# 3D Printing Full Dentures with Formlabs 3D Printers

Today, 50 million dentures are produced globally each year, but only 1 percent are produced using digital tools. Traditional denture manufacturing is a complex craft with a steep learning curve, and dental labs increasingly struggle to find technicians with the advanced skills and expertise required to produce them.

Formlabs Digital Dentures allow dental laboratories to grow or expand production with an efficient, cost-effective 3D printed denture solution. Class II long-term biocompatible Denture Base Resin and Denture Teeth Resin enable dental professionals to produce 3D printed full dentures accurately and reliably, every time.

Although the manufacturing process to create a digital denture is different from the traditional workflow, the chairside process is very similar. This application guide details the critical considerations and steps for going from digitized patient model to 3D printed full denture on Formlabs desktop stereolithography 3D printers.

formlabs ✈ | dental

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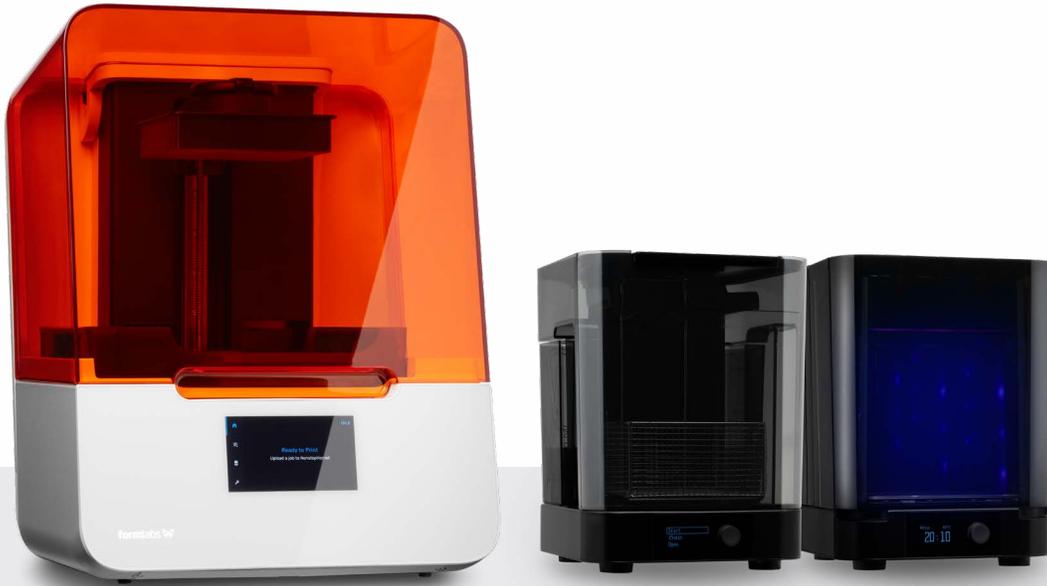
Workflow Requirements

Needed From the Dentist

- A final impression, poured and articulated
- Bite rim with all necessary information, such as: lip line, midline, occlusal plane
- Prescription with desired tooth shape, shade, and other clinical considerations

Made by Formlabs

- Form 2 or Form 3B (SLA) 3D Printer
- The latest Preform and Firmware software
- Resin Tank
  (Form 2 Resin Tank LT or Form 3 Resin Tank 2.0
  or higher)
- Build Platform
  (used with biocompatible materials only)
- Denture Base Resin
- Denture Teeth Resin
- Form Wash or Finish Kit
- Form Cure

Made by 3rd Parties

- Desktop scanner
- Denture design software
- Pyrex 4 cup round container
- Glycerin
- Silicone tongs
- Low speed dental handpiece with cutting and finishing wheels
- Handheld UV light cure unit
- Lathe with rag wheel for polishing
- Steam cleaner

1. Scan and design

1.1 SCAN

Digital denture design software requires a digitized model or impression of the patient's oral anatomy in order to design the removable prosthetic.

