



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

Fernando Rojas-Vizcaya, DDS, MS^a

School of Dentistry, University of North Carolina at Chapel Hill, Chapel Hill, NC

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.¹⁻⁸ 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.⁹ 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.^{10,11} 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.^{12,13}

For a fixed prosthesis to meet esthetic expectations, it is crucial to achieve symmetry and adequate proportions of the gingival contour around the crowns.¹⁴⁻¹⁶ To achieve

appropriate biologic width, the implant should be placed 3 mm apically from the highest point of the cervical margin of the crown.^{10,11} In addition, to preserve between 1.8 mm to 2.0 mm of bone without resorption,¹⁷ the implant should be placed 2 mm in a palatal direction from this highest point.¹⁸ 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 prosthodontic 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.¹⁹ A fixed prosthodontic 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

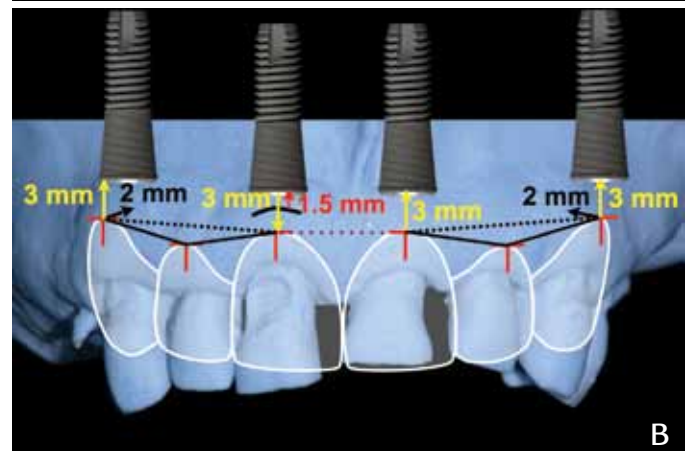
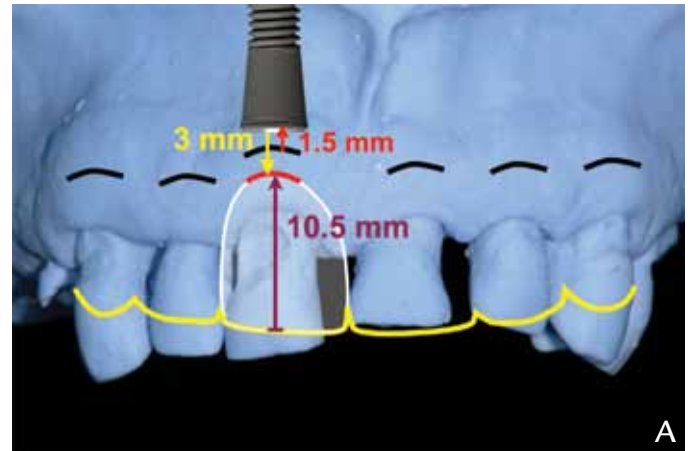
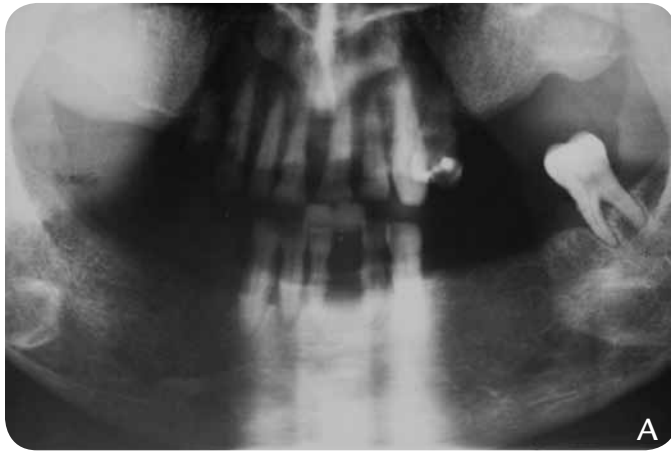
bone crest of the maxillary teeth, the position of the first implant, the first cervical contour, and the length of the planned crown. Clinical photographs were used to determine these points. Considering the patient's age, gender, race, and length of the lips in a resting position, it was calculated that 2-mm incisal borders of the maxillary central incisors needed to be visible.²⁰ 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 anteroposterior 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).²¹

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)

Presented at the American Academy of Fixed Prosthodontics annual meeting, Chicago, Ill, February 2010.

