics went online in advance for themselves or on behalf of family or friends.[5] Furthermore, 49.8% of the dental practitioners surveyed in Wales claimed that patients had asked them about oral health information retrieved from the Internet.[6]

Fixed orthodontic appliances hinder oral hygiene procedures, predisposing patients to the occurrence of hyperplastic gingivitis and enamel demineralization in the peribracket area (that is, white-spot lesions [WSL]).[7] Whereas gingival enlargement and inflammation often are transient and resolve within weeks after appliance removal,[8] WSL may result in irreversible side effects such as compromised dental esthetics and caries. In 1 study,

This article has an accompanying online continuing education activity available at: http://jada.ada.org/ce/home.

7 of 10 general dentists practicing in 3 regions of the United States reported that they had treated WSL during the last 12 months, whereas more than one-third of the practitioners viewed the appearance of severe post-orthodontic WSL as a pitfall to the perception of the treating orthodontist.[9] The results of an epidemiologic study[10] indicated that the role of general dentists in the development of WSL may be of great importance. General dentists were perceived to a large extent (48%) by themselves, orthodontists, patients, and parents as being responsible for preventing WSL.[10] These authors[10] observed that a percentage as high as 69% of dental practitioners appeared to be more strict in their judgment, recognizing the common responsibility with the previously mentioned groups in preventing WSL. Preventive measures such as prescribing topical fluoride products, encouraging patients to engage in appropriate oral hygiene, and providing dietary instructions are well acknowledged in the orthodontic literature.[11-13]

Hypothetically, orthodontic patients may take the initiative to seek oral hygiene educational materials on the Web; however, investigators have expressed concerns about the overall quality, content, and presentation mode of the information distributed by oral health[14-19] and orthodontics-related Web sites.[20,21] General dentists and orthodontists may provide useful services to their patients by recommending reliable sources available on the Internet. Thus, we conducted this study to evaluate the qualitative standards of the available information on the Internet regarding oral hygiene maintenance during fixed orthodontic appliance therapy.

METHODS

Search method. We performed a systematic Internet search in August 2014, alternatively using the top 3 engines—Google (www.google.com), Yahoo (www.yahoo.com), and Bing (www.bing.com)—and the search terms "cleaning braces," "brushing braces," and "oral hygiene and braces." We saved and pooled the first 20 search hits from each search combination for data analysis. We excluded any Web sites that had an access fee or a login requirement, were promotional product sites, involved discussion groups, provided video feeds, and were not written in the English language. For all eligible sites, we collected details regarding the author's name and profession, publication date, origin, and media type.

Standard evaluation. ***Accessibility, usability, and reliability.*** We carried out qualitative analysis of Web sites by using the Minervation validation instrument for health care Web sites (that is, the LIDA tool, Version 1.2, Minervation), a free online semiautomated tool designed to validate the structure of health care Web sites in terms of accessibility, usability, and reliability. LIDA software enables users to calculate the percentile scores for each category that indicate high (> 90%), moderate (50-90%), and low (< 50%) quality, and the average value of the accessibility, usability, and reliability scores, all of which result in the total LIDA score. The accessibility score is generated automatically by typing the URL of the Web site in the address box available on the link (http://lida.minervation.com). We processed 4-point scale responses (never, seldom, often, and always) to 9 questions to determine usability and reliability ratings (Table 1).

Readability. Using the Flesch Reading Ease (FRE) score, we evaluated the ease of understanding or comprehending a Web site's text on the basis of the style of writing. The FRE score integrates average sentence length (ASL) and average number of syllables per word (ASW) into the following equation: FRE score = 206.835 − (1.015 x ASL) − (84.6 x ASW). The FRE score is a number ranging from 0 to 100 that is categorized accordingly: very confusing (0-29), difficult (30-49), fairly difficult (50-59), standard (60-69), fairly easy (70-79), easy (80-89), and very easy (90-100). We extracted a sample text of 200 to 500 words and pasted the sample into the Text Readability Consensus Calculator (http://www.readabilityformulas.com/free-readability-formula-tests.php), a free readability measurement instrument available on the Web.

