Partial Framework Investment Casting Using MED610
3D Printed Patterns

Removable partial dentures (RPDs) are traditionally handmade, which involves a labor-intensive process that can often produce inconsistent results. In addition, there is significant material waste and finding appropriately skilled technicians is difficult. The production process also entails an excessive number of secondary processes. Finally, the only way to scale up production is by adding manpower, adding to a dental lab's recurring labor cost.

An alternative means of producing RPDs is to use 3D printing to create the pattern, accelerating the production process. Multiple frameworks can be 3D printed at the same time, boosting productivity.

This Technical Application Guide presents the steps to cast RPDs using PolyJet™ biocompatible MED610™ material and Nobilium investment casting materials.

stratasys

Procedure

Figure 1: Scanning the dental stone model with a Dental Wings scanner.

Creating the 3D Printed RPD Patterns

1. Scan the dental stone model using a Dental Wings scanner or equivalent scanning equipment (Figure 1).

2. Design the RPD framework using the Dental Wings software or equivalent software (Figure 2).

3. In Objet Studio™ software, orient the RPD frame models onto the build tray, tissue-side up. Print using High Quality - Glossy mode. In the Advanced setting option, select Light Grid.

   Note
   Up to 30 frames at a time can be produced on the Objet Eden260VS™ 3D Printer (Figure 3).

4. When printing is complete, remove the print tray. Using a scraper, remove the parts from the tray and replace the print tray.

5. Support material can be removed mechanically, chemically and with a waterjet. Remove the bulk of material mechanically using a thin knife such as a blunt Bard-Parker or equivalent. Remove as much support material as possible. Hold a finger under the fragile clasps to support them during material removal (Figure 4).

6. Next, clean off the remaining support material with either of the following two methods.

   Note
   The following method requires adequate safety equipment. Chemically resistive apparel, including goggles, a face shield, long sleeves and gloves are necessary. Follow safe handling instructions provided by the manufacturer before using sodium hydroxide solution (NaOH).

   - Prepare a diluted solution of sodium hydroxide (caustic soda) according to manufacturer instructions. Place the prints with the support removed into the solution at room temperature for 15 minutes. There is no need to use ultrasonic cleaning equipment.

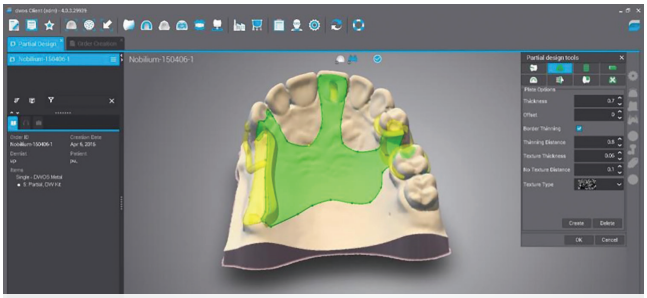

Figure 2: Designing a partial plate framework using Dental Wings software.

Figure 3: A build tray with RPD patterns.

Figure 4: Mechanically remove the soluble support from the 3D printed partial plate framework pattern.

Procedure

- The alternative method uses little or no chemicals. Use a pressure washer to wash the parts, using caution not to break the clasps. Using the sodium hydroxide soaking process after the power wash is an option that reduces cleaning time.

Note
MED610 material will distort if heated above 110 °F (43 °C). If washing in warm water, be sure the water temperature does not exceed 110 °F.

7. Remove the printed model from the sodium hydroxide solution and with a soft toothbrush, gently brush the part. Use caution to avoid breaking thin parts such as posts, clasps or rests. Once the support material is removed, rinse each partial plate with warm water (below 130 °F/55 °C) (Figure 5).

Investment Casting Process

1. Using an electric waxing tool, attach the sprue of the RPD framework to the plastic base former using sticky wax (Figure 6).
2. Obtain a cardboard casting ring and plastic casting base. Coat the cardboard ring with wax.
3. Attach the coated cardboard casting ring to the plastic base. This can be done with an adhesive strip or a staple can be used to hold the ring together. You may also use a foil-lined casting ring. Each ring will hold 600 g of investment (Figure 7).
4. Mix 600 g of CADVEST investment powder with 150 ml of mixed liquid (CADVEST liquid and distilled water, mixed). This is sufficient mixture for one casting ring (Figure 8).
5. Place the mixing bowl with investment in a vacuum mixer (Figure 9).
6. Vacuum-mix the investment for 60 seconds at full vacuum.

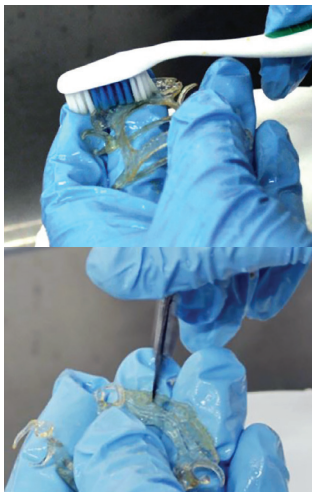

Figure 5: Removal of residual support material.

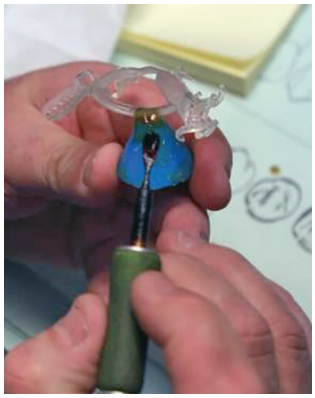

Figure 6: Attaching the sprue of the partial plate to the base former.

