



**Digital Dentistry Technology & Innovation**

# **3D Printing Guide**



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## 3D Printing Guide

### Digital Dentistry Technology and Innovation

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## Introduction

Many influences exist when purchasing 3D printers; an objective assessment of considerations is needed to determine which will fit your patient's and practice's needs.

According to the ADA Clinical Evaluators Panel survey "[Prevalence and applications of 3-dimensional printers in dental practice](#)" dentists report the most common uses for 3D printers were to complement or enhance other digital technologies (63%), control workflows (50%), improve efficiency (50%), use existing digital skills or procedures (48%), and reduce cost or manufacturing time (43%).

For a brief outline of 3D printing digital workflow, please refer to Appendix 1.

## Purpose

3D printers are quickly emerging in the dental field but are not new to the dental lab industry. For some dental teams, including those in academia, these technologies are already part of their practice workflows and could become the industry standard.

Many of the existing product technologies have evolved and have solely focused their 3D printers on providing dental products, meeting many, if not all, of the sought-after capabilities for dental providers, their teams, and their patients.

This guide highlights a broad range of features a dental practice may consider when purchasing such valuable equipment.

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## CONSIDERATIONS

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**Before we jump into considerations about the actual printer selection, ask yourself:**

### Resource Questions

- Have I integrated the digital record taken into my clinical workflow?
- Can my computers handle the software requirements of the new technology?
- Are my team members willing to try new things and embrace technology?

### Patient care questions

- What is/are my practice's main prosthesis and appliance fabricated?
- What are my current lab costs per procedure for outsourcing?
- Will incorporating digital workflows allow me to offer additional/different procedures?
- How will this technology impact patient outcomes?

### Practice setting questions:

- Do I have the capacity to integrate a digital workflow fully or do I need to outsource any aspects (treatment planning, designing)

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### NOW LET'S CONSIDER

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There are four major considerations in selecting the best 3D printers.

#### 1. Intended use/capability

- Printers vary in ability to make diagnostic models to multi-color hard and soft tissue models used for implant treatment planning.
- Biocompatible Products include surgical guides, night guards, crowns, temp veneers, dentures, orthodontic appliances, custom trays.
- Quality can be difficult to assess by requesting a sample print or observing the process, but materials can be researched for composition and compliance with safety standards.

#### 2. Type

- FDA compliance
- Closed vs. Open systems
- Additional software may be required for design, treatment planning, etc
- Cloud-based design options, printer software compatibility with CAD software
- Some brands have a history with dental products only
- Many technology types exist but common for dental use include, PolyJet, Digital light processing (DLP), Stereolithography (SLA), Digital Light Synthesis
- Evolution of versions, frequency of upgrades
- Automated systems vs. post-processing equipment/process
- Resin and materials cartridges may not be interchangeable or have limitations to the type of material used.
- Different products require different resin types
- Size of the building platform is a consideration to the volume and type of products to be printed
- Environmental (temperature, humidity, location) considerations to function of machine and material
- Additional equipment required, such as washing and curing units

#### 3. Price

- Range from \$5,000- > \$100,000
- Consider additional cost if need scanner, IT update
- Technical and Customer support subscriptions
- Training of team
- Material cost to determine the return on investment
- Cost of time and space
- Cost of training
- Software cost and cost of updates (if not included or additional software is required)

#### 4. Time

- Volume of use should be considered for calculating return on investment will design and fabricate?
- Time to print product by type, resin cure time and full vs. quadrant arch
- Curing, finishing, and polishing product time (manual vs automated)
- Printing accuracy and capacity per material and prosthesis (Remakes, adjustment times, shades)
- How long has this printer or material been in the market? What was the last update to the software, printer design, and supply of product upgrades?
- Learning curve and training requirements



## 3D Printing Guide

### Digital Dentistry Technology and Innovation

- Time needed for update of IT to support digital workflow
- Support and/or maintenance contract

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## CONCLUSION

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The decision to expand your technology can be intimidating. Many vendors exist and influencers are available to steer you in a certain direction.

