REHABILITATION OF THE MAXILLARY ARCH WITH IMPLANT-SUPPORTED FIXED RESTORATIONS GUIDED BY THE MOST APICAL BUCCAL BONE LEVEL IN THE ESTHETIC ZONE: A CLINICAL REPORT

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This article describes a prosthetically-driven protocol for the rehabilitation of the completely edentulous maxillary arch using immediate implant placement and loading techniques. After the incisal edges of the planned maxillary central incisors are determined, the most apical buccal bone level in the esthetic zone serves to guide complete arch rehabilitation. (J Prosthet Dent 2012;107:213-220)

Complete maxillary rehabilitation using an immediate implant placement and an immediate loading protocol could be a viable treatment option for patients with badly damaged dentitions. In any type of complete maxillary rehabilitation, it is suggested that the incisal edge of the maxillary central incisors (IEMCI) be determined first when developing the total treatment plan. The distance between the IEMCI and the remaining healed buccal bone may indicate which type of treatment should be selected. If the IEMCI-to-bone distance is 14 mm or less, a fixed prosthesis that restores the crown portion only is recommended. For these restorations, crowns could be 10 mm to 11 mm in length with 3 mm of surrounding soft tissue to achieve biologic width dimensions. If the distance is greater than 14 mm, an implant-supported fixed denture can be fabricated so that the normal length crowns can be fabricated, and the lost soft tissues can be restored with acrylic resin or gingiva-colored ceramics.

For a fixed prosthesis to meet esthetic expectations, it is crucial to achieve symmetry and adequate proportions of the gingival contour around the crowns. To achieve appropriate biologic width, the implant should be placed 3 mm apically from the highest point of the cervical margin of the crown. In addition, to preserve between 1.8 mm to 2.0 mm of bone without resorption, the implant should be placed 2 mm in a palatal direction from this highest point. A prosthetically-driven protocol for rehabilitation of the complete maxillary arch using the implant-supported fixed restoration is described.

CLINICAL REPORT

A 67-year-old woman presented to a private practice with hopeless dentition because of periodontal disease and extensive caries (Fig. 1A, 1B). The patient wanted a fixed prosthetic solution throughout the course of treatment. According to the classification system for partial edentulism developed by the American College of Prosthodontists, the patient was characterized as Class IV. A fixed prosthetic treatment with immediate implant placement/immediate loading protocol was planned. During the analysis of the patient, the following points were defined in the esthetic zone: the IEMCI, the most apical buccal bone level (MABBL) in the buccal bone crest of the maxillary teeth, the position of the first implant, the first cervical contour, and the length of the planned crown. Clinical photographs were used to determine these points. Considering the patient’s age, gender, race, and length of the lips in a resting position, it was calculated that 2-mm incisal borders of the maxillary central incisors needed to be visible. While the patient smiled, the tips of the maxillary left and right canines were determined. On the design cast, the IEMCIs and the tips of both canines were marked (Fig. 2). The anterior position of the labial surface of the maxillary central incisors was determined by calculating the average distance from the distal margin of the incisive papilla to the labial surface of the maxillary central incisor (12.3 mm).

By using periapical radiographs and probing the tissue after administration of local anesthesia, the mesial and distal measurements of the bone level for each tooth within the esthetic zone were determined. The MABBL in the existing condition for the right maxillary central incisor served as the starting point for implant planning (Fig. 3A). The first implant, for the maxillary central incisor, was planned 1.5 mm below the MABBL (Fig. 3A)

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Incisal edge of maxillary central incisors and tips of canines in relation to lips in rest position to create incisal curve. Red line represents cervical contour for crown in area of MABBL.

1 A, Preoperative panoramic radiograph showing different bone levels in remaining dentition. B, Pretreatment condition.

2 Incisal edge of maxillary central incisors and tips of canines in relation to lips in rest position to create incisal curve. Red line represents cervical contour for crown in area of MABBL.

3 A, Measurements obtained to determine type of restoration and design the prosthesis by using most apical buccal bone level (MABBL). Yellow line represents incisal edge of maxillary incisors and tip of both canines. Black lines represent different bone levels in esthetic zone. Red line represents cervical contour for crown in area of MABBL. White outline of right maxillary central incisor shows the size of the planned crown. B, Esthetic zone design using MABBL. Black half circle represents MABBL. Red “T” represents zenith of anterior planned crowns. Black lines represent natural balance of gingival levels. C, Vertical dimension of occlusion is maintained during design.
to compensate for bone resorption after extraction. The cervical contour or margin of the right maxillary central incisor was measured to be 3 mm coronal to the implant (Fig. 3A), providing space for the biologic width.\textsuperscript{10,11} The resulting distance from the cervical contour or margin of the planned maxillary central incisor to the IEMCI was 10.5 mm (Fig 3A), indicating the availability of a traditional fixed partial denture on the implant abutments.