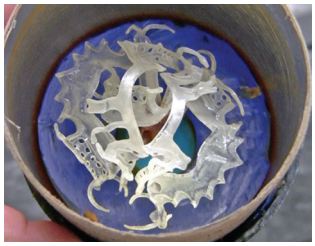

Figure 7: A coated cardboard casting ring and multiple partial framework patterns attached to the base.

Figure 8: Combine the CADVEST investment powder and liquid.

Figure 9: A mixing bowl attached to the vacuum mixer.

Procedure

7. Place the cardboard casting ring at a 45° angle on a vibrator set at low settings and pour the investment mixture into the cardboard casting ring.

   Note
   Be careful not to trap air in the investment. Carefully pour the investment to ensure no bubbles are trapped (Figure 10).

8. Place the rings containing partial frameworks inside a pressure vessel for 15 minutes (Figure 11).
9. After 15 minutes, remove the rings from the pressure vessel and allow them to bench set for one hour.
10. Place the rings into a room-temperature burnout furnace (Figure 12).
11. Turn the furnace on and heat to a casting temperature of 1,850 °F for one hour.
12. Place the ring in a casting machine (Figure 13).
13. Place metal inside the crucible within the casting machine.
14. Turn on the spin cycle to start the casting process.
15. When the casting process is complete, place the cast rings on a cooling rack for one hour (Figure 14).
16. After cooling, carefully break the investment around the cast framework (Figure 15).
17. Sandblast any remaining investment off the partial framework.
18. Place the partial framework in an electrolytic de-plating machine for five minutes (Figure 16).
19. Upon removal, clean and polish the partial framework (Figure 17).

Figure 10: Pour the investment mix into the casting ring.

Figure 11: Cardboard casting rings inside the pressure vessel.

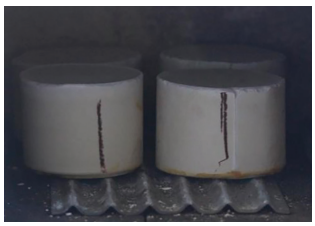

Figure 12: Casting rings inside the burnout furnace.

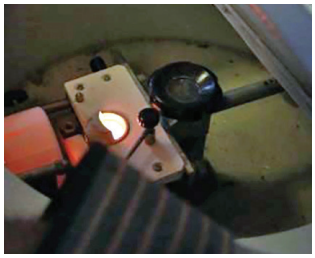

Figure 13: Place the casting ring into an induction casting machine.

Figure 14: Cast rings cooling on the cooling racks.

Figure 15: Break the investment surrounding the cast framework.

Figure 16: Place the partial plate framework in an electrolytic de-plating machine such as this Esmadent Electropolisher.

Figure 17: Multiple frames produced in a single casting process.

Procedure

20. Cut off the casting sprue from the partial framework (Figure 18).
21. Using a carbide finishing bur, smooth and adjust the partial framework to fit the stone dental model (Figure 19).
22. Polish the framework using a polishing wheel (Figure 20).
23. Do a fit check to ensure proper fit (Figure 21).

Tools and Supplies

Stratasys PolyJet 3D Printer

- Scanning equipment (Dental Wings scanner and software used in this guide)
- Electric waxer
- Vacuum mixer machine
- Pressure vessel
- Burnout furnace
- Casting machine
- Sandblaster
- Electropolisher
- Polisher/grinder machine
- Vibrator
- Waterjet washer (optional)

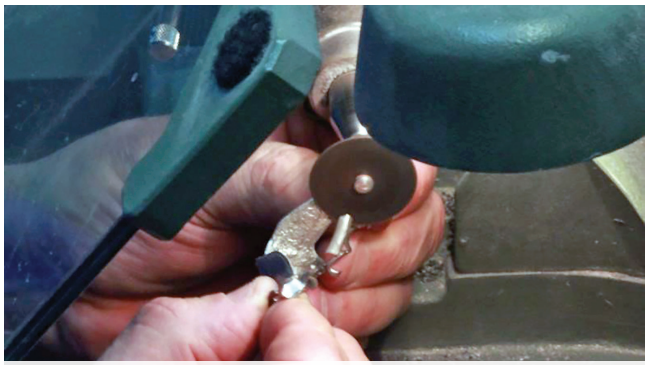

Figure 18: Cut off the casting sprue.

Figure 19: Smooth and adjust the RPD.

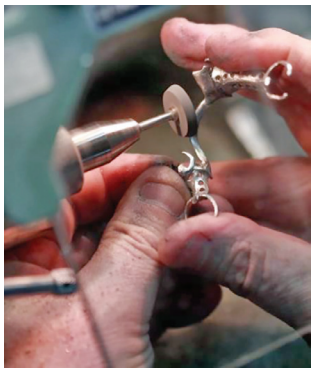

Figure 20: Using a polishing wheel to polish the cast partial framework.

Figure 21: Perform a fit check on the stone model.

Tools and Supplies

Consumables and Miscellaneous

- Sodium hydroxide (NaOH) solution
- Cardboard casting rings and plastic bases
- Investment powder (CADVEST)
- Sticky wax
- Polishing wheels/stones
- Plastic former
- Plastic investment ring
- Electropolishing solution compatible with electropolishing equipment used

Safety Equipment

- Safety glasses
- Latex gloves

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