Completeness of information. Two of the authors (W.A.V., C.L.) examined simultaneously whether Web sites presented dietary advice and information on toothbrushing and dental care accessories. If their assessments did not match, they discussed the discrepancy until they reached consensus. In particular, they checked and scored information about toothbrushing on the grounds of the description of the technique, the suggested frequency per day, and the recommended concentration of fluoride toothpaste. In addition to assessing content for recommendations of toothbrushing with a fluoride toothpaste, the same 2 authors screened the Web sites for information on the use of interdental brushes, additional interdental accessories, and fluoride products. We added 1 point for each parameter if we noted that relevant information had been cited. Ideally, a Web site could reach a maximum score of 7 points if it included comprehensive instructions on all areas of interest. We converted completeness ratings into percentiles to enable homogenous presentation of outcomes.

RESULTS

Search results. The original search yielded 27,887,000 hits (Table 2). By collecting the first 20 Web sites identified by each search, we evaluated 180 search results for eligibility. After excluding 65 duplicates, 19 video feeds, 3 advertisements, 8 discussion groups, and 23 irrelevant

ABBREVIATION KEY. **ASL:** Average sentence length. **ASW:** Average number of syllables per word. **FRE:** Flesch Reading Ease. **ICT:** Information and communications technology. **WSL:** White-spot lesions.

TABLE 1

List of LIDA* questions aimed at evaluating the usability and reliability of the Web sites reviewed.

QUESTION	EVALUATION AREA	QUESTION FORMULATION
1	Usability	Is the site design clear and transparent?
2	Usability	Is the site design consistent from one page to another?
3	Usability	Can users find what they need on the site?
4	Usability	Is the format of information clear and appropriate for the audience?
5	Reliability	Is it clear who has developed the Web site and what their objectives are?
6	Reliability	Does the site report a robust quality control procedure?
7	Reliability	Is the site content checked by an expert?
8	Reliability	Is the site updated regularly?
9	Reliability	Does the Web site include citations of relevant sources where appropriate?

* The LIDA tool is a Minervation validation instrument for health care Web sites (version 1.2, Minervation [http://lida.minervation.com]).

TABLE 2

Distribution of hits by search engine and term.

SEARCH ENGINE	SEARCH TERM		
	Cleaning Braces	Brushing Braces	Oral Hygiene and Braces
Google	7,820,000	903,000	674,000
Yahoo!	4,970,000	1,700,000	5,740,000
Bing	4,440,000	828,000	812,000

Web sites, we found 62 domains that appeared to meet the study requirements.

Authorship information and mode of presentation. In 9 of the 62 Web sites (15%), the identity of the author was unclear (Figure 1), with 2 of the contributors being former orthodontic patients. Oral hygiene materials were edited by oral care specialists such as orthodontists (71%), faculty staff members (3%), dentists (3%), and oral hygienists or dental assistants (3%). Media professionals signed the articles uploaded from 3 Internet domains (5%). One Web site was run by orthodontists who intended to provide basic information about orthodontics. Regarding the mode of presentation, we noted that plain and illustrated text was used in 25 and 19 Web sites, respectively. We noted that 18 Web sites used more dynamic content with the combination of text, illustrations, and animation or video, and 9 domains posted the last date the Web site had been modified.

