

# FABRICATION OF IMPLANT-ASSISTED RESTORATIONS UTILIZING FUNCTIONAL IMPRESSION TECHNIQUES: CASE REPORTS

Bulent Uludag, DDS, PhD; Gozde Celik, DDS, PhD; Volkan Sahin, DDS, PhD; Ozge Ozturk, DDS, PhD

This article describes the fabrication of implant-supported overdentures and removable partial dentures attached to anterior fixed partial dentures utilizing impression techniques to transfer the position of implants and record soft tissue areas in a functional state.

**Key Words:** impression technique, implant overdenture, removable partial

## INTRODUCTION

**C**linicians are often challenged to provide efficient and affordable implant restorations to patients with resorbed edentulous jaws. Deficient residual alveolar bone and other anatomical limitations may prevent placement of implants in the most desirable positions,<sup>1</sup> especially in the posterior regions of the mandible.<sup>2,3</sup> In the edentulous maxilla, residual ridge width is often inadequate to accommodate implants, and bone height may also be limited by the close proximity of the maxillary sinus.<sup>4,5</sup> Despite these anatomic limitations, placement of implants in the anterior regions of both jaws may generally occur.<sup>6,7</sup> The use of an efficient minimal number of implants and a removable prosthesis also offers a less expensive option for an edentulous patient.<sup>8,9</sup> Two restorative solutions include a removable overdenture with combined implant and soft tissue support,<sup>10</sup> and an anterior fixed partial denture with distal precision attachments to stabilize a posterior removable partial denture.<sup>6</sup>

There are two basic methods used for transferring implant positions from the mouth to working casts: direct and indirect impression techniques.<sup>11</sup> In addition,

an impression technique that records the alveolar mucosa in a functional state and the implant components accurately has been reported.<sup>12-14</sup> This functional impression technique is utilized to minimize the difference in resiliency between implants and the supporting soft tissues. While considering the proper impression technique for combined implant- and tissue-supported removable overdentures, attachment selection may also play an important role.

In general, implant-supported overdenture attachments can be classified as studs, magnets, or bars.<sup>15</sup> Determinants for attachment selection include type of prosthesis, the length of the bar, the number and inclination of implants, and the dexterity, expectations, and financial capabilities of the patients.<sup>16</sup>

Plastic and metal clips are generally used to connect the prosthesis to the bar attachment.<sup>17-19</sup> Although electroforming technology has been generally used for galvanoceramic restorations,<sup>20,21</sup> it can also be used with bars to retain the prosthesis. The electroforming process makes for a viable, convenient, and economic alternative to cast metal substructures.<sup>20</sup>

This report describes 3 cases that utilized functional impression techniques to fabricate economical implant-supported prostheses for patients with resorbed edentulous jaws.

## CLINICAL REPORT

### Case 1

A 75-year-old woman suffering from soft tissue irritation and poor retention of her mandibular

*Bulent Uludag, DDS, PhD, is a professor at Ankara University, Faculty of Dentistry, Department of Prosthodontics. Address correspondence to Dr. Uludag at Ankara University, 06500 Besevler, Ankara, Turkey (e-mail address: uludag@dentistry.ankara.edu.tr).*

*Gozde Celik, DDS, PhD, Volkan Sahin, DDS, PhD, and Ozge Ozturk, DDS, PhD, are research assistants at Ankara University, Faculty of Dentistry, Department of Prosthodontics.*

complete denture was referred to the prosthodontics clinic at Ankara University Faculty of Dentistry. Intraoral and radiographic evaluation revealed that she had resorbed mandibular posterior ridges, and bone bulges in the anterior mandible region. Although her maxillary complete denture was retentive and stable, the esthetics of the denture was compromised.

A new mandibular implant-supported overdenture and maxillary complete denture were prescribed for the patient. After her approval, 4 implants were treatment planned, but compromised anatomy limited the placement of 3 implants (Tapered Screw-Vent; Zimmer Dental Inc, Carlsbad, Calif), 3.3 mm in diameter and 10 mm in length, between the mandibular mental foramina. During surgery, the bone bulges were removed and alveoloplasty was performed.