^aAdjunct Assistant Professor, Department of Prosthodontics, University of North Carolina School of Dentistry; Private practice, Castellon, Spain.

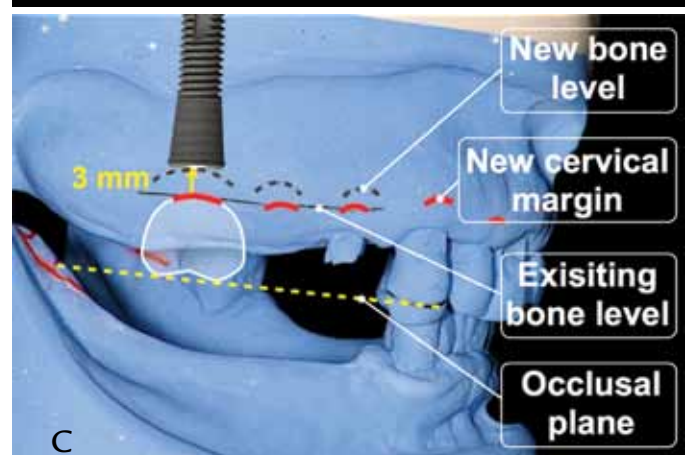




1 A, Preoperative panoramic radiograph showing different bone levels in remaining dentition. B, Pretreatment condition.



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.



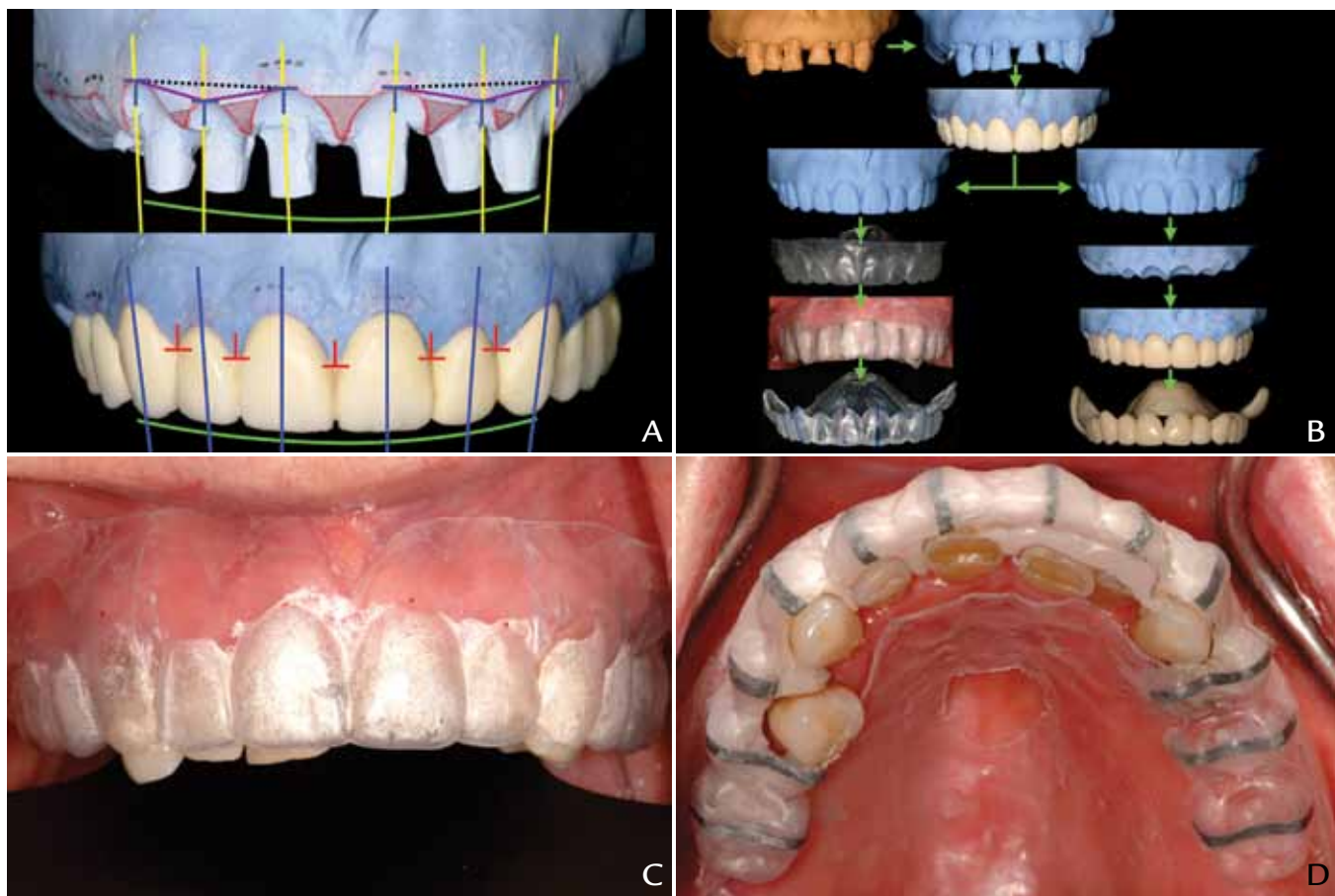
3 A, Measurements obtained to determine type of restoration and design the prosthesis by using most apical buccal bone level (MABBL). Yellow line represents incisal edge of maxillary incisors and tip of both canines. Black lines represent different bone levels in esthetic zone. Red line represents cervical 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.²² 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.^{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.