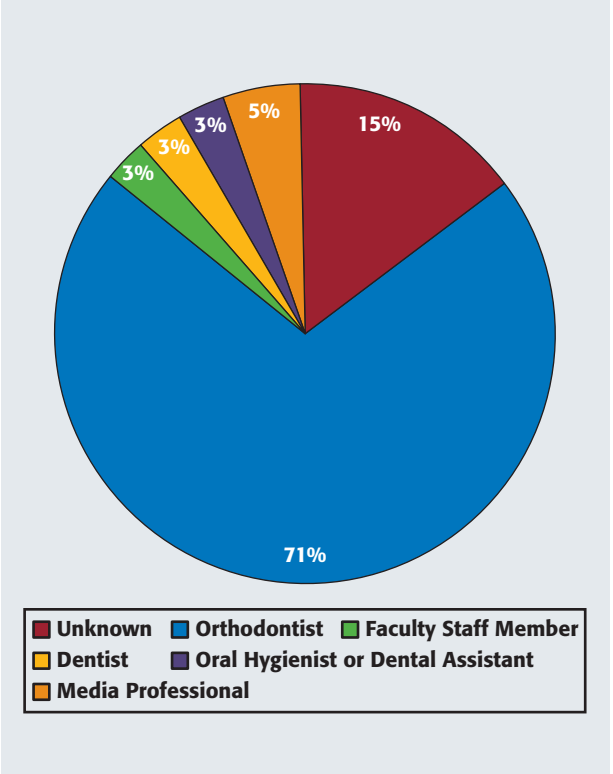

Figure 1. Distribution of the types of authors noted in the reviewed Web sites.

Quality evaluation. Figure 2 indicates that scores for usability, reliability, and completeness of oral hygiene information were scattered over a wide range, indicating the high variability of these features in the reviewed Internet sources.

Accessibility, usability, reliability, and total LIDA scores. The mean (standard deviation [SD]) score for accessibility was 85.9 (7.0). The easiest-to-visit Web sites with the highest possible score belonged to 2 orthodontic practices. The least accessible Web page, which was rated with a score of 63.0, also was produced by an orthodontic practice.

Among the Internet sources we analyzed in this study, the mean (SD) usability score indicated medium quality (66.5 [20.0]). Eight of the Web sites, all of which were administered by orthodontists, achieved a score of 100%. All these Web pages included static and animated pictures in the patient education materials.

The Internet portals exhibited an average reliability score of 47.9 (SD = 10.0). We assigned low-quality ratings to 40 Internet sources, with the lowest scores equal to or even lower than 20% given to the Web pages produced by an oral care product manufacturer and 1 former orthodontic patient.

The mean (SD) value of the total LIDA score was 71.2 (5.3). All Web sites presented LIDA scores ranging

from 60 to 82, a finding that points toward moderate quality of the available oral hygiene instructions related to orthodontic treatment (Figure 3). None of the 62 Web pages we reviewed in this study exceeded the high quality limit of 90.

Readability. The mean (SD) FRE score was 68.6 (9.7), which fell within the range of scores that indicate easily understandable text for 13- to 15-year-old students. Most of the Web sites (54 of 62) displayed patient material that required a reading comprehension level for text that was standard, easy, or very easy to read (Figure 4). The lowest FRE score (24.7), which corresponded with the highest level of reading difficulty and was comparable with requiring a college education was assigned to an Internet platform that had been developed by an oral hygienist.