Following a one-week period, the mandibular denture was relined with a resilient liner (Ufi Gel P; Voco GmbH, Cuxhaven, Germany). The implants were exposed and healing caps were placed after 4 months. Preliminary impressions of both arches were made with irreversible hydrocolloid (CA 37; Cavex Holland BV, Haarlem, Netherlands) the following week. Acrylic custom trays were fabricated. The mandibular custom tray was prepared by excluding anterior region where the implants were placed. Six positive notches 2 mm in height and 2 mm in diameter were prepared only on the anterior lingual side of the mandibular tray to provide retention for the elastomeric impression material. Escape holes 1 mm in diameter were prepared on the tray (Figure 1).

Tapered abutments (4-mm cuff height, 3.5-mm D platform, Zimmer Dental) and tapered abutment direct transfer components (Zimmer Dental Inc) were placed on the implants. The access holes of these components were temporarily occluded (Cavit; 3M ESPE, Seefeld, Germany) to avoid flowing of impression material into the holes. After border molding with plastic material (Impression Compound; Kerr Italia S.p.A., Salerno, Italy), an impression of posterior edentulous regions was made with zinc oxide eugenol impression paste (SS White; Prima Dental Group, Gloucester, UK) (Figure 2). The tray was removed from the mouth and excessive impression material was cleaned around the tray border. Dental floss was wrapped between the transfer components and a glove piece was positioned above the floss to provide a support to the resin. The transfer components were fixed together with a self-curing attachment pickup material (ERA Pickup; Sterngold, Attleboro, Mass).

After the polymerization of the material, the glove material and dental floss were removed. The tray was resealed into the mouth.

Light-body elastomeric impression material (Speedex; Coltene/Whaledent Inc, Cuyohoga Falls, Ohio) was injected around transfer components, and supported with heavy body elastomeric impression material (Speedex), which was placed above the light body material (Figure 3). The tray was removed by unscrewing the screws retaining the transfer components. Tapered abutment replicas were screwed to transfer components that were inside of the impression. A smooth transition between the impression materials was noted (Figure 4).