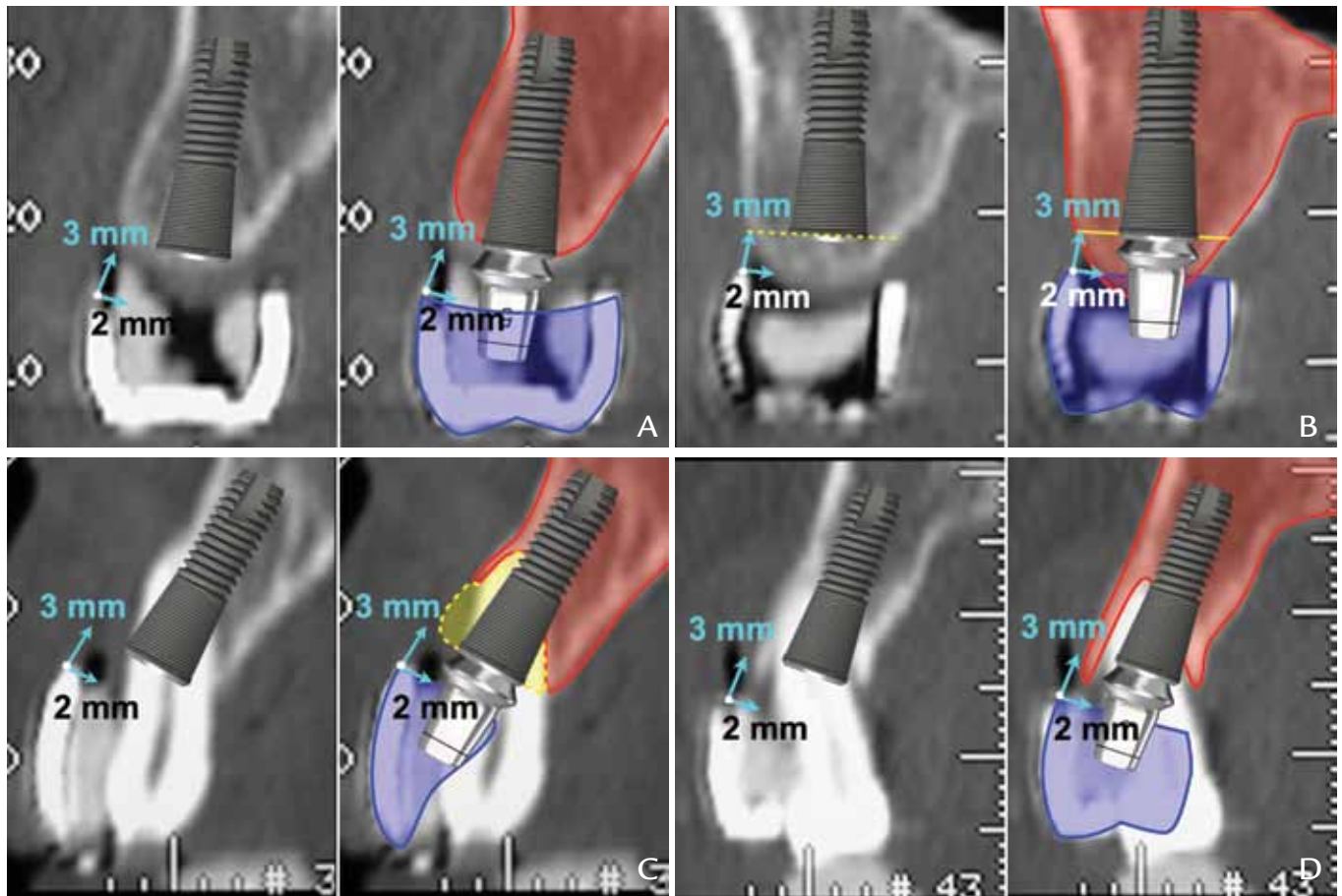
The remaining cervical contours for all maxillary crowns were determined by using symmetry (Fig. 3B, C). The teeth in the cast were prepared with a high-speed diamond rotary cutting instrument (Komet 5850.314.016; Komet USA LLC, Rock Hill, SC). New cervical margins were created, and a diagnostic waxing 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.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