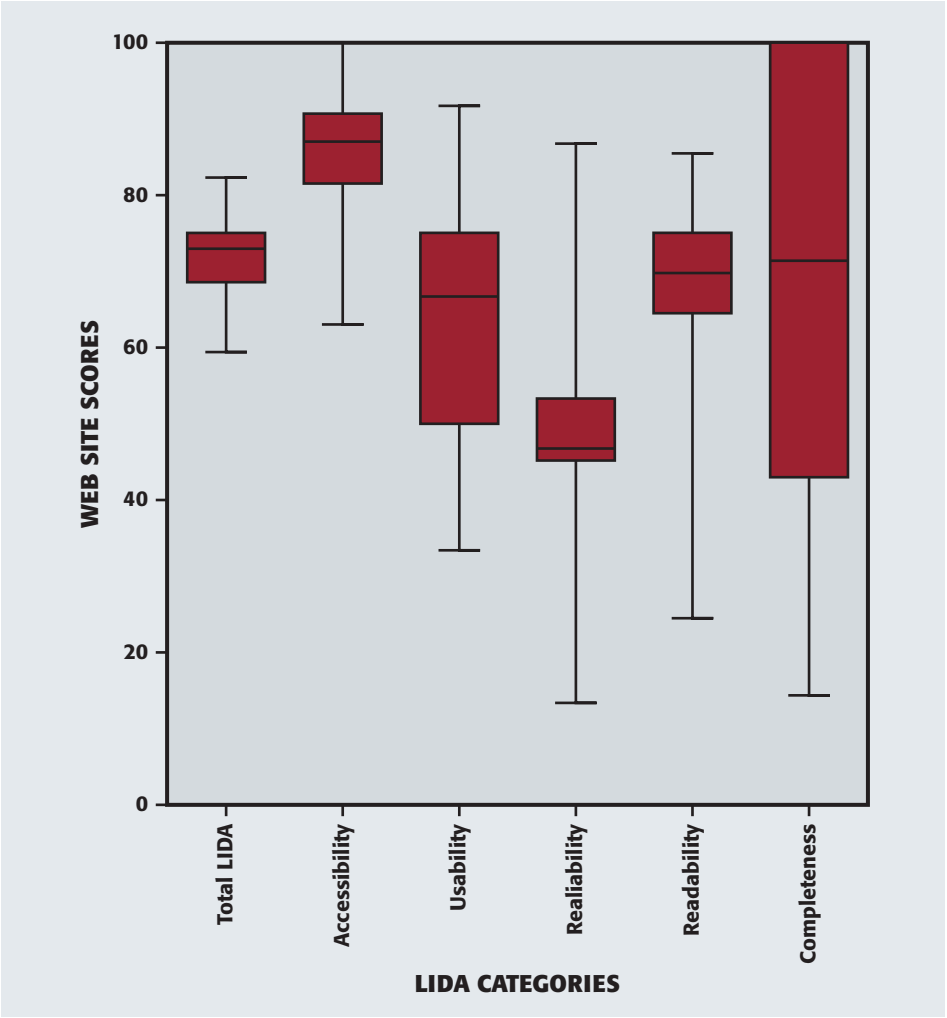

Figure 2. Box-and-whisker diagram illustrating the distribution of evaluation percentile scores.

Completeness of information. We found the mean (SD) score for completeness of information to be 67.1 (27.8). Seventeen Web sites delivered complete guidelines for oral hygiene. Fifty-four domains provided information about the preferred method of toothbrushing, 51 Web sites prescribed the preferred frequency of toothbrushing, and 32 Web sites advised the use of fluoride toothpaste. In addition, content in 35 and 49 of the Web pages instructed readers in the use of interproximal brushes and interdental cleaning aids. Content in one-half of the examined Web platforms provided advice on fluoride supplements such as gels, tablets, and mouthwashes, whereas content in 40 Web sites provided dietary information.

DISCUSSION

E-health facilitates the transition of decision making and responsibility from the professional to the Internet-informed and -empowered consumer.[22] Because orthodontic patients have identified themselves as being the most responsible for preventing WSL,[10] oral health clinicians may expect these orthodontic patients to search the Web for home-based oral hygiene measures while they undergo treatment with fixed appliances. Previously, study respondents perceived the lack of quality filters, questionable trustworthiness, and fullness of descriptions as among the top difficulties encountered when searching the Internet for health-related topics.[4] Because seekers of online health information regularly begin their sessions with a search engine rather than going directly to a specialized health information Web site,[23] we aimed our investigation at analyzing the search results produced by the world's most popular search engines.[24] In agreement with the results of other oral health care studies whose investigators used the LIDA tool,[17,20,21] we found that the overall quality of the online