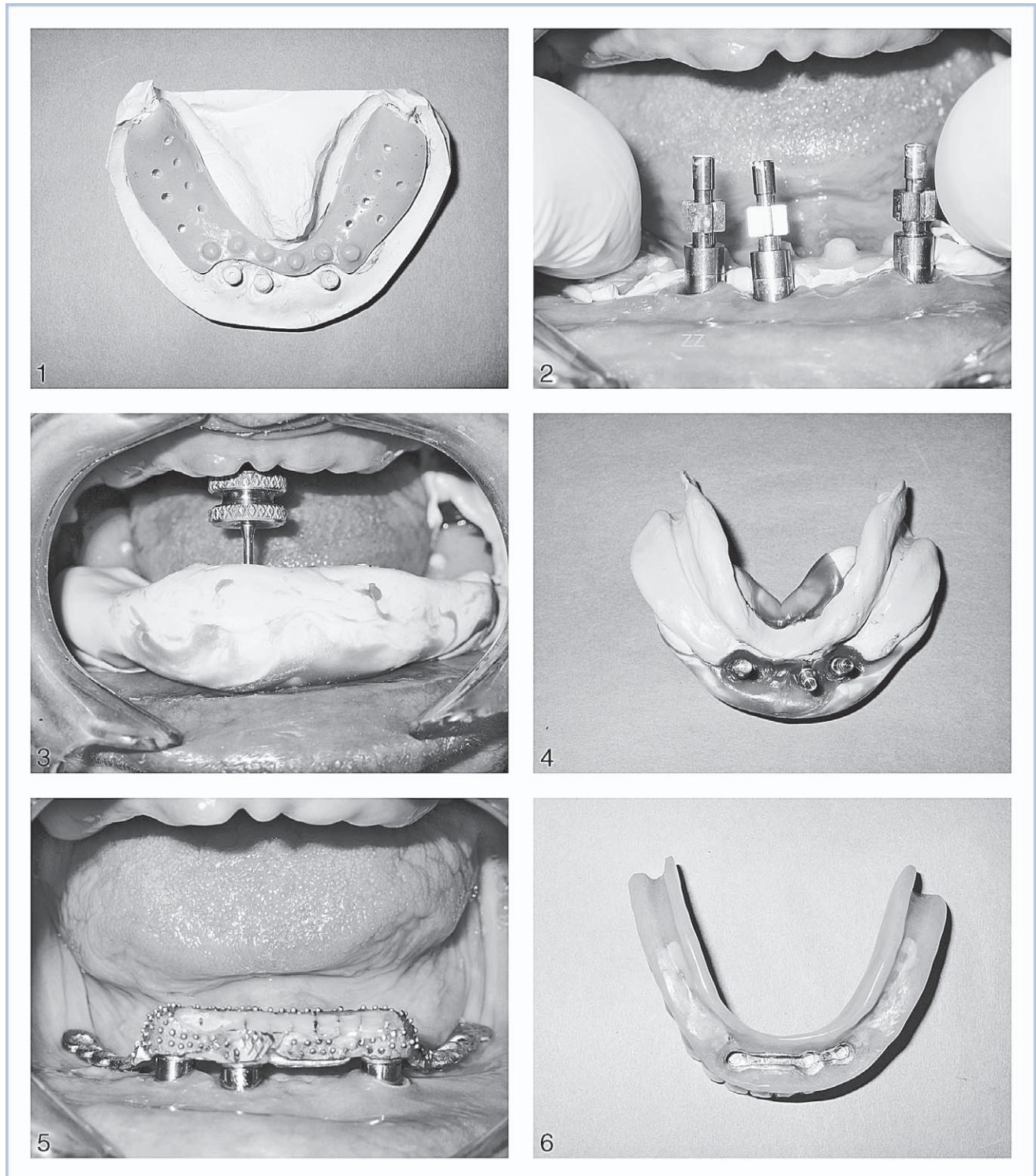
The maxillary impression was made with zinc oxide impression material and the border-molded custom tray. The impressions were poured with Type IV stone (BEGO; Bremen, Germany).

Record bases and occlusion rims were prepared using plastic castable copings (Zimmer Dental Inc) on terminal abutments to stabilize record bases. The casts with centric and vertical relation records were transferred to a semi-adjustable articulator (Denar Advantage; Teledyne Waterpik, Fort Collins, Colo) using face-bow. Maxillary and mandibular teeth were arranged. The vertical dimension of occlusion and centric relation were confirmed intraorally and a protrusive record was obtained. Balanced occlusion was obtained on the articulator. Mandibular teeth were transferred to a silicone index.

A parallel-sided bar (Bredent, Senden, Germany) was cast with base metal alloy (Biosil-F; Degussa, Hanau, Germany), sectioned and soldered to ensure a passive fit. The bar was milled with a surveyor (BEGO). After the passive fit of the bar was verified intraorally, a gold secondary superstructure was fabricated by electroforming process in the laboratory.

A mandibular framework was fabricated to retain the secondary superstructure (Biosil-F). The gold secondary structure was fixed onto the framework with a self-curing resin cement (DTK Kleber; Bredent, Germany) and verified intraorally (Figure 5). The teeth were transferred from the silicone index onto the framework. The maxillary complete denture was reinforced with a metal mesh. A pink colored opaquer (Ropak Kompaktopaker UV; Bredent, Senden, Germany) was applied on meshes of the framework to cover the metal color. The dentures were completed in a conventional manner (Figure 6).

The patient was recalled for follow-up visits every 2 months during a 16-month follow-up, and no complications were reported.



FIGURES 1-6. FIGURE 1. Prepared mandibular custom tray. FIGURE 2. Impression of mandibular edentulous areas with zinc oxide eugenol. FIGURE 3. Elastomeric impression material was added around the implant components. Note that the access holes of the transfer pieces were uncovered. FIGURE 4. Definitive impression of the mandible. FIGURE 5. Gold structure fixed into the framework was verified intraorally. FIGURE 6. Tissue-side view of final prosthesis.

