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A New Surgical Template with a Handpiece Positioner for Use During Flapless Placement of Four Dental Implants to Retain a Mandibular Overdenture

Moustafa Abdou ELsyad, BDS, MSc, PhD

Lecturer, Department of Removable Prosthodontics, University of Mansoura, Faculty of Dentistry, Eldakahlia, Egypt

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Correspondence
Moustafa Abdou ELsyad, Department of Removable Prosthodontics, Faculty of Dentistry, University of Mansoura, P.O. Box 35516, 68 EL Gomhoria Street, EL Mansoura, EL Dakahlia, Egypt. E-mail: M_syad@mans.edu.eg

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Abstract

This article describes the fabrication of a new and inexpensive surgical template from a radiographic template for flapless placement of dental implants to retain a mandibular overdenture. A radiographic template with radiopaque metal plate markers is constructed and used as a guide for achieving three-dimensional evaluation of bone using computed tomography (CT). The potential position and angulation of the implants are measured relative to the metal plates using the CT data. The radiographic template is converted into a surgical template by attaching rigid metal rods that guide the handpiece precisely during subsequent drilling procedures.

Implant-retained overdentures and implant-supported prostheses are sensitive to the position and angulation of the implants for two reasons: (1) to fabricate an esthetic, hygienic, and functional prosthesis, and (2) to position the implants and the retentive matrices parallel to each other and to the path of insertion of the prosthesis.[1-3] The precise placement of implants requires the use of appropriate imaging techniques together with the use of a well-constructed surgical template.[4] Surgical templates are often fabricated either manually or stereolithographically[5] according to computer-assisted implant planning. These templates provide adequate precision of implant placement in the mesiodistal and buccolingual directions and simplify immediate loading protocol, particularly for complete dentures due to minimally invasive surgery and possibility of prosthesis construction before the surgery.[6-8] However, critical objections to such technology are the costly software or the stereolithographically produced surgical templates.[6] Moreover, most of these templates depend on the use of surgical sleeves or cylinders, which only allow control of the initial drilling, and it is not possible to use the template as the drill diameter increases during the osteotomy preparation.[9] Even with the use of the NobelGuide (NobelBiocare, Yorba Linda, CA) sleeve-in-sleeve system, implant placement accuracy can also be influenced by drill attrition from inevitable contact with the titanium sleeves with consecutive drilling.[10]

Transfer of radiographic information to the surgical template remains a challenge, especially in an edentulous arch, because the reflection of the flap makes a conventionally made surgical template inaccurate and less predictable due to space between the alveolar crest and the template.[11-12] The flapless procedure reduces chairside time,[13] minimizes invasive surgical procedures, and preserves tissue support for the template during surgical manipulation.[1]

This article describes a step-by-step technique for the fabrication of a sleeveless surgical template for implant placement in the edentulous mandible using a flapless approach. The template is inexpensive and does not require complex equipment or techniques.

Technique

Maxillary and mandibular irreversible hydrocolloid impressions (Alginate CA 37 Superior Pink, Cavex Holland BV, Amsterdam, The Netherlands) are made and poured with type IV stone (ZETA, Orthodontic Stone; Whip Mix Corp., Louisville, KY). The resultant casts are mounted on a semi-adjustable articulator (Model 8800; Whip Mix Corp.) in centric relation at the correct occlusal vertical dimension (OVD). The diagnostic tooth arrangement that satisfies function and esthetics is completed on trial denture bases.

Figure 1 Metal plates attached to the radiographic template in the same horizontal plane and perpendicular to the arch.

