

## ■ PROSTHODONTICS

# Fabrication of a single-visit additively manufactured flexible removable partial denture as an immediate temporary prosthetic solution

Medhat Sameh Abdelaziz, BDS, MSD/Reham B. Osman, BDS, MSD, PhD/Hossam I. Nassar, BDS, MSD, PhD/  
Amal Ali Swelem, BDS, MSD, PhD

A technique for designing and manufacturing a single-visit temporary removable partial denture is described. This immediate provisional prosthesis is made of a newly introduced esthetic 3D-printed thermoplastic material. The arch to be restored, the antagonist, and the maxillomandibular relationship were optically scanned using an intraoral scanner (Medit i700, Medit). The removable partial denture was designed using the Exocad software program (Dental CAD). The denture base was 3D printed in flexible gingiva-colored resin, while the teeth were 3D printed in permanent tooth-colored resin. This digi-

tally fabricated prosthesis will provide partially edentulous patients with a time- and cost-effective esthetic temporization with adequate retention and high patient acceptance. This technique demonstrates free-form designing of the flexible clasps and their geometry. It also highlights the need to develop specialized dental software programs to include ready-made flexible clasps to cope with the continuous development of flexible 3D-printed resinous materials. (*Quintessence Int* 2025;56:530–536; doi: 10.3290/j.qi.b6354176)

**Keywords:** 3D printing, digital flexible denture, Exocad, same-day denture, temporary denture, thermoplastic resin

A provisional prosthesis serves as a temporary solution during oral rehabilitation until the installation of the definitive prosthesis.<sup>1</sup> Its main function is to preserve esthetics, phonetics, and masticatory function while maintaining occlusal vertical dimension.<sup>2,3</sup>

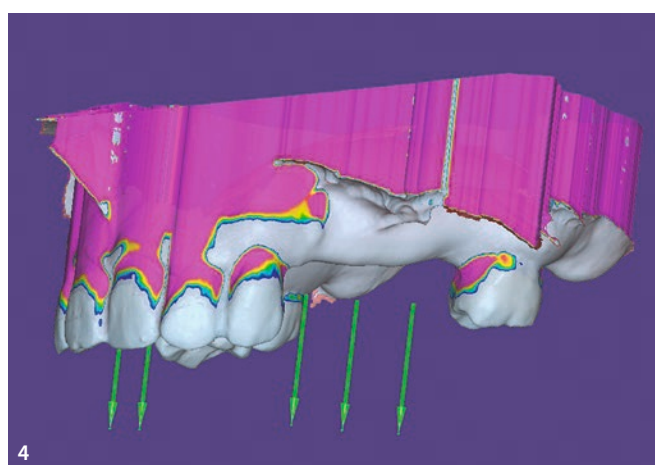
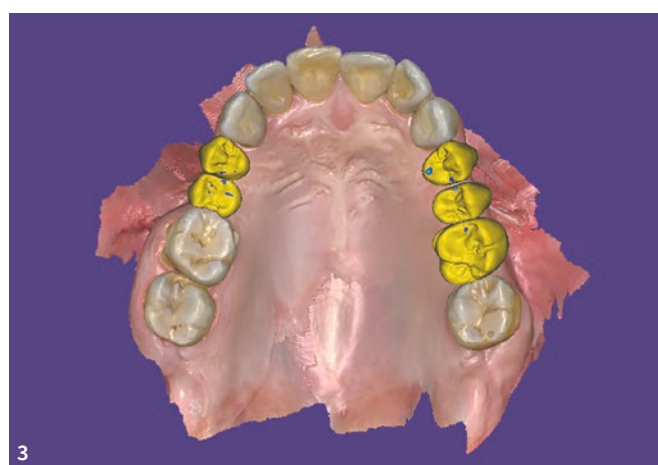
In partially edentulous patients, a temporary prosthesis may be used to restore single or multiple missing teeth, either anterior or posterior.<sup>4,5</sup> Temporary prostheses are mainly used until the patients are rehabilitated with the definitive prosthetic appliance or osseointegration of dental implants and definitive prosthesis loading, or after surgical procedures ranging from simple extraction to bone grafting and sinus elevation.<sup>5</sup> The number of visits and time required for temporary prosthesis fabrication are the most important factors for patient satisfaction.<sup>6,7</sup>

Removable temporary prostheses are usually fabricated from several polymeric materials, such as polymethyl methacrylate (PMMA), which generally depend on metallic clasps for retention. More recently, flexible resin removable partial dentures have been introduced and provided a highly esthetic treat-

ment option with the possibility of constructing the retentive clasps from an esthetic thermoplastic material. The flexibility of the prosthesis enables its use in anatomically complex cases with severe undercuts. However, the conventional way of fabricating either type of temporary removable appliance can be technique-sensitive, requiring multiple visits, time, and skills.<sup>3,8</sup>