4 A, Diagnostic waxing (below) developed after soft tissue contour design. B, Scheme of laboratory procedures for fabricating thermoplastic template and provisional restoration. C, Evaluation of parameters of esthetics and lip support with thermoplastic template. D, Due to extrusion of some remaining teeth, radiographic template was perforated to allow fit in palatal area.



5 A, Distance between buccal bone crest (red) and cervical margin of crown (blue) is 3 mm. Implant must be placed at the level of bone. B, According to planned implant position guided by cervical margin of crown (blue), bone reduction is necessary. C, Distance between buccal bone crest (red) and cervical margin of crown (blue) is more than 3 mm, which indicates guided bone regeneration (yellow). D, Distance between buccal bone crest (red) and cervical margin of crown (blue) is less than 3 mm. Implant must be placed below bone level.

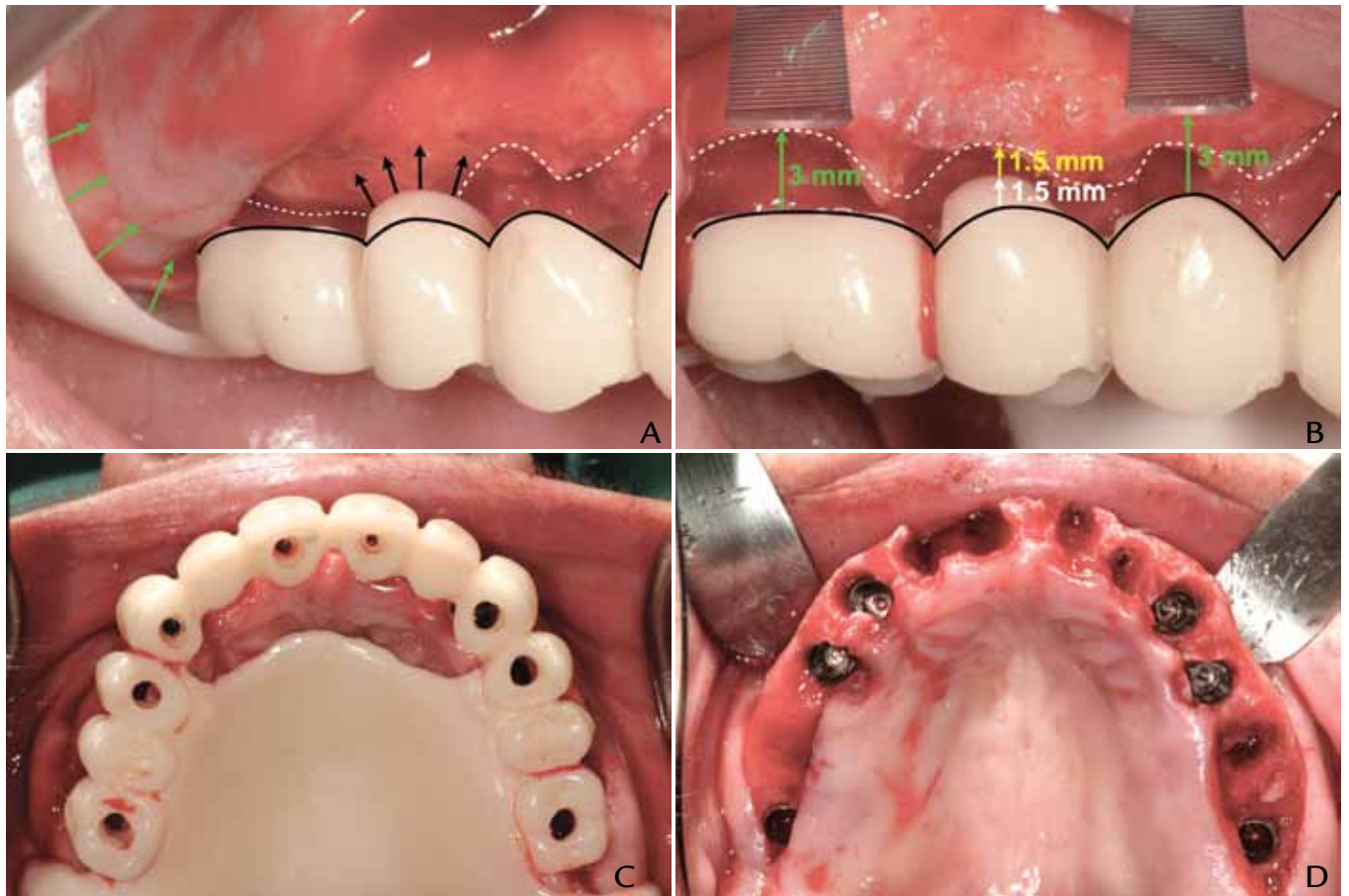
from the cervical margin, a guided bone regeneration (GBR) technique was planned (Fig. 5C). In regions of an extraction socket where the crestal bone was less than 3 mm from the cervical margin, the implant was planned to be placed below the bone, without bone reduction (Fig. 5D).