The most important question if you, your team and your patients are ready to embrace the benefits of 3D printing is:

**What am I trying to accomplish?**

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**APPENDIX 1: 3D PRINTING WORKFLOW**

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1. **Scan**- Capture data with a compatible scanning system.
  - a. Data is sent to the software program.
2. **Design**– Once uploaded, the software program will populate options based on the type of prosthesis being fabricated.
  - a. Based on the criteria selected, the software populates a file of the prosthesis for approval and adjustments via your dashboard. Many programs allow you to do this remotely.
  - b. Once approved, the file is sent to the 3D printer.
  - c. This step can be outsourced..
3. **Print**- Ensure the model form is clean and there is no residual resin left from the prior fabrication.
  - a. Pour the resin into the mold.
  - b. Start printing.
4. **Process**- Depending on the end product and manufacturer, this may include a wash, curing and polish process.
5. **Deliver** to patient and verify.



# 3D Printing Guide

## Digital Dentistry Technology and Innovation

### APPENDIX 2: 3D PRINTER COMPARISON CHART

Manufacturers, capabilities, materials, and prices are subject to change and the information below is a reflection as of 07/06/2023, per manufacturers website or representative. Manufacturers were selected per most commonly used by the respondents of the [ACE Panel Survey](#).

| Manufacturer<br><br>(listed alphabetically) | Clinical Indication |                   |                  |                      |                          | Unique Feature   | Initial Investment<br><br>*Price reflects printer only |
|---|---------------------|-------------------|------------------|----------------------|--------------------------|--|--|
|   | Surgical Guides     | Diagnostic Models | Digital Dentures | Splints & Nightguard | Temporary Crown & Bridge |  |  |
| <b>3D Systems NextDent 5100</b>             | ✓                   | ✓                 | ✓                | ✓                    | ✓                        | Biocompatible and CE certified in accordance with Medical Device Directive 93/42/EEC | <b>\$ 5,000 - \$215,000</b>                            |
| <b>Asiga</b>                                | ✓                   | ✓                 | ✓                | ✓                    | ✓                        | Smart Positioning System (SPS),<br>Open Material System Compatibility                | <b>\$9,990 - \$29,990</b>                              |
| <b>Form Labs 3B+Desktop</b>                 | ✓                   | ✓                 |                  | ✓                    |                          | Instant release build platform<br>Automatic resin dispenser and mixer                | <b>\$6,299.00-<br/>\$13,000.00+</b>                    |
| <b>Kulzer Cara Print 4.0</b>                | ✓                   | ✓                 |                  | ✓                    |                          | Lightweight professional printer   | <b>\$15,000 - \$20,000</b>                             |
| <b>Sprint Ray</b>                           | ✓                   | ✓                 | ✓                | ✓                    | ✓                        | Designed for the dental profession specifically                                      | <b>\$10k-\$50k</b>                                     |