### Case 2

A 60-year-old man presented to prosthodontics clinic with a chief complaint of unretentive and unstable dentures and a request for a fixed prosthesis. In the intraoral and radiographic evaluations, the patient's maxillary complete denture and mandibular removable partial denture (RPD) were observed to lack retention and stability. The patient presented with resorbed posterior residual ridges and only a mandibular right canine, which had a bad prognosis and needed to be extracted.

After extraction of the canine, immediate complete dentures were fabricated and several treatment options were offered to the patient: (1) a maxillo-mandibular fixed implant-supported prosthesis after rebuilding the posterior ridge heights and sinus lifting, (2) implant-supported overdentures, or (3) a maxillary overdenture and mandibular bilateral removable partial denture (RPD) anchored to an anterior implant-supported fixed partial denture (FPD). After discussing the treatment options, the patient chose the latter because it provided a fixed anterior restoration in the mandible without the need for advanced surgical procedures to rebuild the posterior alveolar ridges.

Three months after extraction of the canine, 3 implants ( $3.7 \times 11$  mm, Tapered Screw Vent) were placed in the anterior maxilla and 3 implants ( $3.7 \times 13$  mm, Tapered Screw Vent) were placed in the mandibular interforaminal area according to the patient's anatomic needs, expectations, and economic limits. One week after stage-1 surgery, the patient's existing dentures were relined with resilient material (Ufi Gel P). After 6 months of submerged healing, stage-2 surgery was performed. Mandibular healing caps and maxillary tapered abutments (2-mm cuff height, 3.5-mm D platform) with healing caps (Zimmer Dental Inc) were placed. One week later, preliminary impressions were made (CA 37). Custom trays (Figure 7) were prepared by excluding the anterior region where the implants were placed. Positive notches on mandibular molar regions and maxillary midpalatal region were prepared on acrylic trays to apply finger pressure while impressing. Border moldings were completed with impression compound material. Mandibular healing caps were replaced with impression posts. The access holes on the impression posts were occluded with temporary filling material (Cavit). An impression of the posterior ridges was made with zinc oxide eugenol impression paste (SS White). Excessive impression material was cleaned according to the tray border around implants and the tray was placed carefully into the mouth again. Light body elastomeric

impression material (Bresicion; Bredent, Senden, Germany) was injected around the impression posts. An impression was made with heavy body impression material using a stock tray over the acrylic tray. A smooth transition between the impression materials was achieved. After removal of the impression from the mouth, impression posts were removed from the implants and screwed to implant analogs. The impression post/implant analogs were inserted into the impression.