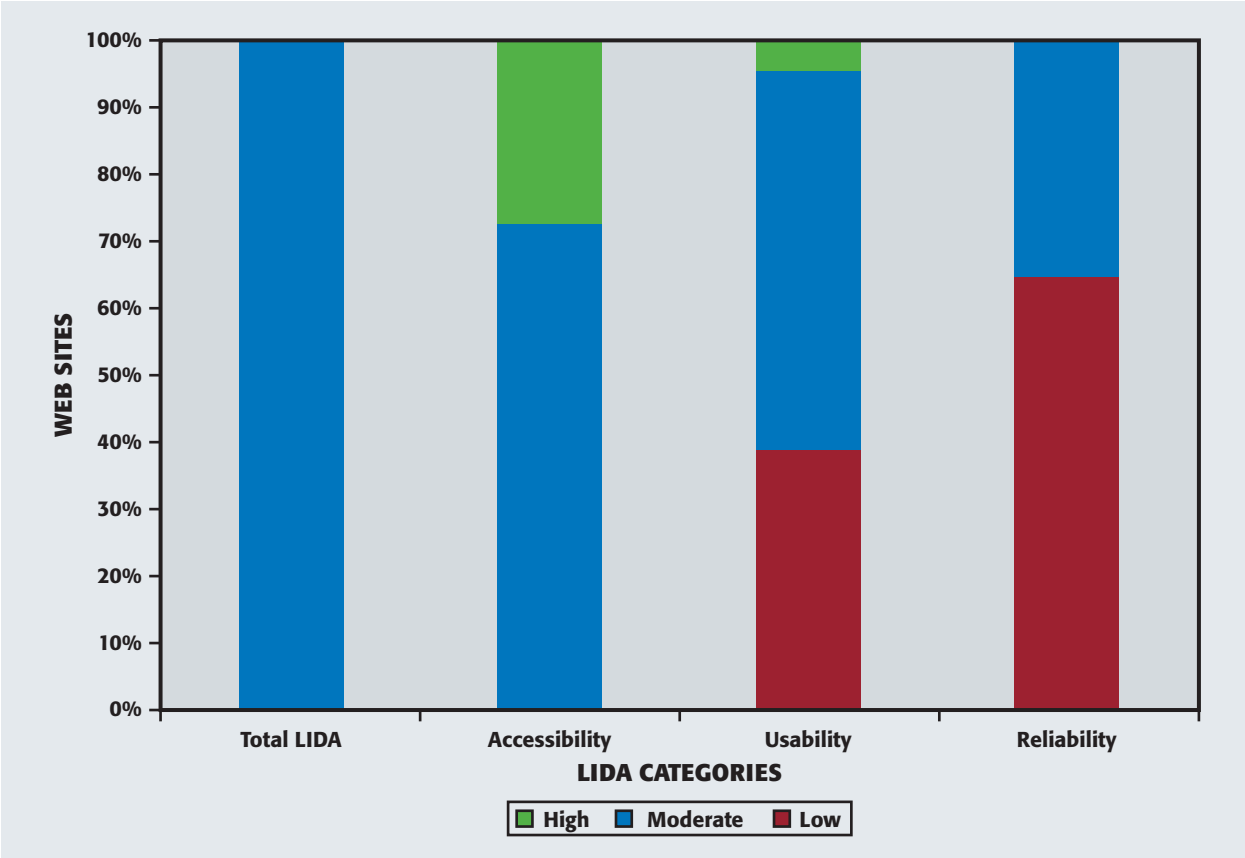

Figure 3. Percentages of Web sites achieving high, moderate, and low LIDA scores for each LIDA category. The LIDA tool is a Minervation validation instrument for health care Web sites (Version 1.2, Minervation [http://lida.minervation.com]).

oral hygiene instructions for fixed appliances was moderate, calling for further development.