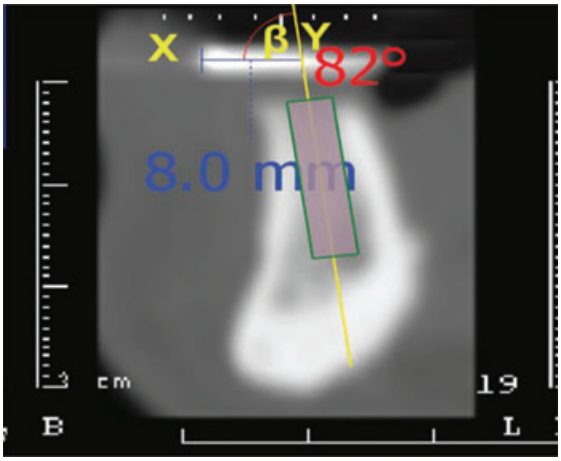

Figure 3 Line and angle analysis of cross-sectional images that bisect the metal plates.

Figure 2 Metal plate markers in the CT images.

A CT scan of the head is performed using a Philips Brilliance 16-Slice CT scanner (Philips Medical Systems, Cleveland, OH) with the radiographic template in position. The cross-sectional images at the lines bisecting the metal plates faciolingually are selected (Fig 2). The images are reviewed using software (MxLiteView, version 1.24 DICOM viewer, Philips Medical Systems), and virtual implants with proper sizes and angulations are drawn. The software tools are used to calculate the angle β between the longitudinal axis of each implant and the metal plate in the faciolingual dimensions. The distance (x–y) between the facial edge of the plate (x) and the drill entry point (y) is measured (Fig 3). If the line bisecting the metal plates faciolingually does not correspond to proper implant location, a point is drawn on the plate proximal to this line at the new implant location in the panoramic view of the CT scan, and the distance from this point to the bisecting line is measured. A new line parallel to the first one is then drawn on the plate at proper implant location.

Radiographic template fabrication

Lines are drawn on the mandibular cast perpendicular to the ridge crest from the facial to lingual at the anticipated implant positions (the centers of the canines and first molar prosthetic teeth). A clear, processed acrylic resin radiographic template (Lucitone 199, Dentsply International, Inc. York, PA) is fabricated on a duplicate mandibular cast and repositioned on the original mandibular cast (if any ridge undercuts exist, the fitting surface of the template is relieved with an acrylic bur). Four cast metal plates (16 mm length, 8 mm diameter, 1 mm thickness) are attached to the radiographic template using autopolymerizing acrylic resin (Lucitone 199) with the line that bisects each plate longitudinally corresponding to the marked implant position (Fig 1). An occlusion rim is added to the template at the accepted OVD, then a poly(vinyl siloxane) (PVS) interocclusal record (Exabite II NDS; GC America, Alsip, IL) is made at centric relation to stabilize the template against the dentition of the maxillary denture base during the computerized tomography (CT) scan.[14]

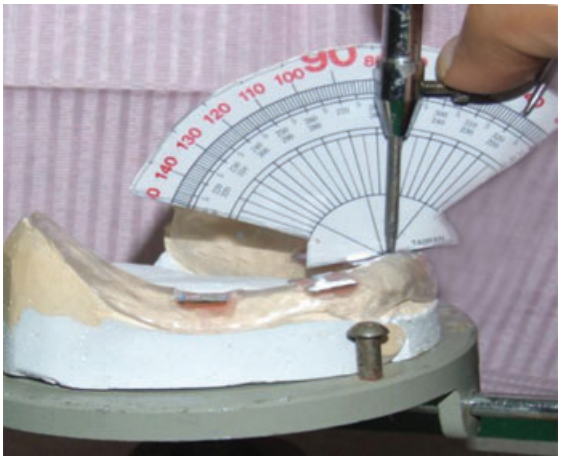

Figure 4 Adjusting the cast on the surveyor table to reflect buccolingual and mesiodistal angulations of future implants.

