Profile Surgical Template: A Systematic Approach to Precise Implant Placement. A Technical Note

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The precise placement of dental implants is essential to designing a prosthesis that fulfills the esthetic and functional requirements of the patient, and simultaneously allows clear phonetics and facilitates oral hygiene. To achieve this, an effective surgical template is essential: it must provide good orientation, be comfortable, have adequate intraoral fixation, allow freedom of choice to the surgeon, and be capable of use during image-diagnostic procedures. In accordance with this criteria, the profile surgical template, based on utilization of the buccal contour of missing teeth, has been designed.
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Key words: esthetics, implants, osseointegration, profile surgical template

To achieve the best results with implant treatment, the diagnostic, surgical, and prosthetic phases of treatment must be coordinated.[1,2] Whether these functions are carried out by a group of specialists or by a single professional, a means must be found to transfer all the information obtained during preoperative diagnosis and evaluation to the surgical situation. In this way, intraoperative decisions concerning the position and orientation of the implants can be made with the confidence that they will fulfill as much as possible the requirements initially planned. Until now, this need has been satisfied through the design of different types of surgical templates. For a systematic study and evaluation of their defects and virtues, awareness of the orientation system that they employ and their form of intraoral fixation is essential.

The Orientation System

The orientation systems most frequently used are based on reproduction of the facial buccal surfaces of the missing teeth (vestibular surgical templates [VST] or facial veneer splints) using either *(a)* a vacuum-formed clear plastic template[3–6] or *(b)* clear acrylic resin guides[1,2,6–14] (Fig 1). Other authors, who use similar procedures, prefer to eliminate the vestibular in favor of the lingual surface (lingual surgical templates [LST] or lingual veneer splints) as a frame of reference.[15] This approach makes both visibility and the process of external irrigation easier (Fig 2). A simple perforation of an acrylic resin occlusal guide (Fig 3) to orient only the initial drilling has also been proposed.[6,10,16]

In general, those designs that conserve the vestibular surface make both visibility and irrigation difficult during surgery. Those that use the lingual surface are better in this regard, but they lack a clear vestibular limit; as a consequence, an inadequate buccal positioning of the implant is possible (Fig 2).

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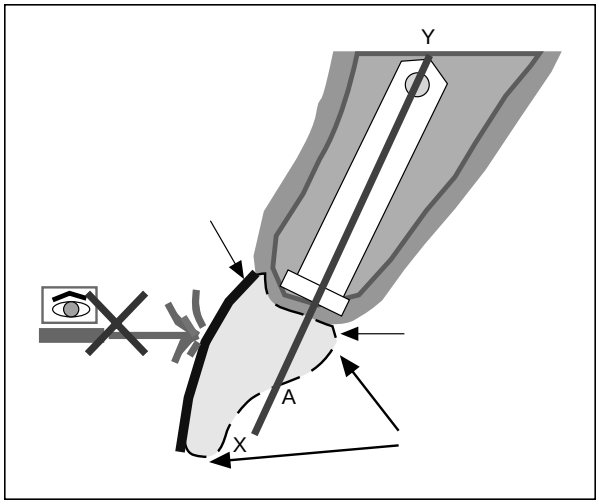


Fig 1 Drawing of a section perpendicular to the alveolar ridge in a patient with a vestibular surgical template. The facial portion of the surgical template interferes with access, visibility, and external irrigation; nevertheless, it provides the surgeon with good orientation and permits freedom of choice in the lingual area. X-Y = axis of implant placement; A = ideal access hole for the abutment screw.

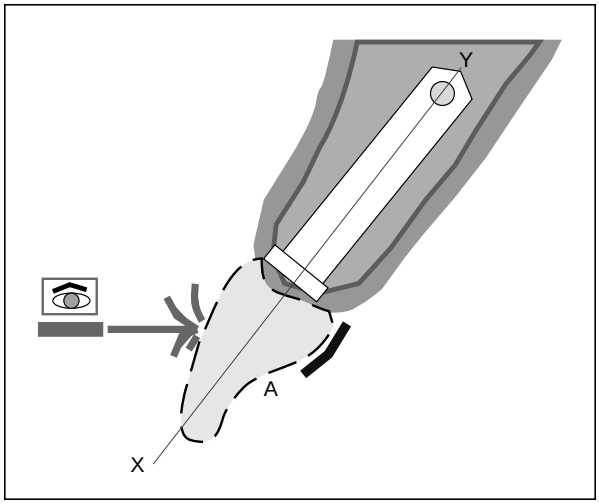


Fig 2 Drawing of a section perpendicular to the alveolar ridge in a patient with a lingual surgical template. Good visibility and irrigation capacity is allowed. The absence of a clear vestibular limit, however, can lead one to place the implant in a problematic buccally oriented position, and does not allow the surgeon freedom of choice in the lingual area.