The best available method for creating a digital file for edentulous patients is to scan the fully articulated, poured model and wax rim with a desktop laboratory scanner.

To optimize the accuracy of the bite, use a desktop scanner that can scan the bite of the fully articulated model without unmounting it. For example, 3Shape's E Series scanners can scan the bite with the model in the articulator.

1.2 DESIGN

1.2a Denture Design Software

Import the digital file of the patient's anatomy into your denture design software to begin creating the prosthetic.

At Formlabs and in this guide, we use 3Shape Full Denture Design 2018 (2.18.1.0). Older versions may be missing some features. Adjust your workflow according to the software you use. Contact your CAD software distributor for specific questions and guidance.

Download our 3Shape materials library (DME).

1.2b Order Setup

To start, create an order in 3Shape Dental Manager. Correct order setup ensures correct manufacturing output.

1. **Select all of the teeth** for the digital denture.

2. **Under "Anatomy," select "Artificial Tooth Type."** Under the plus sign, select "Formlabs Dentures" as the material type.

3. **Under "Gingiva"**, select the default setting, "Dentures Gingiva." Under the plus sign, select "Formlabs Dentures" as the material type.

4. **Under "Bridge",** select the default setting, "Connector Bridge." This setting is required for dentures that will be splinted together. To print individual teeth, skip this selection.
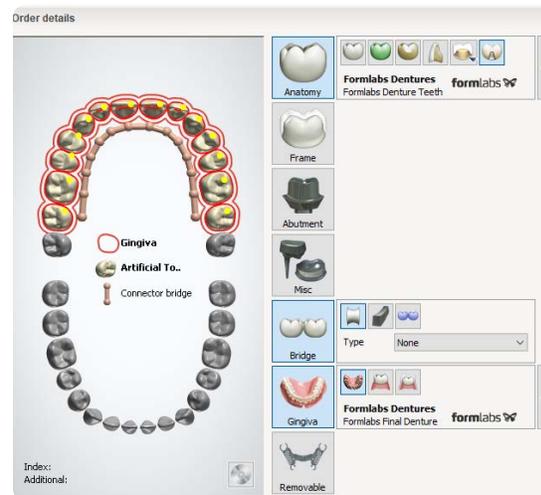
Return to the "Gingiva" submenu. Select the plus sign. Under "Type," choose one of the following options:
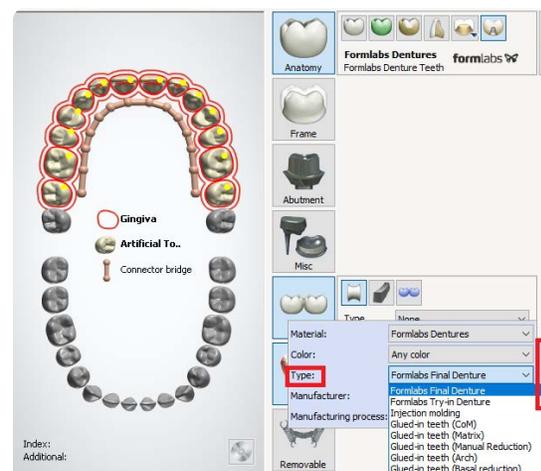
1. Select "**Formlabs Final Denture"** or "**Glued-in teeth (Arch)"** to produce the base and teeth as separate manufacturing files. This is ideal for 3D printing full dentures.