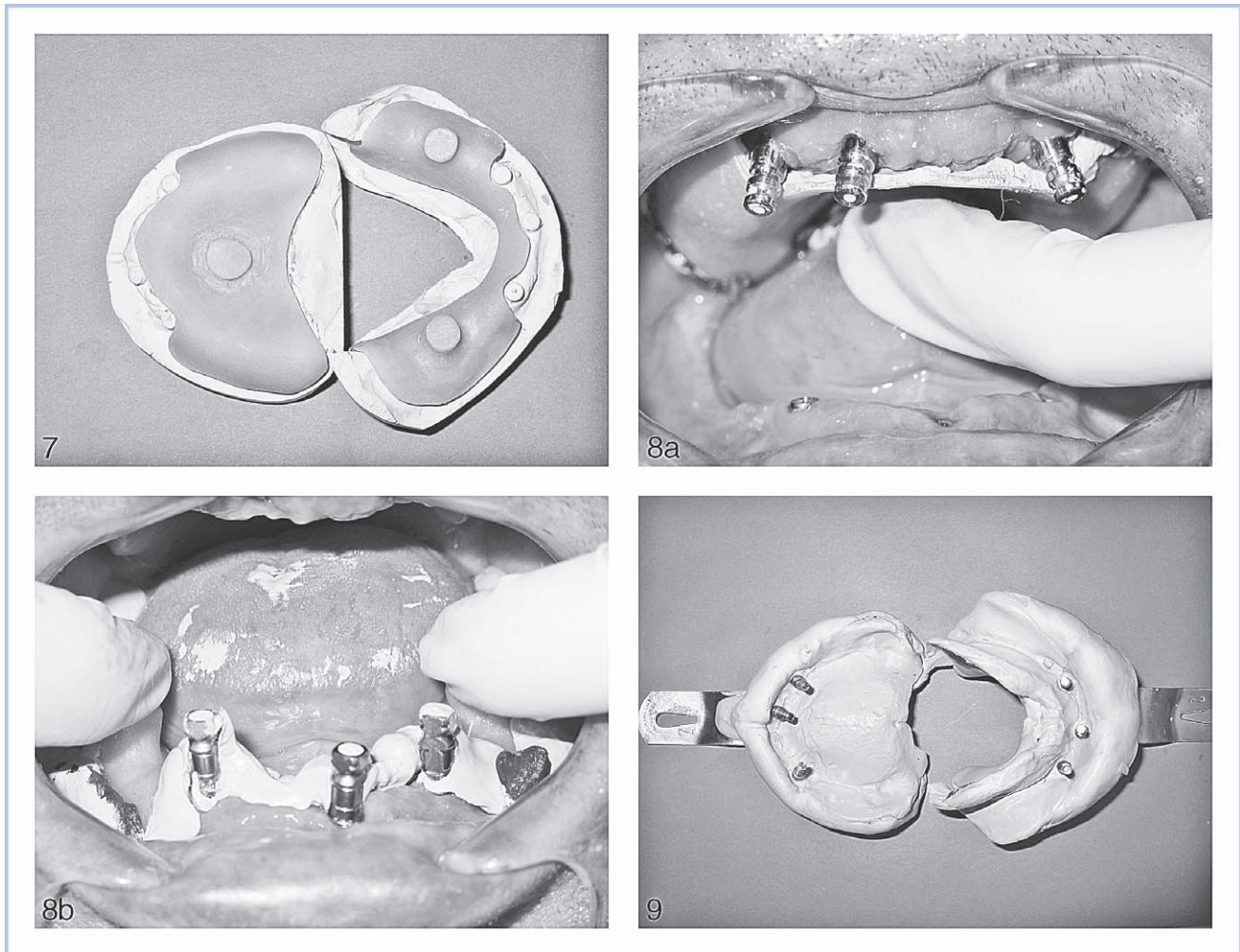
The maxillary tapered abutment healing caps were removed and tapered abutment indirect transfer components (Zimmer Dental Inc) were placed onto the abutments. The impression of posterior edentulous regions was made with zinc oxide eugenol impression paste (SS White) (Figure 8a). A maxillary impression was completed using the same technique as the mandible (Figure 8b). Indirect abutment transfer pieces were removed from the mouth, screwed to tapered abutment replicas, and inserted into the impression (Figure 9). The impressions were poured with Type IV stone (BEGO).

Centric and vertical relation records were obtained with record bases and occlusion rims. The casts were transferred to a semi-adjustable articulator (Denar Advantage) using face-bow.

Mandibular abutments were milled with a surveyor (BEGO). An anterior metal-ceramic restoration with distal ball attachments (OTcap; Rhein 83, Italy) was waxed and cast with a base metal alloy (KeraN; Eisenbacher Dentalwaren GmbH, Woerth, Germany). After the fit of casting was verified intraorally, the metal-ceramic restoration was completed (Omega 900; VITA Zahnfabrik, Bad Sackingen, Germany).

A mandibular RPD framework with a lingual bar major connector was fabricated (Biosil-F), and a passive fit was verified intraorally. Maxillary and mandibular posterior tooth arrangements were evaluated. The vertical dimension of occlusion and centric relation were confirmed, and a protrusive record was obtained. Balanced occlusion was obtained on the articulator. Maxillary teeth were transferred to a silicone index.