The accessibility outcomes we found approximated the high-quality score ranges found in published reviews on available Internet information regarding orthodontic pain[21] and xerostomia.[17] In many countries, the originators of Web pages are obligated legally to provide equal accessibility opportunities to all potential users, including those with difficulties in seeing, hearing, and making precise movements.[25] Web site administrators may consult experts in search engine optimization to ensure that their platforms are easily accessible.[17]

We found that the usability rates of the Internet domains we examined in this study were considered to be of medium value, but we noted that this result was higher than the level of usability indicated in previously published reports. The higher score may be attributed to the information display mode, which was not limited to static text but was enhanced with pictures, video clips, or both. As indicated by the cognitive theory of multimedia learning, people learn information better when the information is presented both visually and auditorily.[26] In this sense, Web sites with video-aided instructions performed better than printed instructions alone in areas like knowledge gain, skill training, and behavior change. Except for the clarity of the presentation mode, video projection endorses self-learning in a private environment.[27]

Some practitioners claim that Internet-derived information can lead patients to demand inappropriate dental care.[6] Interestingly enough, the reliability of the Web platforms we studied—though mediocre—outpaced those studied by previous investigators who used the same validation instrument.[17,20,21] The relatively high performance might be related to the broad involvement of orthodontists in Web site management. Nonetheless, clinicians should interpret such a finding with caution because Web pages administered by health care professionals may not necessarily include information of superior quality.[21,28]

Patient education materials frequently are written at a level that is too difficult for a significant proportion of the general population to understand.[29] A manual for clinicians published by the American Medical