2. Select **"Formlabs Try-in Denture"** or **"Injection molding"** to produce the base and teeth as one solid piece. This is ideal for try-in dentures.
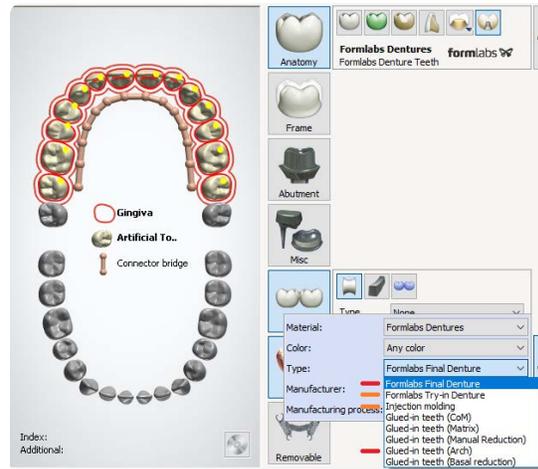

1. **Base thickness is greater than 2.0 mm.** A thicker base creates a stronger 3D printed denture.

2. **Disable drill compensation.**
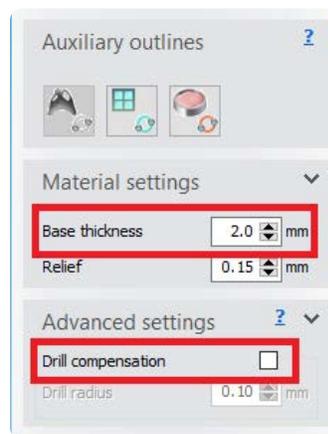
1.2c Design Settings

Vertical non-load-bearing walls can be thinner than 2.0 mm if needed (for example, to thin the facial of the denture for esthetic reasons). Always use the 2D cut tool to confirm thickness.

When designing or drawing the denture base during the "Full Denture Initial Setup" stage, open the "Materials settings" and "Advanced settings" submenus. Confirm the following:
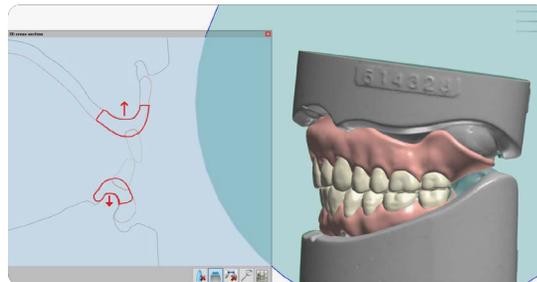
1.2d Coupling Settings

To achieve a natural look for the gingival margin, follow these "Coupling mechanism" recommendations. These settings determine how the denture teeth cut sockets from the denture base.

Since Denture Base Resin is very translucent, long roots to the teeth can look unnatural. Unlike traditional denture teeth, a longer root does not correlate to a stronger bond. The final cure unites the two resins, base and teeth, into one solid part.

Under "Coupling Settings," confirm that the depth is set to 1.00 mm and the angle is between 15 and 30 degrees for optimal results.
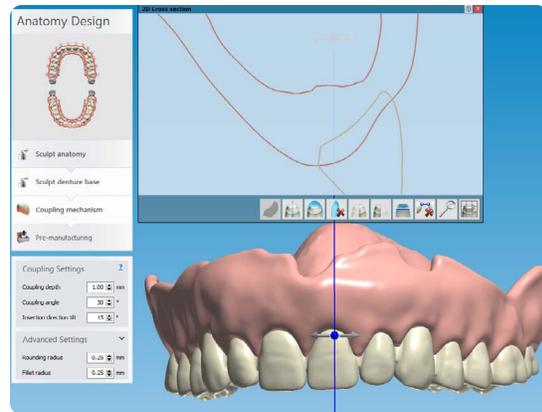
2. STL File Output

Denture teeth or card libraries are an important part of the digital denture process. Library compatibility varies by software. For example, some "open" libraries restrict output. Some libraries generate the denture teeth splinted, but not individually.

OFFICIAL TEETH LIBRARIES AND OUTPUT OPTIONS

Manufacturing output (Assembly type)		ivoclar vivadent:	Candulor	KULZER	Vertex Dental	VITA
	Monoblock	🟢 Distributed by Ivoclar	🟢 Free of charge	🟢 Free of charge	🟢 Free of charge	🟢 Free of charge + noising
	Teeth in arch	🟢 Distributed by Ivoclar	🟢 Free of charge	🟢 Free of charge	🟢 Free of charge	🔴 Not available
	Standalone teeth	🔴 Distributed by Ivoclar	🔴 Not available	🟡 Enabled by Kulzer	🟢 Free of charge	🔴 Not available

Denture libraries supported by 3Shape and what output they support.