A maxillary bar was fabricated and cast (Biosil-F) using plastic castable copings (Zimmer Dental Inc) and a plastic bar with 2 resilient Ceka attachments (Ceka Attachment system; Ceka N.V., Antwerpen, Belgium). The framework's passive fit was verified intraorally. A metal superstructure with a U-shaped major connector was waxed over the bar and cast in cobalt chromium alloy (Biosil-F). The teeth in the silicone index were transferred to the wax-up. A pink-colored opaquer (Ropak Kompaktopaker UV) was applied on



FIGURES 7-9. FIGURE 7. Prepared custom trays. FIGURE 8. (a) Impression of maxillary edentulous areas with zinc oxide eugenol. (b) Impression of mandibular edentulous areas with zinc oxide eugenol. FIGURE 9. Definitive impressions.

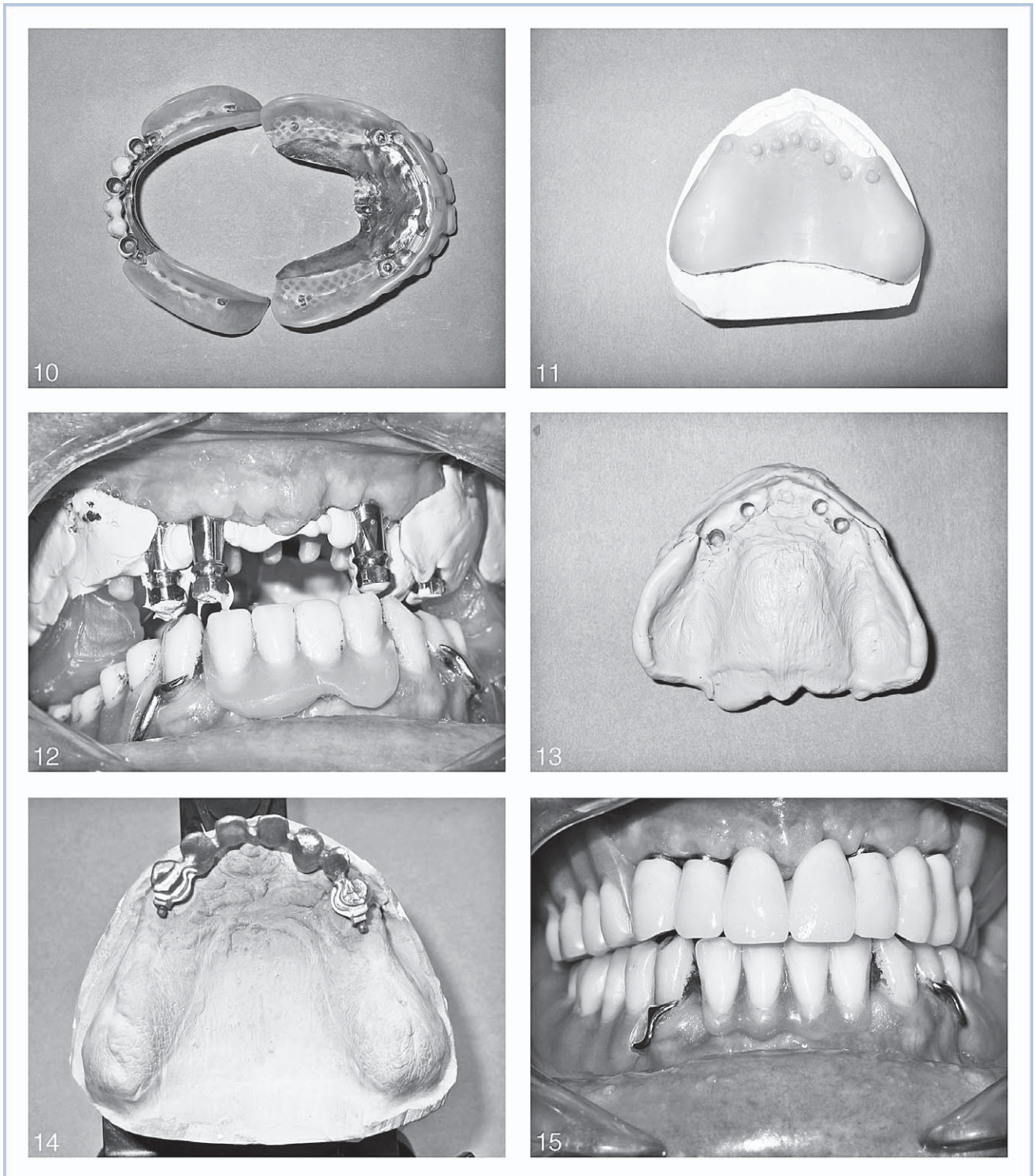
meshes of both frameworks to cover the metal color. The dentures were completed in a conventional manner (Figure 10). The mandibular anterior FPD was cemented with zinc phosphate cement (HY-Bond; Shofu Inc, Kyoto, Japan). The dentures were delivered to the patient.