The introduction of intraoral optical scanners, computer-aided design (CAD), and computer-aided manufacture (CAM) processes, along with the continuous development of printable dental resin materials, has greatly affected the workflow of the design and fabrication of provisional restorations.<sup>9–13</sup> 3D printing technology has decreased the number of visits and time required to fabricate provisional restorations.<sup>14,15</sup> However, reports on the digital design and fabrication of flexible temporary prostheses using CAD/CAM technology are lacking.

The present technique aimed to implement digital technology in designing and fabricating an immediate, cost-effective temporary prosthesis made of the newly introduced 3D-printable flexible resin material.



**Fig 1** The optical scan of the maxillary and mandibular arches in the correct maxillomandibular relationship.

**Fig 2** The optical scan of the maxillary and mandibular arch in the correct maxillomandibular relationship (lateral view).

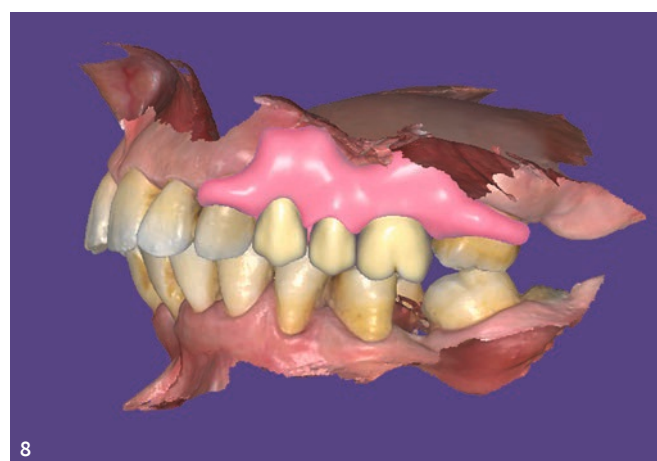
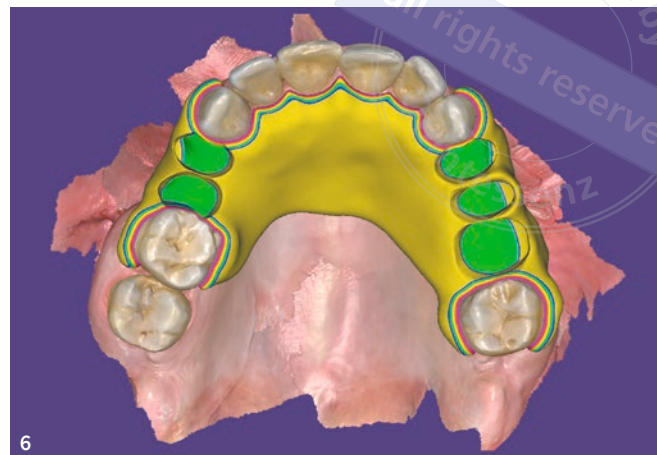
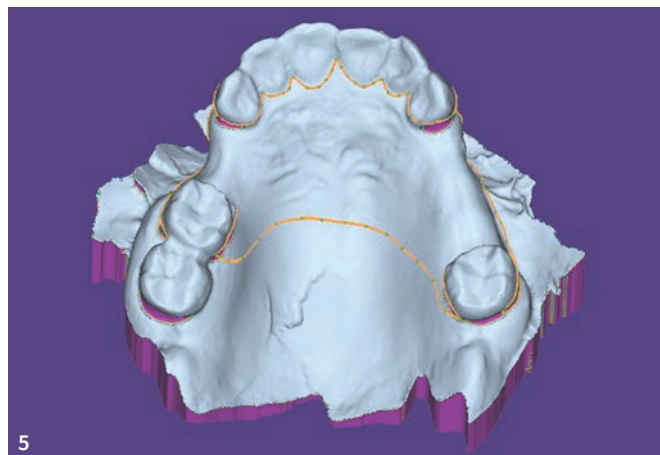
**Fig 3** Virtual 3D teeth setting in the predetermined maxillomandibular relationship.

**Fig 4** Selection of the temporary prosthesis path of insertion; the areas with undercuts greater than 0.5 mm are represented in purple color.

## Technique

The technique consists of digitally designing the temporary prosthesis in two parts: teeth and denture base, followed by 3D printing of the denture base in flexible pink resin and the teeth in tooth-colored resin.