Open the Download Center in the 3Shape Dental Manager Control Panel to download new libraries. See 3Shape's documentation for details.

> **Note:** Denture teeth library availability and outputs will likely change as the industry evolves. Follow your digital denture design software provider's guidelines for the most up-to-date information.

3. Preparing

3.1 Import Files Into PreForm

Once you export the STL files from the denture design software, import the files into PreForm, the software that nests files for printing on the 3D printer.

Select the material for printing: Denture Teeth or Denture Base Resin.

Note: For the best results, use the latest version of PreForm and printer firmware.

Denture Teeth

Orientation:

Position the denture teeth at a 10 to 25 degree angle with the anterior teeth closest to the build platform. The occlusal surface of the teeth can face towards or away from the build platform, depending on preference in finishing the part.

Teeth Orientation
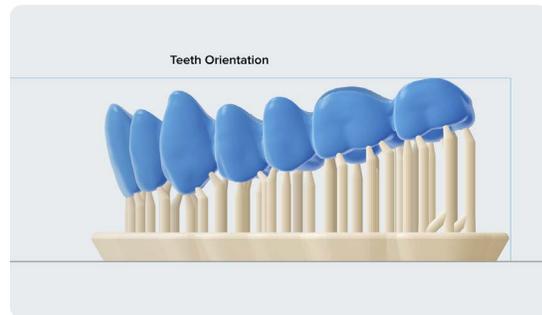
Supports:

To edit support touchpoints, choose "Edit…" in the Supports menu.

Avoid support touchpoints on areas where the teeth meet with the base.

Add support touchpoints to the teeth or arch on the tallest areas of the anatomy, facing the build plate.
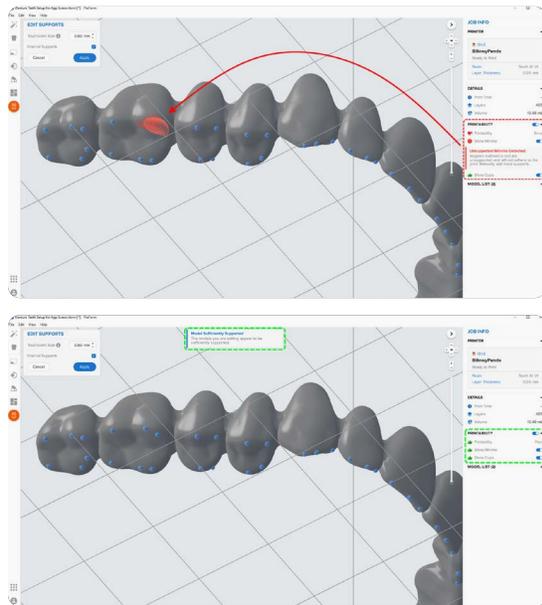
3.2 Orientation

Proper part orientation is critical to ensure part accuracy and reduce post-processing after printing.

Denture Base

Orient the denture base parts at a slight angle, with the intaglio surface toward the build platform. The anterior buccal can face toward or away from the build platform.
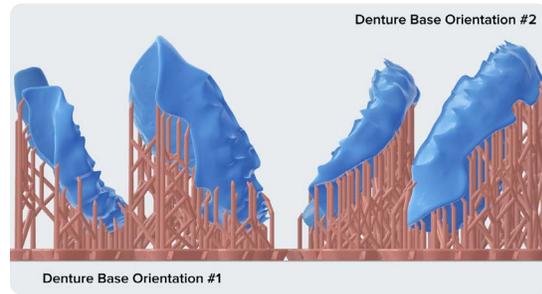
Concentrate support touchpoints around the perimeter edge of the denture. Support removal from these areas is less laborious and leaves critical detailed areas support-free.