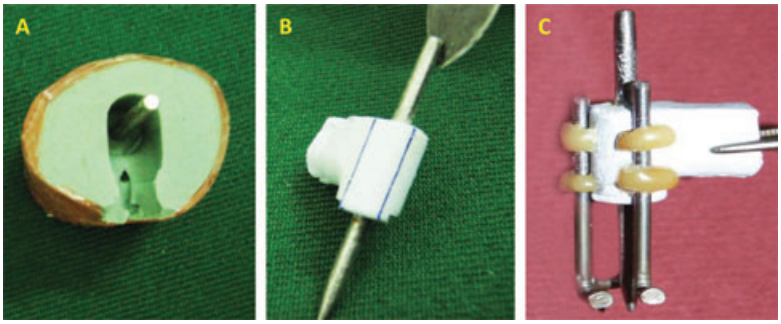

Figure 5 (A) The impression of the handpiece head and the bur shank. (B) Parallel vertical lines on the stone handpiece. (C) Metal rods attached to the stone handpiece with sticky wax.

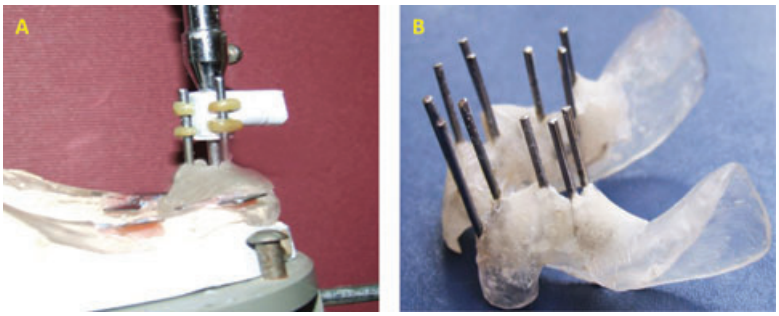

Figure 6 (A) Metal rods picked up to the occlusal surface of the template. (B) The final surgical template.

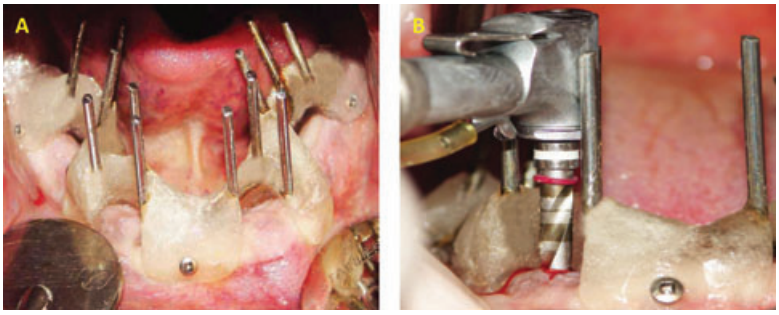

Figure 7 (A) The surgical template secured to the ridge with miniscrews. (B) Drilling through the template.

Surgical template fabrication

The template is replaced on the original cast, and the occlusion rim is removed. A mesiodistal line is drawn on each plate at the x–y distance. The intersection point between buccolingual and mesiodistal lines represents the drill entry. Using a small rounded bur, an access hole (1 mm depth) is drilled through the metal plate and the template at the drill entry point (y).

The stone cast and the template are placed on the surveying table of the parallelometer (Bego Bremer Goldschagerei Wihl. Herbst Gmbh & Co., Bremen, Germany). A straight, pointed bur shank (of the same diameter as the implant drill shank) is attached to the surveyor mandrel as a paralleling rod. The pointed end of the shank is positioned in the prepared hole. The angle β between the bur shank and the metal plate is reestablished in the faciolingual dimension by pivoting the surveyor table faciolingually (Fig 4), and then the shank is paralleled for each implant position in the mesiodistal direction.

The bur shank is attached to the head of a contra angle handpiece (Steri-Oss, Yorba Linda, CA), and an impression of the handpiece is made using PVS (Speedex, Coltene Whaledent, Altstatten, Switzerland) in a circular wax tray (Fig 5A). The bur shank is removed from the handpiece and replaced in the impression, extruded 1 cm. The impression is poured with type IV stone, and then three parallel vertical lines are drawn on the sides and front of the stone handpiece head (Fig 5B). Three rigid L-shaped metal rods are attached to the lines with sticky wax (Kerr Corporation, Orange, CA) (Fig 5C).