1. Obtain an intraoral optical scan (Medit i700; Medit) of the arch to be restored, the antagonist arch, and the correct maxillomandibular relationship. It is important to accurately scan the proximal, buccal, and lingual surfaces of teeth adjacent to the edentulous areas. It is also important to scan the edentulous ridge, the vestibular sulcus, the palate, and the cingula of the anterior teeth. Export the data in the form of object (OBJ) files (Fig 1 and 2).
2. Import the OBJ files of the scanned arch and its antagonist into the partial denture module of a CAD software program (Dental CAD, Exocad).
3. To design the temporary removable partial denture, start with a virtual setting of the artificial teeth in the predetermined maxillomandibular relationship using the move, rotate, and scale software tool (Fig 3).
4. Select the removable partial denture path of insertion by blocking out unfavorable undercuts that may prevent the prosthesis from seating. The temporary prosthesis will be 3D printed in a flexible material, which allows the presence of undercuts up to 0.5 mm (Fig 4).
5. Outline the denture base that represents the gingival part of the prosthesis and clasps on the blocked-out model (vir-



**Fig 5** Outline of the temporary prosthesis on the blocked-out model.

**Fig 6** The final design of the clasps and denture base should have at least 2.5 mm thickness.

**Fig 7** Occlusal view of the final design of the temporary prosthesis.

**Fig 8** Lateral view of the temporary prosthesis showing artificial teeth in occlusion with its antagonist.

tual wax-up bottoms).<sup>16</sup> Make sure when you are drawing the clasp outline to give the clasp an occluso-gingival height of at least 2 mm to provide a surface area for frictional retention and prevent future fracture of the clasp, as it is made of flexible resin material (Fig 5 and 6).

6. Design the denture base with a thickness of 2.5 mm at least, as recommended by the resin manufacturer. Finally, sculpt the gingival part of the prosthesis using add, remove, and smooth software tools to give the denture a natural and esthetic appearance (Fig 7 and 8; Supplementary Video 1, available online).

7. Export the finalized temporary prosthesis into two pieces, the virtually designed teeth and denture base, including the retentive clasps, in Standard Tessellation Language (STL) format. Prepare the prosthesis for 3D printing using a slicing software program (Chitubox, CBD Technology) by adding supporting arms only on the cameo surface of the denture base, as any supporting arms on the intaglio surface will affect the seating of the prosthesis intraorally.

8. 3D print the denture base using flexible pink resin (Flexo Denture Base, Senertek) and the teeth using definitive tooth-colored resin (P-Crown Resin, Senertek).



**Fig 9** Intraoral occlusal view of the 3D-printed denture base of the temporary prosthesis.

**Fig 10** Intraoral lateral view showing clasp thickness, adaptation, and finishing.

**Fig 11** Finishing the denture base and applying the candy coat layer.

**Fig 12** Joining the 3D-printed teeth to the denture base.

9. Prepare the resin for the 3D printing by shaking the resin bottle for at least 1 minute to ensure proper mixing of all the nanoceramic fillers and pigments within the resin solution. After the printing process, wash the prosthesis with ethanol until there are no shiny areas on the printed denture base or teeth (Fig 9 and 10; Supplementary Video 2, available online).
10. Trim the supporting arm and use the candy coat technique to polish the denture and close any porous areas, applying a thin denture base resin layer on the whole denture base surface using a brush, followed by curing for 2 minutes (Fig 11).

11. Bond the teeth to the denture base by applying a thin layer of denture base resin in the sockets and seating each tooth into its corresponding socket, followed by light curing using an ultraviolet light of 80 to 100 W for 3 minutes (Fig 12).
12. Finally, disinfect the temporary prosthesis with ethanol for 30 seconds, insert it in the patient's mouth after a water bath at 60°C for 5 seconds, and adjust the occlusion if required (Fig 13).



**Fig 13** Intraoral view of the final temporary prosthesis.

## Discussion

This technique reports how to employ digital technology, 3D printing, and newly introduced flexible resin material to design and fabricate a single-visit thermoplastic temporary removable prosthesis. Previous reports have discussed only the digital fabrication of temporary fixed prostheses and metal frameworks of definitive removable prostheses,<sup>12,17</sup> but to the best of the present authors' knowledge, there are no previous articles that discussed the use of CAD/CAM technology to fabricate a temporary removable flexible prosthesis.

In this technique, many challenges were addressed, starting with the design of the temporary prosthesis with adequate clasp height and thickness to prevent fracture and allow for adequate flexibility to engage teeth and soft tissue undercuts without material fracture or deformation. Another challenge was how to implement the available 3D printing technologies to fabricate this thermoplastic material with accurate dimensions, finishing, and polishing.