On the **intaglio surface**, manually add as few supports as possible. Remove support touchpoints from the red, unsupported, or minima areas.

Remove support touchpoints from the denture teeth sockets or cervical margin.
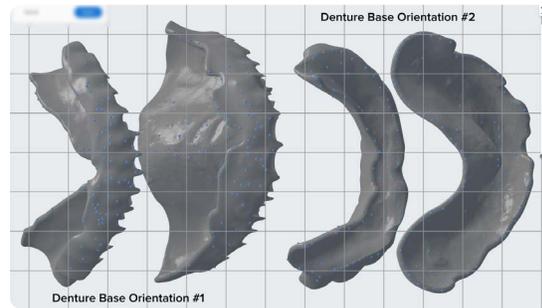
Tip: While adding or editing supports, click the "Printability" button and enable "Show Minima". The Printability feature guides you to add only as many supports as necessary to reduce post-processing time.

Denture Try-in

Print the full denture, teeth, and base with the occlusal side facing downward, at a 30 or 0 degree angle.

Add supports to the teeth as described in **Denture Teeth: Supports** above.
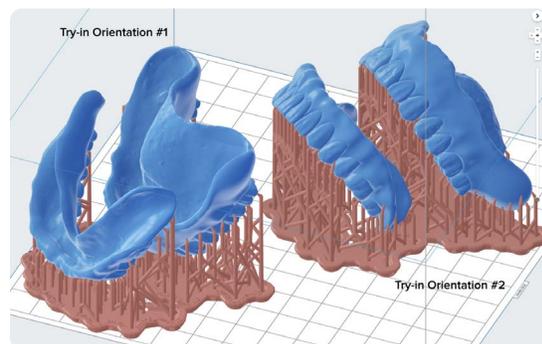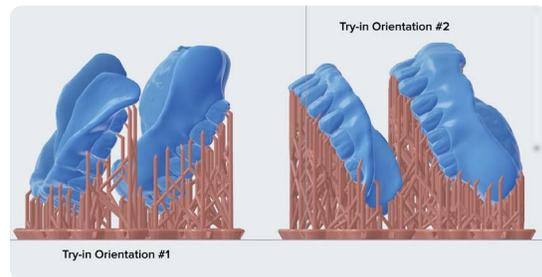
4. Print

Prepare the 3D printer by inserting a resin tank, resin cartridge, and build platform into the printer. Thoroughly shake the resin cartridge before use. Send the job to the printer from PreForm, and start the print.

> **Notice:** For full compliance and biocompatibility, Denture Base Resin and Denture Teeth Resin each require a dedicated resin tank, build platform, and Finish Kit or Form Wash. Only use the Finish Kit or Form Wash with other Formlabs biocompatible resins, such as Dental LT Clear Resin.

5. Post-Processing

5.1   **Primary Wash**

> **Note:** Always use gloves when handling uncured resins and parts.

Remove the printed denture base or teeth from the build platform using the part removal tool provided by Formlabs, or wash directly on the build platform using Form Wash. Rinse the part in isopropyl alcohol (IPA), 96 percent or higher, for ten minutes in Form Wash, or five minutes in an ultrasonic bath, to dissolve any uncured or excess resin.

After washing, allow the parts to air dry or use compressed air to remove alcohol from the parts' surfaces.

5.2 Support Removal

Once the parts have been washed completely, remove the raft and supports from the base and teeth. To save time, consider using a low speed dental handpiece, cutting disc, and rubber wheel.

To remove the raft and supports:

1. Cut through supports a few millimeters from where they meet the part.

2. Remove the raft.

3. Continue to remove and smooth the remaining support structure to the desired outcome.

Cut through supports a few millimeters from where they meet the part.

Remove the raft.

Continue to remove and smooth the remaining support structure to the desired outcome.