The remaining cervical contours for all maxillary crowns were determined by using symmetry (Fig. 3B, C). The teeth in the cast were prepared with a high-speed diamond rotary cutting instrument (Komet 5850.314.016; Komet USA LLC, Rock Hill, SC). New cervical margins were created, and a diagnostic waxing was performed (Fig. 4A). An impression of the diagnostic waxing was made with irreversible hydrocolloid impression material (Cavex CA37; Cavex, Haarlem, The Netherlands), and a duplicate cast was made in Type IV dental stone (TC 15; Techim Group, Milan, Italy). On the duplicate cast, a silicone index (Zetalabor; Zhermack, Rovigo, Italy) was made, and then the teeth were removed from the cast, retaining the soft tissue contour and creating the space for the ovate pontic (Fig. 4B). By using the silicone index and autopolymerizing acrylic resin (Bosworth Trim II; Bosworth company, Skokie, Ill), a provisional restoration was fabricated (Fig. 4B). A thermoplastic template (Temp Splint 0.5mm; Denta Flux, Madrid, Spain) was created on a second duplicate cast (Fig. 4B) and was perforated in the areas of extruded teeth to allow posterior palatal sealed and evaluation of parameters of esthetics and lip support (Fig. 4C) intraorally. The thermoplastic template was transformed into a radiographic template (Fig. 4B). Twelve radiopaque markers made of 1 mm lead strips from periapical radiograph films were fixed with sticky wax (Kerr Corporation, Orange, Calif) from the buccal to the palatal cervical margin of each planned crown (Fig. 4D). This was done to visualize the relationship between the existing bone and the cervical margin of each planned crown in a computerized tomography (CT) scan.\textsuperscript{13} In some regions, the bone was 3 mm from the cervical margin (Fig. 5A). In other regions, the bone was in contact with the cervical margin and therefore planned to be reduced (Fig. 5B). For bone more than 3 mm away

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from the cervical margin, a guided bone regeneration (GBR) technique was planned (Fig. 5C). In regions of an extraction socket where the crestal bone was less than 3 mm from the cervical margin, the implant was planned to be placed below the bone, without bone reduction (Fig. 5D).

After extraction of the remaining teeth, an inadequate posterior palatal seal of the provisional restoration was noted because of the ovate pontics and some of the cervical contour areas that were contacting the crest of the bone (Fig. 6A). By using the provisional restoration as a surgical guide, the bone was reduced in those areas until the posterior palatal seal of the provisional restoration was obtained. In the areas of bone surrounding the site of implant placement, the bone was reduced until a 3-mm space between the cervical contour of the planned restoration and the bone was achieved. In the regions of the ovate pontic of the planned restoration, the bone was reduced until a 1.5-mm space between the base of the ovate pontic and the bone was created (Fig. 6B). Alveolar bone was reduced only if it interfered with the positioning of the provisional restoration. After the provisional restoration was in the proper 3-dimensional (3-D) position (Fig. 6C), 4 fluoride-modified screw-shaped implants (Fixture MT OsseoSpeed; Astra Tech AB), 5.0 mm diameter and 11 mm long, were placed in the position of maxillary right and left first molars (Fig. 6D). The implants were placed at least 1 mm to 1.5 mm below the buccal bone level in the extraction sockets and 3 mm away from the cervical margin of the planned crowns (Fig. 5D, 6B, 6D). In the areas where bone was reduced to create a 3-mm space, the implants were placed at the bone level. The implants were positioned at least 2 mm from the cervical margin in the palatal direction (Fig. 6D).

In the maxillary central incisor region a GBR technique was performed (Human freeze dried demineralized ground cortical bone; Transplant Service Foundation, Barcelona, Spain).
A, Bone requires reduction around pontic area (black arrows) to seat provisional restoration completely. B, Bone reduction was accomplished creating space of 3 mm for retainer and 1.5 mm for ovate pontic. C, Proper fit of provisional restoration on palatal area after bone reduction. D, Implants were placed by using reference points of buccal bone crest and both provisional restoration and thermoplastic templates.