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 areas²³ 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, Mölndal, Sweden), 4.5 mm in diameter and 13 mm long, were placed in the position of maxillary left and right canines and maxillary left and right first premolars. Two fluoride-modi-

fied 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).

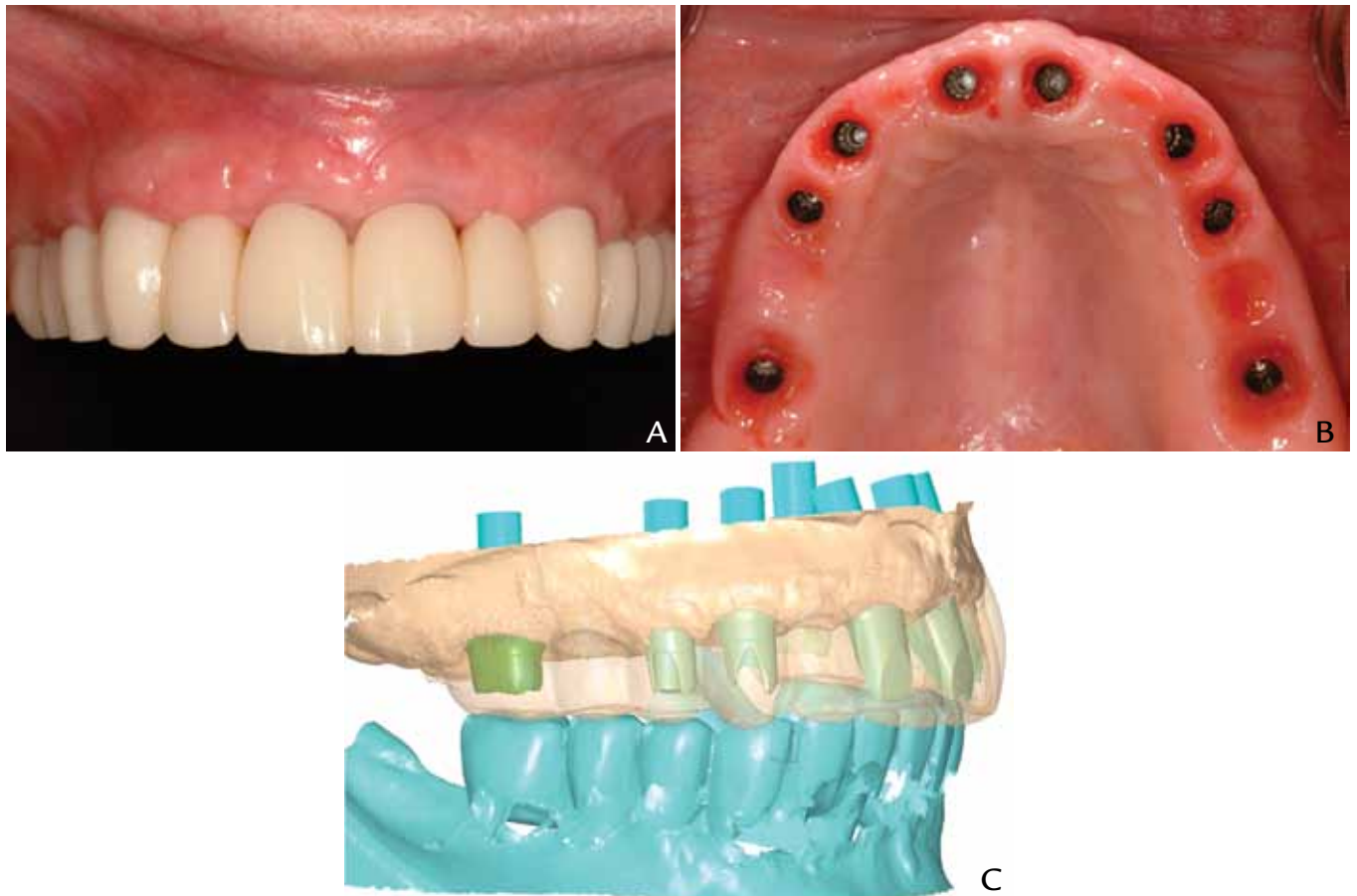


6 A, Bone requires reduction around pontic area (black arrows) to seat provisional restoration completely. B, Bone reduction was accomplished creating space of 3 mm for retainer and 1.5 mm for ovate pontic. C, Proper fit of provisional restoration on palatal area after bone reduction. D, Implants were 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 Odontoiatria 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, Emmingen-Liptingen, Germany). An abutment level impression was made with vinyl polysiloxane impression material (Coltoflax; Coltène/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 the impression with vinyl polysiloxane (Gingifast Rigid; Zhermack, Rovigo, Italy), and a maxillary definitive cast was poured with Type IV stone (TC15;

Techim Group, Milan, Italy). The provisional restoration was relined with an autopolymerizing 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 per-

forated to serve as a surgical guide and maintain the cervical margin of the 2 maxillary central incisors. By using the cervical margin of the provisional restoration as a reference, the implants were placed 3 mm apically and 2 mm palatally from the cervical margin. The 2 preparable abutments for the cement-retained restoration (Direct Abutment; Astra Tech AB) were screwed into each implant. Plastic copings (Healing Cap; Astra Tech AB) were placed into the abutments and fixed to the provisional restoration with 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



7 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.

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, Waltham, Mass) (Fig. 7C) and subsequent fabrication of 8 computer aided design-computer aided manufacturer (CAD/CAM) abutments

in zirconia (Atlantis; Astra Tech Dental) (Fig. 8A). Four zirconia frameworks (ICE Zircon; Zirkozahn, 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 of 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.