Since the retentive flexible clasp arm geometry differs from the conventional metal clasp arm, the design of the denture base was performed on the Exocad software using the free-form gingiva drawing software tool to ensure proper width and geometry of the retentive clasp arms.

The design step of the retentive clasp arm highlighted a major limitation of the available dental design software programs. The specialized partial denture software cannot design flexible clasp arms with thickness and geometry that could be used with the recently introduced and developed flexible 3D printed resinous materials. This technique thus highlights the need for collaboration between prosthodontists and software programmers to add designing modules that offer ready-made flexible clasp arms, similar to those present in metallic removable partial dentures. This added module will facilitate the design steps and reduce time, especially for operators with fewer skills in free-form designing.

The optical scan for the patient's mouth was exported in an OBJ file format, as it is a colored 3D file, which allows for differentiation between the teeth and gingival margins during the prosthesis design step. Determining the path of insertion and blocking out the undercuts was an important step, as it will save time during chairside adjustment, allowing for the ease of insertion and removal of the prosthesis. Moreover, the virtual model blocking-out stage helps save time and reduces fabrication costs compared to model duplication in conventional fabrication methods.<sup>18</sup>

During the design step, the denture base was designed to contact the natural teeth directly. It was extended slightly above the height of contour on the palatal surface of the posterior teeth to provide adequate reciprocation to the buccal clasps.<sup>18</sup>

During the 3D printing step, the resin bottle was shaken for at least 1 minute to ensure proper mixing of all the nanoceramic fillers and pigments within the resin solution, as less shaking time results in a more transparent denture base, and on the contrary, shaking for more than 1 minute will lead to an opaque pink denture base. The patient should be instructed to soak the prosthesis in warm water at 60°C for 5 seconds before use to facilitate its insertion intraorally.

Since this digitally fabricated, flexible, temporary, removable partial denture was made from 3D-printed resinous material, the prosthesis could be repaired and relined, which cannot be performed in conventionally fabricated flexible partial dentures.

In this introduced technique, the process of data acquisition, design, fabrication, and intraoral insertion of the temporary prosthesis can be performed in approximately 2 hours, thereby allowing a single-visit temporization procedure. Furthermore, the conventional impression step was omitted, increasing the patient's comfort and acceptance.

The described technique is not recommended as a definitive prosthesis, as the introduced prosthesis is mucosa-supported; hence, the occlusal load is mainly transmitted to the soft tissue. This could eventually affect the periodontium and

supporting structures negatively. Therefore, it is only recommended for temporary use for esthetic and functional requirements until the fabrication of the definitive prosthesis.

Limitations to constructing this type of prosthesis are related to the digital designing skills of the operator, the availability of optical scanners in the dental clinic, and the availability of the 3D printer and the resin material. Clinical studies are also recommended to evaluate both short- and long-term intraoral use of the introduced prosthesis in terms of retention and prosthetic complications. ■■

## Conclusion

The technique described depends on digital technology and 3D printing of novel thermoplastic resin material to design and fabricate a single-visit and cost-effective solution that could be used as an esthetic and flexible temporary prosthesis.

## Disclosure

The authors have no conflicts of interest to declare.