# 3D Printing Guide

## Digital Dentistry Technology and Innovation

| Manufacturer                 | Print Time and Quantity  |   |   |   |  |
|------------------------------|--|---|---|---|--|
|                              | <i>The print times listed represent print time only. It does not reflect complete workflow. Print times may vary based on angulation and microns per unit.</i> |   |   |   |  |
|                              | Surgical Guides  | Diagnostic Models   | Digital Dentures  | Splints & Nightguards   | Temporary, Crown & Bridge  |
| <b>Asiga Max UV</b>          | 30-40 minutes<br>3-4<br>60-90 minutes<br>4-6 per platform (standing)   | 20 min<br>2-3 per platform (lying flat)<br>50 min<br>6-8 (standing) | 60-90 min<br>6-8 dentures bases (standing)  | 60-90 min<br>6-8 splints  | Asiga brand materials for Temporaries and crowns is unavailable.<br><br>3D party materials are available         |
| <b>Formlabs 3B+ Desktop</b>  | 49 minutes<br>1 per platform<br><br>2 hours 24 min<br>6 per platform   | 35 minutes<br>1 per platform<br><br>2.5 hours<br>8 per platform     | 3.5 hours<br>1 base platform<br>10 hours<br>8 bases per platform<br>5 hours<br>8 arches of Denture Teeth per platform | 51 minutes<br>1 unit per platform<br>3 hours<br>6 per platform (Hard)<br>3.5 hours<br>6 per platform (soft) | 40-45 minutes<br>1 temp or crown per platform<br><br>5 hours<br>100 units per platform                           |
| <b>Kulzer Cara Print 4.0</b> | 15 minutes<br>5 surgical guides per platform (lying flat)  | 11 minutes<br>14 models per platform (standing)                     | Not Listed<br>Metal framework available to print  | 10 minutes<br>2 splints per platform (lying flat)   | 26 minutes<br>1 crown per platform<br>32 minutes<br>32 crowns per platform<br>35 minutes<br>1-4 unit cast bridge |
| <b>Sprint Ray Pro55 S</b>    | 60 minutes<br>Up to 13 per platform  | 60 min<br>Up to 18 per platform                                     | Not Listed  | 60 min<br>Up to 11 per platform   | Not Listed   |

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**APPENDIX 3: FOR MORE INFORMATION ON DIGITAL IMPRESSIONS AND SCANNERS**

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1. [American Dental Association Technical Report No. 142 CAD/CAM Guided Surgical Devices and Maxillofacial Prosthetics](#)
  - a. This technical report describes methods used to produce repeatable, predictable, and accurate digitally produced surgical guides and maxillofacial prosthetic appliances and is applicable for both dental digital data capture and dental laboratory CAD/CAM (computer-aided design/computer-aided manufacturing) systems
  
2. [American National Standard/ American Dental Association Standard No. 132 Scanning Accuracy of Dental Chairsides and Laboratory CAD/CAM Systems](#)
  - a. ADA/ANSI Standard 132 provides a comprehensive procedure to evaluate 3D optical metrology systems used in dentistry. This standard describes three test objects that represent typical dental scanning parameters use to assess the accuracy, repeatability and reproducibility of 3D optical metrology systems. Additionally, this standard describes the test analysis methods and the acceptable relative error for dental chairside and laboratory CAD CAM systems
  
3. [International standard- ISO/TR 20896-1 Dentistry — Digital impression devices — Part 1: Methods for assessing accuracy](#)
  - a. This document describes test methods for evaluating the accuracy of digitizing devices that acquire data by direct scanning of a patient's dentition with a manually guided; that is hand-held, device in order to obtain a digital impression. A companion document, ISO 12836, provides test methods for assessing the accuracy of fixed devices for digitizing physical impressions or models cast from such impressions. Separate standards were deemed necessary after it became apparent that two of the test objects described in ISO 12836 are unsuited for successful interpretation of data acquired from these objects with a hand-held scanning device.
  
4. [International standard- ISO/TR 20896-2 Dentistry — Digital impression devices — Part 2: Methods for assessing accuracy for implanted devices](#)
  - a. This document describes possible test methods for evaluating the accuracy of digital impression devices designed for direct oral scanning of implant bodies, intended as support for prosthetic appliances to replace a patient's dentition, in order to obtain a digital impression. It is a complement to [ISO 20896-1](#), which assesses the accuracy of digital impression devices from which a digital impression of a patient's dentition can be created. A companion standard, [ISO 12836](#), provides test methods for assessing the accuracy of fixed devices for digitizing physical impressions or models/casts made from such impressions. Separate standards were deemed necessary after it became apparent that two of the test objects described in [ISO 12836](#) were unsuited for successful interpretation of data acquired with a digital impression device.