The patient was informed about oral hygiene. At the first follow-up visit, he stated that greater comfort functionally and psychologically had been achieved. The patient returned for follow-up visits every 2 months during a one-year period.

### Case 3

A 55-year-old man was referred to prosthodontics clinic with an unretentive and unstable maxillary complete denture. After intraoral and clinical examination, an overdenture with 4 implants in the maxillary

anterior region was suggested to the patient. After his approval, 4 implants ( $3.7 \times 12$  mm, SwissPlus; Zimmer Dental Inc) were placed. After 6 months, healing caps were placed onto the implants. One week later, a preliminary impression (CA 37) was made. An acrylic custom tray (Figure 11) was prepared by excluding the anterior region and creating positive notches on the palatal side of the tray to retain the elastomeric impression material (Bresiclon). Occlusion rims were placed on the tray to achieve the optimum vertical occlusion dimension. Mandibular healing caps were replaced with fixture mounts (Swissplus). Border molding was performed with impression compound material (Impression Compound). The screw access holes on the fixture mounts were temporarily occluded (Cavit) to prevent the ingress of impression material. An impression of the posterior edentulous



FIGURES 10-15. FIGURE 10. Intraoral view of the final dentures. FIGURE 11. Prepared maxillary custom tray. FIGURE 12. Impression of maxillary edentulous area with zinc oxide eugenol. Note occlusion rims. FIGURE 13. Definitive impression. FIGURE 14. Maxillary anterior FPD with distal ball attachments. FIGURE 15. Intraoral view of definitive prosthesis.

ridges was made with zinc oxide eugenol impression paste (SS White) (Figure 12). The tray was removed, excessive impression material was cleaned according to the tray border around implants and the tray was placed carefully into the mouth again. Light body elastomeric impression material (Bresicion) was injected around the fixture mounts and then supported with heavy body elastomeric impression material (Bresicion). After removal of the impression from the mouth (Figure 13), fixture mounts were removed from the implants and screwed to implant analogs. The impression post/implant analogs were inserted into the impression. After the cast was poured with Type IV stone (BEGO), centric and vertical relationships were obtained with record bases and occlusion rims. The cast was then transferred to a semi-adjustable articulator (Denar Advantage) using face-bow. A metal FPD framework with distal attachments (Bredent) was cast from a base metal alloy (Kera N) (Figure 14). After try-in of the metal framework, veneering porcelain (Vita Omega 900 Metal Ceramics; VITA Zahnfabrik, Bad Sackingen, Germany) was applied and the FPD was evaluated for color, form, and occlusal contacts. The metal RPD framework was cast from base metal alloy (Biosil-F) and try-in was performed. The teeth were arranged, and a trial denture setup was made. The denture was finished (Figure 15). The patient was recalled for follow-up visits every 2 months during an 18-month follow-up

### DISCUSSION

Although a double impression technique has been recommended for overdentures supported by only 2 implants,<sup>13</sup> a functional impression technique was utilized in the presented cases. In the dental literature, one type of impression material is generally used for implant-supported overdentures.<sup>13</sup> However, successful results with alternative impression techniques utilizing impression materials with different viscosities can be achieved. The aim of the described technique is to ensure the adaptation of the denture base and to transfer the relation of implant components and prosthesis base in an accurate way. Another aim of the technique is to reduce the resilience difference between implants and supporting soft tissue.<sup>12</sup> The advantage of this type of impression is that the soft tissues and implants can be recorded with impression materials of different viscosities, which decreases the chair time for post insertion maintenance. The post-insertion period requires less maintenance and chair-side time than conventional techniques.<sup>14</sup> The disadvantage of the technique is its sensitivity and the

requirement of experience and time during the impression phase. Further experimental studies in regard to accuracy of such techniques would be useful.