## References

1. Saini RS, Gurumurthy V, Quadri SA, et al. The flexural strength of 3D-printed provisional restorations fabricated with different resins: a systematic review and meta-analysis. *BMC Oral Health* 2024;24:66.
2. Lee J, Clark SR, Tantbirojn D, Koriath TVP, Hill AE, Versluis A. Strength and stiffness of interim materials and interim fixed dental prostheses when tested at different loading rates. *J Prosthet Dent* 2022;127:161–167.
3. Bergamo ETP, Campos TMB, Piza MMT, et al. Temporary materials used in prosthodontics: The effect of composition, fabrication mode, and aging on mechanical properties. *J Mech Behav Biomed Mater* 2022;133:105333.
4. Garg P, Ravi R, Ghalaut P. Outcome of provisional restorations on basis of materials and techniques of choice: a systematic review. *EAS J Dent Oral Med* 2021;3:6–15.
5. Mazurek-Popczyk J, Nowicki A, Arkusz K, Pałka Ł, Zimoch-Korzycka A, Baldy-Chudzik K. Evaluation of biofilm formation on acrylic resins used to fabricate dental temporary restorations with the use of 3D printing technology. *BMC Oral Health* 2022;22:442.
6. Chen C, Lai H, Zhu H, Gu X. Digitally pre-fabricated versus conventionally fabricated implant-supported full-arch provisional prosthesis: a retrospective cohort study. *BMC Oral Health* 2022;22:335.
7. Kumar N, Koli DK, Jain V, Nanda A. Stress distribution and patient satisfaction in flexible and cast metal removable partial dentures: Finite element analysis and randomized pilot study. *J Oral Biol Craniofacial Res* 2021;11:478–485.
8. Abd Allah DAEM, Nawar NH, Abdelfattah AM. Effect of two esthetic digitally produced materials used in fabrication of extracoronal attachments on the stresses Induced in removable partial dentures. *BMC Oral Health* 2024;24:760.
9. Wulfman C, Naveau A, Rignon-Bret C. Digital scanning for complete-arch implant-supported restorations: A systematic review. *J Prosthet Dent* 2020;124:161–167.
10. Medhat Sameh Abdelaziz, Mohamed Wael Ayad EAESAEMT. Fabrication of a reverse-engineered custom scan body as a digital solution for recording implant position: A dental technique (Epub ahead of print, 25 Oct 2023). *J Prosthet Dent* doi: 10.1016/j.prosdent.2023.09.020.
11. Sokolowski A, Horak D, Behlau A, Madreiter-Sokolowski C, Lorenzoni M, Sokolowski A. Evaluation of two printing techniques for maxillary removable partial denture frameworks. *J Prosthet Dent* 2024;131:707.e1–707.e8.
12. Oh KC, Jeon J, Kim JH. Fabrication of a removable partial denture combining conventional and digital techniques. *J Prosthet Dent* 2021;125:588–591.
13. Fekri LK, Dohiem MM, Abdullah MF. Retention of rapid prototyped complete dentures using two retention of rapid prototyped complete dentures using two different types liquid resin. *Futur Dent J* 2021;7:75–78.
14. Nishiyama H, Taniguchi A, Tanaka S, Baba K. Novel fully digital workflow for removable partial denture fabrication. *J Prosthodont Res* 2020;64:98–103.
15. Wang X, Ma D, Zhong S, et al. A digital workflow for designing and manufacturing metal frameworks and removable partial dentures: A novel dental technique (Epub ahead of print, 3 Apr 2024). *J Prosthodont* doi: 10.1111/jopr.13845.
16. Medhat Sameh Abd El Aziz EAESAEMT. Fully digital workflow for reinforced mandibular implant overdenture: a novel method. *J Indian Prosthodont Soc* 2022;22:205–209.
17. Moon W, Kim S, Lim BS, Park YS, Kim RJY, Chung SH. Dimensional accuracy evaluation of temporary dental restorations with different 3D printing systems. *Materials (Basel)* 2021;14:1487.
18. Blakely L, Beare WAV, McColl E. Top tips for removable partial dentures: Part 1 – fundamentals of success. *Br Dent J* 2023;234:202–206.

## Supplementary Videos

[https://video.qvnet.de/qi\\_2025\\_07\\_video/qi\\_2025\\_07\\_v1.mp4](https://video.qvnet.de/qi_2025_07_video/qi_2025_07_v1.mp4)

[https://video.qvnet.de/qi\\_2025\\_07\\_video/qi\\_2025\\_07\\_v2.mp4](https://video.qvnet.de/qi_2025_07_video/qi_2025_07_v2.mp4)



**Medhat Sameh Abdelaziz**

**Medhat Sameh Abdelaziz** PhD Candidate, Department of Prosthodontics, Faculty of Dentistry, Cairo University, Giza 12613, Egypt; and Assistant Lecturer, Prosthodontics Department, Faculty of Oral and Dental Medicine, Future University in Egypt, Cairo, Egypt

**Reham B. Osman** Professor, Department of Prosthodontics, Faculty of Dentistry, Cairo University, Giza, Egypt

**Hossam I. Nassar** Professor, Prosthodontics Department, Faculty of Oral and Dental Medicine, Future University in Egypt, Cairo, Egypt

**Amal Ali Swelem** Professor, Department of Prosthodontics, Faculty of Dentistry, Cairo University, Giza, Egypt

---

**Correspondence:** Dr Medhat Sameh Abdelaziz, Department of Prosthodontics, Faculty of Oral and Dental Medicine, Future University in Egypt, Fifth Settlement, End of 90 Street, New Cairo, Cairo, Egypt; and Cairo University, Giza 12613, Egypt.

Email: medhat.shehata@dentistry.cu.edu.eg; medhat.abdelaziz@fue.edu.eg; dr.medhatsameh@gmail.com. ORCID: 0000-0002-9646-2343

*First submission: 2 May 2025*

*Acceptance: 28 Jun 2025*

*Online publication: 8 Jul 2025*