8 A, Zirconia abutments fabricated by CAD/CAM process. B, 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.

REFERENCES

1. Grunder U. Immediate functional loading of immediate implants in edentulous arches: two-year results. *Int J Periodontics Restorative Dent* 2001;21:545-51.
2. Jaffin RA, Kumar A, Berman CL. Immediate loading of dental implants in the completely edentulous maxilla: a clinical report. *Int J Oral Maxillofac Implants* 2004;19:721-30.
3. Degidi M, Piattelli A, Felice P, Carinci F. Immediate functional loading of edentulous maxilla: a 5-year retrospective study of 388 titanium implants. *J Periodontol* 2005;76:1016-24.
4. Balshi SF, Wolfinger GJ, Balshi TJ. A prospective study of immediate functional loading, following the Teeth in a Day protocol: a case series of 55 consecutive edentulous maxillas. *Clin Implant Dent Relat Res* 2005;7:24-31.
5. Tealdo T, Bevilacqua M, Pera F, Menini M, Ravera G, Drago C, Pera P. Immediate function with fixed implant-supported maxillary dentures: a 12-month pilot study. *J Prosthet Dent* 2008;99:351-60.
6. Pieri F, Aldini NN, Fini M, Corinaldesi G. Immediate occlusal loading of immediately placed implants supporting fixed restorations in completely edentulous arches: a 1-year prospective pilot study. *J Periodontol* 2009;80:411-21.
7. Gallucci GO, Morton D, Weber HP. Loading protocols for dental implants in edentulous patients. *Int J Oral Maxillofac Implants* 2009;24 suppl:132-46.
8. Artzi Z, Kohen J, Carmeli G, Karmon B, Lor A, Ormianer Z. The efficacy of full-arch immediately restored implant-supported reconstructions in extraction and healed sites: a 36-month retrospective evaluation. *Int J Oral Maxillofac Implants* 2010;25:329-35.
9. Spear FM, Kokich VG, Mathews DP. Interdisciplinary management of anterior dental esthetics. *J Am Dent Assoc* 2006;137:160-9.
10. Hermann JS, Buser D, Schenk RK, Higginbottom FL, Cochran DL. Biologic width around titanium implants. A physiologically formed and stable dimension over time. *Clin Oral Implants Res* 2000;11:1-11.
11. Kan JY, Rungcharassaeng K, Umez K, Kois JC. Dimensions of peri-implant mucosa: an evaluation of maxillary anterior single implants in humans. *J Periodontol* 2003;74:557-62.
12. Zitzmann NU, Marinello CP. Treatment plan for restoring the edentulous maxilla with implant-supported restorations: removable overdenture versus fixed partial denture design. *J Prosthet Dent* 1999;82:188-96.
13. Cooper L, De Kok IJ, Reside GJ, Pungpa-pong P, Rojas-Vizcaya F. Immediate fixed restoration of the edentulous maxilla after implant placement. *J Oral Maxillofac Surg* 2005;63 suppl 2:97-110.
14. Chu SJ, Tan JH, Stappert CF, Tarnow DP. Gingival zenith positions and levels of the maxillary anterior dentition. *J Esthet Restor Dent* 2009;21:113-20.