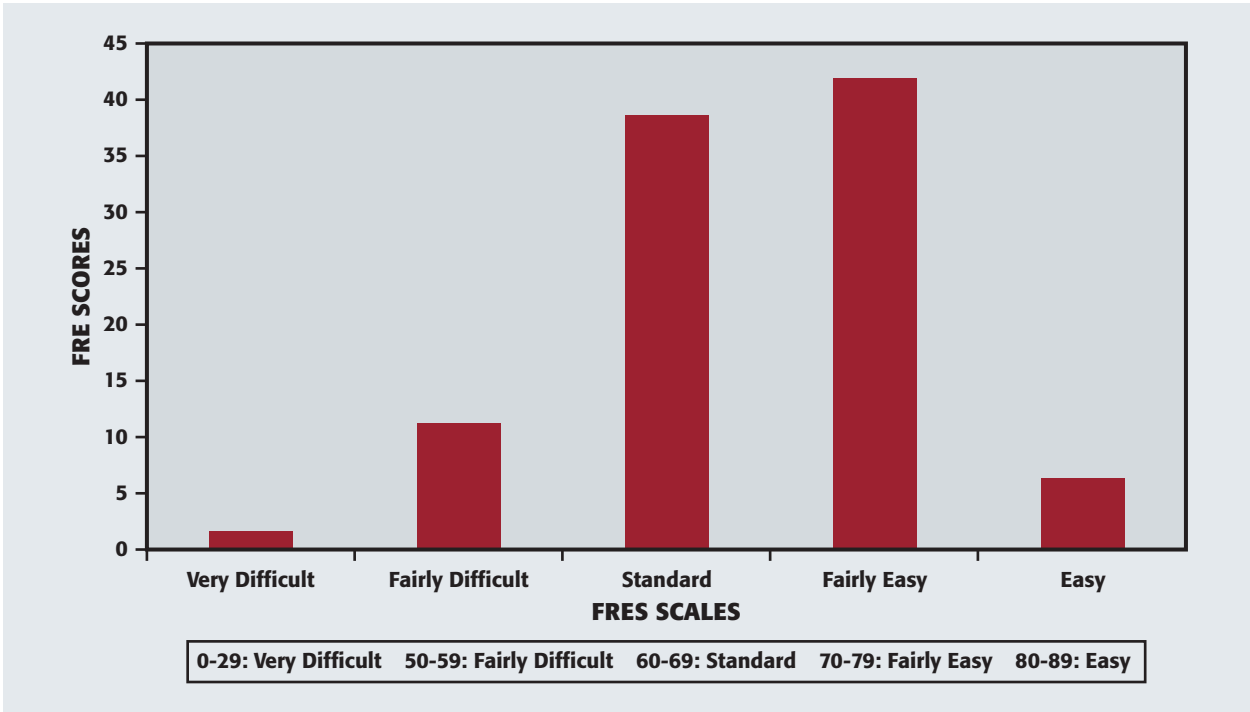

Figure 4. Distribution of Flesch Reading Ease (FRE) scores in the reviewed Web sites.

Association advises the use of short sentences, generally containing up to 10 words.[30] Others suggest that an article's text should be supplemented with an adequate number of illustrations and easily readable fonts, whereas the inclusion of capital letters, italics, and uncommon fonts should be avoided.[31] We found that the general readability of the available oral health instructions was appropriate for young adolescents. As indicated by estimates provided by the American Association of Orthodontists, there are almost 4 million orthodontic patients in North America, and a substantial portion of these patients are high school aged.[32] Our findings are in line with recommendations of the U.S. Department of Health and Human Services that advise patient education materials to be written at the readability level of 6th to 7th graders to facilitate reading and comprehension.[33]

Regarding the comprehensiveness of patient education materials, approximately 1 in 4 of the Web sites we studied provided information on basic oral hygiene like toothbrushing, using interdental accessories and fluoride products, and dietary suggestions. The results might have been theoretically more disappointing if we had been focused on determining the accuracy or the evidence base of available oral hygiene measures on the Web. In a previous study, investigators found that orthodontists did not implement the best available evidence in either clinical practice or oral hygiene instructions to inhibit enamel demineralization.[34] Moreover, evidence remains rather weak on the effectiveness of preventive measures such as using a daily rinse with 0.05% sodium fluoride during orthodontic treatment as well as using fluoridated toothpaste,[35] using a toothpaste and gel with a high concentration (1,500-5,000 parts per million) of fluoride, or using complementary chlorhexidine[13] and interdental brushes.[36]

Our study has the same limitations as previously published studies whose investigators ran e-health searches to review Web-based patient education materials. First, owing to the ever-changing nature of the Internet, our results were time-specific, corresponding with the day that we conducted the electronic search. Second, we examined only Web pages written in the English language, and therefore, we cannot generalize our conclusions to dental care Web sites written in other languages. Third, like many readability formulas, FRE scores rely on the length and structure of sentences, and as a result, we may have overlooked factors that influence comprehension such as illustrations, layout, and most importantly, a reader's motivation.[29]

Previous researchers have recommended improving communication among general dentists, orthodontists, patients, and parents to decrease the incidence of WSL in the orthodontic population.[10] With the significant benefits of participating in an oral health promotion program by patients with fixed orthodontic appliances being rather short term,[37] clinicians should recommend

that patients continue to receive counseling and oral hygiene monitoring throughout treatment.[10] Although investigators have recommended verbal oral hygiene advice accompanied with written and, if possible, videotaped instructions immediately after placement of fixed appliances,[37] patients' comprehension of oral hygiene regimens may be improved if clinicians refer them to valid Internet educational resources with structured interactive educational programs. For example, the results of a study of patients who had received computer-aided learning about major hypertension topics had higher knowledge scores and a more positive learning attitude than patients who conducted random Internet searches.[38]

CONCLUSIONS

The overall and individual LIDA scores for accessibility, usability, and reliability of Web pages that offer information on oral hygiene measures for orthodontic patients with fixed appliances indicated moderate quality. We considered the reading level of the content presented on the reviewed Internet domains to be appropriate for young adolescents. The completeness of oral hygiene information appeared highly variable. Our findings warrant the need for further optimization of the structure and information content of orthodontic Web sites. ■

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