The graft was covered with a collagen membrane (Collagene AT; Centro di Odontoiaatria Operativa srl, Padua, Italy), and 6 preparable abutments for the cement-retained restoration (Direct Abutment; Astra Tech AB) were screwed into the implants and sutured with 3-0 silk (Silk; Stoma, Emminingen-Liptingen, Germany). An abutment level impression was made with vinyl polysiloxane impression material (Coltoflax; Coltèn/Whaledent AG, Altstätten, Switzerland) and a closed tray. Abutment analogs (Direct Abutment Replica; Astra Tech AB) were positioned in the impression. Soft tissue was reproduced in thermoplastic templates. An impression of the 2 maxillary central incisors. By using acrylic resin (Bosworth Trim II; Bosworth Company) on the definitive cast. After the provisional restoration was polished with pumice (Kerr Corporation) and a goat hair brush (Finopolish slim polishing brush; Laboshop Spain SA, Barcelona, Spain), it was cleaned, disinfected with chlorhexidine gluconate (0.12%) (Chlorhexidine Lacer; Lacer SA, Barcelona, Spain) and cemented with provisional cement (Temp Bond; Kerr Italy Srl, Salerno, Italy). After 12 weeks of graft consolidation, 2 fluoride-modified screw-shaped implants (Fixture MT OsseoSpeed; Astra Tech AB) were placed in the region of the 2 maxillary central incisors. The provisional restoration was perforated to serve as a surgical guide and maintain the cervical margin of the 2 maxillary central incisors. By using acrylic resin (Bosworth Trim II; Bosworth Company). Extraorally, the emergence profile was finalized by using acrylic resin (Bosworth Trim II; Bosworth Company). The provisional restoration was cemented (Temp Bond; Kerr Italy Srl), and soft tissue
sutured with 3-0 silk (Silk; Stoma).

After 8 weeks, the provisional restoration (Fig. 7A) and the 8 abutments were removed, and impression copings (Fixture Pick-up; Astra Tech AB) were connected to the implants. An open tray definitive implant level impression was made with a vinyl polysiloxane impression material (Coltoflax; Coltène/Whaledent AG, Altstätten, Switzerland), capturing the matured soft tissue contour (Fig. 7B). The soft tissue was reproduced in the impression by using vinyl polysiloxane (Gingifast Rigid; Zhermack, Rovigo, Italy), and the definitive cast was poured with Type IV stone (T.C. 15; Techim Group, Milan, Italy). The definitive cast was sent to the laboratory and scanned for virtual abutment design (VAD Atlantis; Astra Tech Dental) (Fig. 8A). Four zirconia frameworks (ICE Zircon; Zirkonzahn, Gais, Italy) were produced to fabricate the zirconia partial fixed dental prostheses (FDPs) (Fig. 8B-D). The FDPs were cemented with provisional cement (Temp Bond; Kerr Italy Srl). The fit of the FDPs over the abutments was verified with periapical radiographs, and the marginal bone at the level of the implants was confirmed (Fig. 8E).

For the duration of the treatment and a follow-up period of over 3 years, the patient did not present with any complications.

**SUMMARY**

This clinical report describes the rehabilitation of a complete maxillary arch by using fixed implant-supported restorations with an immediate implant placement and immediate loading protocol. The provisional restoration is designed by first finding the IEMCI and then using the MABBL to determine the position of the first implant and the cervical margin of the restoration. The first cervical margin is used to guide all phases of the design, including bone reduction and implant placement. The MABBL protocol can only be used in situations where there is a distance of at least 14 mm between the planned IEMCI and the MABBL after the bone has healed, or at least 12.5 mm if the MABBL is in a postextraction socket. In the latter situation, the implant should be placed 1 to 1.5 mm below the buccal bone of the socket to compensate for bone remodeling, thus ultimately making it 14 mm from the IEMCI. If the distance is greater than 14 mm, an implant-supported fixed complete denture to restore the lost soft tissue with acrylic resin or ceramic is suggested.
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A, Intraoral labial view of provisional restoration. B, Two more implants were placed on central incisor areas guided by provisional restoration. C, Implant abutments were virtually designed considering shape of provisional restoration to create ideal restorative space. D, Zirconia abutments fabricated by CAD/CAM process. E, Four zirconia partial fixed dental prostheses (FDPs) were cemented. C, Intraoral lateral view of definitive FDPs after 3 years. D, Facial view of definitive FDPs after 3 years. E, Marginal bone level remains stable after 3 years.
A technique for immediate occlusal implant loading of a completely edentulous mandible: A clinical report

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