If teeth were printed splinted together, reduce the embrasures between teeth with a thin flexible diamond disc for a more natural look.

5.3 Final Wash

Once the supports and raft have been removed, wash parts in IPA one more time for five minutes in Form Wash or an ultrasonic bath to remove any debris. Again, let the part dry or use compressed air to remove alcohol from the parts' surfaces.

6. Assembly

Follow the steps below to insert and bond the teeth into the base.

Insert the teeth into the denture base to test the fit. If anything inhibits seating, trim the teeth and base as needed using the hand tool.

Remove the top vent cap from the cartridge. Pour a small amount of uncured Denture Base Resin (the same shade as printed) into a glass container.

Fill a small glass cup with uncured Denture Base Resin (the same shade as printed). A large tipped syringe can be used to transfer the resin.

Use an instrument, like a small brush, to wet the internal surface of the tooth socket with resin. Do not fill the entire socket with resin.

Work around the entire base, painting the Denture Base Resin into each socket. Insert the teeth into the appropriate socket on the base and press together firmly, applying more pressure toward the posterior of the arch.

Using a small brush, remove any excess resin from the buccal and facial of the denture.

While still pressing the arch together, use a handheld UV cure light to start curing where the teeth and base meet. Start by curing the rearmost molars on both sides of the arch. Increase the clamping pressure towards the front of the arch, then move to cure the anterior teeth. Remove or add Denture Base Resin as needed. Finally, move the handheld UV cure light around the entire arch to complete the tack cure.

Inspect for proper assembly of the denture, and confirm that any triangles or open areas between the base and teeth have been filled with Denture Base Resin. If necessary, add additional resin and repeat the process above.

Warning Always use protective eyewear when working with UV cure lights.

7. Final Post-Cure

At this point, the denture is ready for the final post-cure. Form Cure is recommended and meets all the requirements for optimal post-curing.

Fill a glass container with glycerin. Preheat the glycerin to 80 °C in Form Cure. Use heat resistant silicone tongs to fully submerge the assembled denture in the glycerin, leaving the container inside Form Cure. Cure at 80 °C for 30 minutes.

Note: To maintain biocompatibility, post-cure the assembled denture while submerged in glycerin. When using Form Cure, we recommend a Pyrex 4 cup round glass container and vegetable glycerin.

Warning: The glycerin and denture at 80 °C are hot. Use heat resistant silicone tongs to insert and remove the denture from the curing chamber. To prevent burns, do not touch the metal turntable or container.

After the first 30 minute post-cure, use the tongs to flip the denture to the opposite side. Post-cure the denture again at 80 °C for 30 minutes.

8. Finishing

After post-curing is complete, carefully remove the denture from the glycerin with silicone tongs. Wash the part in a sink under room temperature water until it is no longer slippery or slick to the touch. Allow it to air dry. As with a traditional denture, polish the denture at low speeds using a rag wheel on a lathe with pumice. Finish polishing at high speeds using a polishing compound.

Rinse again with room temperature water and steam clean to sterilize the finished denture.

9. Deliver

Digital manufacturing of prosthetics is the future of dental technology, with the potential to bring higher affordability and quality to patient care as it evolves. Digital techniques do not remove the artistry from from production of dentures: they are another set of tools to help technicians produce highly customized, patient-specific prosthetics.

3D printing has promised to change the way things are made, and 3D printed dentures are one of the first truly economical ways in which people outside of fabrication industries will come to use and interact with 3D printed parts on a day to day basis. When you deliver your 3D printed denture, we hope you will take pride in being a part of this groundbreaking shift.

Additional Resources

Explore Formlabs dental resources for in-depth guides. step-by-step tutorials, white papers, webinars, and more.

See all Dental Resources

Everything You Need to Control Your Digital Future

The Form 3B Complete Package includes all of the tools required to bring high-precision 3D printing into your lab or office.

Request a Free Sample Part