### CONCLUSIONS

The application of a functional impression technique for fabrication of implant-supported dentures resulted in improved function, esthetics, and comfort for the patients. No clinical complications were noted during the follow-up periods.

### REFERENCES

1. Taylor TD, Agar JR. Twenty years of progress in implant prosthodontics. *J Prosthet Dent.* 2002;88:89–95.
2. Nevins M, Mellonig JT, (eds). *Implant therapy: Clinical Approaches and Evidence of Success.* Carol Stream, IL: Quintessence; 1998:142–148.
3. Misch CE. *Contemporary Implant Dentistry, 2nd ed.* St. Louis, MO: Mosby; 1999:89–108,210–211,378.
4. Chan MFWY, Narhi TO, DeBaat C, Kalk W. Treatment of the atrophic edentulous maxilla with implant-supported overdentures: a review of the literature. *J Prosthet Dent.* 1998;11:7–15.
5. Ulm CW, Solar P, Gsellmann B, Malejka M, Watzek G. The edentulous maxillary alveolar process in the region of the maxillary sinus—A study of physical dimension. *Int J Oral Maxillofac Surg.* 1995;24:279–282.
6. Starr NL. The distal extension case: an alternative restorative design for implant prosthetics. *Int J Periodont Restorative Dent.* 2001;21:61–67.
7. Pellecchia M, Pellecchia, Emtiaz S. Distal extension mandibular removable partial denture connected to an anterior fixed implant-supported prosthesis: a clinical report. *J Prosthet Dent.* 2000;83:607–612.
8. Ochiai KT, Williams BH, Hojo S, Nishimura R, Caputo AA. Photoelastic analysis of the effect of palatal support on various implant-supported overdenture designs. *J Prosthet Dent.* 2004;91:421–427.
9. Johns RB, Jemt T, Heath MR, et al. A multicenter study of overdentures supported by Branemark implants. *Int J Oral Maxillofac Implants.* 1992;7:513–522.
10. Sadowsky SJ. The implant-supported prosthesis for the edentulous arch: design considerations. *J Prosthet Dent.* 1997;78:28–33.
11. Akca K, Cehreli MC. Accuracy of 2 impression techniques for ITI implants. *Int J Oral Maxillofac Implants.* 2004;19:517–523.
12. Uludag B, Celik G. An alternative impression technique for implant-retained overdentures. *J Prosthet Dent.* 2006;96:377–378.
13. Mericske-Stern R, Taylor TD, Belser U. Management of the edentulous patient. *Clin Oral Impl Res.* 2000;11:108–125.
14. Uludag B, Sahin V. A functional impression technique for an implant-supported overdenture: a clinical report. *J Oral Implantol.* 2006;32:41–43.
15. Preiskel H. *Overdentures Made Easy: A Guide to Implant and Root Supported Prosthesis.* 1st ed. London: Quintessence; 1996:81,105.

16. Block M, Kent J, Guerra L. *Implants in dentistry*. Philadelphia, PA: WB Saunders: 1997:100.
17. Chung KH, Chung CY, Cagna DR, Cronin RJ. Retention characteristics of attachment systems for implant overdentures. *J Prosthodont*. 2004;13:221–226.
18. Williams BH, Ochiai KT, Hojo S, Nishimura R, Caputo AA. Retention of maxillary implant overdenture bars of different designs. *J Prosthet Dent*. 2001;86:603–607.
19. Davodi A, Nishimura R, Beumer J. An implant-supported fixed-removable prosthesis with a milled tissue bar and Hader clip retention as a restorative option for the edentulous maxilla. *J Prosthet Dent*. 1997;78:212–217.
20. Vence BS. Electroforming technology for galvanoceramic restorations. *J Prosthet Dent*. 1997;77:444–449.
21. Erpenstein H, Borchard R, Kerschbaum T. Long-term clinical results of galvano-ceramic and glass-ceramic individual crowns. *J Prosthet Dent*. 2000;83:530–534.