The plates are removed from the template. The bur shank and the stone handpiece are replaced in the mandrel of the parallelometer. The pointed end of the shank is positioned in the corresponding hole of the metal plate. The metal rods are picked up to the occlusal surface of the template (Fig 6A) using autopolymerizing clear acrylic resin (Orthodontic Resin; Dentsply International Inc, Milford, DE), then the bur shank and the attached stone handpiece are removed. The occlusofacial segments of the template are sectioned corresponding to the proposed implant positions to allow adequate visualization of the osteotomy site and enhance external irrigation of the drills (Fig 6B). The path of the handpiece head created by the metal rods is tested to ensure free vertical sliding of the head without impedance.

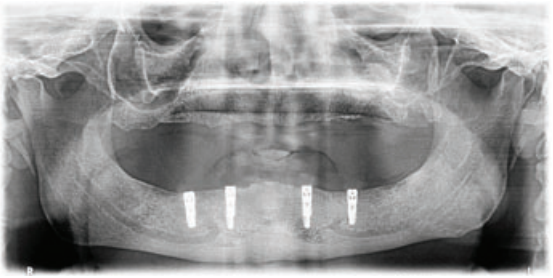

Figure 8 Postoperative panoramic radiograph.

Surgical technique

The template is placed in glutaraldehyde (Cidex, Surgikos Incorporated, Arlington, TX) for disinfection, then secured to the ridge anteriorly and posteriorly with bone fixation titanium miniscrews (Martin GmbH & Co. Ltd., Tuttlingen, Germany) at the onset of the surgical procedure (Fig 7A). Tissue punch and drilling procedures are performed through the template (Fig 7B), whereas metal rods guide the handpiece during subsequent drilling procedures. The implants (Dyna Dental Engineering, Bergen op Zoom, The Netherlands) are inserted in the prepared osteotomies, and the implant parallelism is evaluated by panoramic radiography (Fig 8).

Discussion

Template stability during the surgical phase is a key element in the success of proper implant placement.[10] Most mandibular surgical templates are not reliable because of lack of stability resulting either from resorption of the mandible or from the interference with mucoperiosteal flaps elevated during surgery.[1] In this article, the combined use of fixation screws together with the flapless approach provides excellent template stability during surgery. The bone screws are more beneficial than the concomitant maxillary stabilization,[1] especially in cases of severe alveolar atrophy with high muscular attachment.[15] The flapless approach preserves tissue support for the surgical template during surgical manipulation,[1] although this approach does not preserve the minimal keratinized tissues of severe atrophied ridge. Furthermore, the use of CT helps to give the implant the proper axial direction and minimize the risk of cortical bone perforation associated with flapless implant surgery.[6,16]

The use of multislice CT together with thin metal plates helps in reduction of the metal artifacts in the axial CT images. As long as the interarch space can accommodate the contra angle handpiece with the attached dill, no limitation exists to the use of the template, as the long guide metal rods can be shortened to the level of the lower third of the handpiece head in limited mouth opening. Three metal rods for each implant can be used in case of widely separated two or four implants; however, when four implants are to be placed in the anterior mandible in close proximity to one another, small diameter rods or pins can be used, and mesial or distal rods can be omitted (according to the accessibility) to provide more horizontal space. The remaining rod is used to guide the handpiece in the mesiodistal direction.

The advantages of the presented technique include cost effectiveness and great benefit in situations where guided surgery software and manufactured guides are not available; however, the fabrication time may be prohibitive to the prosthodontist. Therefore, the clinician may only make the impression of the head of the handpiece and calculate the angle between the drill and the metal plate using the software, whereas all other steps can be performed by the dental technician. Future research is needed to assess the implant placement accuracy of the presented template.

Conclusion

A new surgical template for proper implant placement in buccolingual and mesiodistal positions has been described. The radiopaque metal plate markers attached to the template facilitate line and angle analysis of implant sites using CT scan. The metal rods serve as a precise guide for the contra angle handpiece during subsequent drilling procedures with no need for metal sleeves.

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