15. Mattos CM, Santana RB. A quantitative evaluation of the spatial displacement of the gingival zenith in the maxillary anterior dentition. *J Periodontol* 2008;79:1880-5.
16. Charruel S, Perez C, Foti B, Camps J, Monnet-Corti V. Gingival contour assessment: clinical parameters useful for esthetic diagnosis and treatment. *J Periodontol* 2008;79:795-801.
17. Spray JR, Black CG, Morris HF, Ochi S. The influence of bone thickness on facial marginal bone response: stage 1 placement through stage 2 uncovering. *Ann Periodontol* 2000;5:119-28.
18. Evans CD, Chen ST. Esthetic outcomes of immediate implant placements. *Clin Oral Implants Res* 2008;19:73-80.
19. McGarry TJ, Nimmo A, Skiba JF, Ahlstrom RH, Smith CR, Koumjian JH et al. Classification system for partial edentulism. *J Prosthodont* 2002;11:181-93.
20. Vig RG, Brundo GC. The kinetics of anterior tooth display. *J Prosthet Dent* 1978;39:502-4.
21. Ellinger CW. Radiographic study of oral structures and their relation to anterior tooth position. *J Prosthet Dent* 1968;19:36-45.
22. Caneva M, Salata LA, de Souza SS, Baffone G, Lang NP, Botticelli D. Influence of implant positioning in extraction sockets on osseointegration: histomorphometric analyses in dogs. *Clin Oral Implants Res* 2010;21:43-9.
23. Kinsel RP, Lamb RE, Moneim A. Development of gingival esthetics in the edentulous patient with immediately loaded, single-stage, implant-supported fixed prostheses: a clinical report. *Int J Oral Maxillofac Implants* 2000;15:711-21.

Corresponding author:

Dr. Fernando Rojas-Vizcaya
Mediterranean Prosthodontic Institute
Avenida Rey Don Jaime, 5
12001 Castellon
SPAIN
Fax: +34-964-253-843
E-mail: frojasv@prosthodontics.es

Acknowledgment

The author thanks dental technicians Emilio Royo and Jorge Cid for their collaboration during the development of the study.

Copyright © 2012 by the Editorial Council for
The Journal of Prosthetic Dentistry.

Receive Tables of Contents by E-mail

To receive tables of contents by e-mail, sign up through our Web site at <http://www.journals.elsevierhealth.com/periodicals/ympr>.

Instructions

Log on and click "Register" in the upper right-hand corner. After completing the registration process, click on "My Alerts," then "Add Table of Contents Alert." Select the category "Mosby" or type *The Journal of Prosthetic Dentistry* in the search field and click on the Journal title. The title will then appear, and having already completed the Registration process, you may add tables of contents alerts by accessing an issue of the Journal and clicking on the "Add TOC Alert" link.

You will receive an e-mail message confirming that you have been added to the mailing list.

Note that tables of contents e-mails will be sent when a new issue is posted to the Web site.