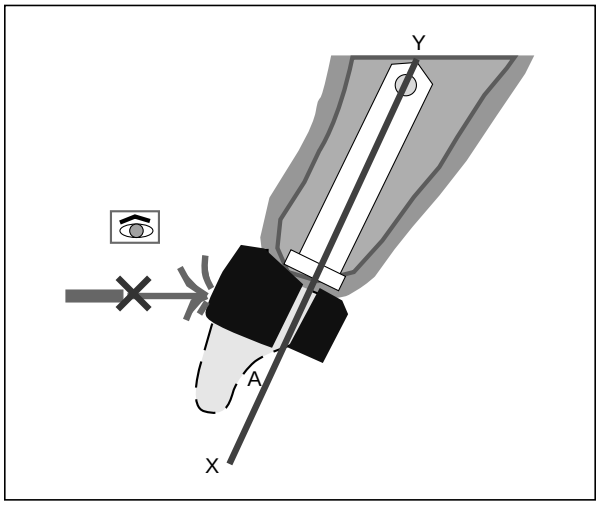


Fig 3 Drawing of a section perpendicular to the alveolar ridge in a patient with a channeled surgical template. Visibility is acceptable, but external irrigation is made difficult. The canal made in the acrylic resin block marks a fixed unmovable position, permitting only the initial drilling and totally restricting intraoperative freedom of choice.

Finally, occlusal templates (with or without tooth shape) with a perforation of the occlusal zone (perforated surgical templates or channeled surgical templates [CST]) only allow control of the initial drilling, and it is very difficult to use these during the remaining surgical procedure.

In an effort to overcome these difficulties, an attempt has been made to reduce template volume and improve operating visibility. Titanium-reinforced templates that reproduce the gingival profile of the tooth,[17] and resin templates in which the tooth is trimmed in such a way that only the peripheral part of its vestibular surface and its section at the gingival level remains, have been developed for partially edentulous patients.[1] For the repositioning of a single tooth, a case study has been published in which a surgical template with an orthodontic wire in the vestibular surface of the missing teeth contours was used.[18]

To document preoperative findings and orient the surgeon as to the position of the alveolar bone in the desired relation to replacement teeth, it is important that the surgical template be used during the image-diagnostic procedures.[5,9,10,12,17] Therefore, it is necessary to add to the template some contrasting devices that should be situated in a known position, identifiable and reproducible during surgery. According to the literature, the majority of authors agree that the information obtained from the surgical template must be reliable (based on a diagnostic waxup[19] and on the image-diagnostic procedures), and used with a vestibular surface system of orientation.[1–3,6–14] The best template is the one that will be used by the surgeon,[13] and thus it is important to reduce the volume of its vestibular surface[13,18] so as to improve visibility, access, and simultaneous external irrigation.

Intraoral Fixation

To obtain a comfortable template and accurate supporting information, appropriate intraoral fixation is fundamental. For the partially edentulous patient, this is not particularly a problem, and it is easy to achieve good retention of the template by using acrylic resin occlusal overlays[1,2,4–6,12–14,16,17] or different retainer types,[7,10,18] clasps,[10] wires,[7] or Adam's retainers,[18] which are attached to the remaining teeth. However, this is not possible with the completely edentulous patient. Fortunately, the use of a template is not always necessary for the mandible,[16] but in the maxilla it is a primary requirement. Many authors have tried to solve this problem by basing their efforts on the principles of retention, support, and stability developed for the fabrication of complete dentures.[8–12,15] Unfortunately, when the tissue surface of a denture must be trimmed to permit implant placement (which reduces the contact surface), the soft tissues must be reflected during the intervention, making the adjustment between the denture and its base worse; or if the denture has considerable bulk, the denture as a template is relatively ineffective. Furthermore, the template moves during the intervention, even if the dental auxiliary attempts to stabilize it. Consequently, the supporting information is not accurate, and template movement could create a nausea response in the patient.

To circumvent these problems in the patient with no maxillary teeth, but with some remaining teeth in the mandible, a surgical template has been designed which can be attached by use of a resin block to the mandibular teeth and from which arises a series of metal pins that mark the position of the ideal initial drilling in the opposite alveolar ridge,[20] when the patient closes his mouth.

Characteristics of the Ideal Surgical Template

To summarize the aforementioned and the experience of a team in placing more than 4,000 implants using surgical templates, certain requirements of these ideal templates are proposed:

1. Good orientation: must offer a vestibular and mesiodistal limit that enables the placement of the implant in a desired position and allows the creation of a good emergence profile, leaving a convenient space for the papillae, making transmission of occlusal forces easier, and preventing the need for an access hole for the abutment screw in the buccal surface, which interferes with esthetics
2. Contrast: must have a system of contrast for use during diagnostic imaging procedures
3. Correct fixation: must be placed in the mouth in a reproducible and stable way, so that it does not move during oral manipulation, allowing more reliable information to be obtained
4. Comfort: must not restrict surgical access or tissue reflection, but permit both good visibility and simultaneous external irrigation
5. Freedom of choice: must allow the surgeon to make appropriate decisions regarding intrasurgical anatomic findings, and to continue the intervention using the information provided by the surgical template, even though final implant position may not be as initially planned

Design of the Profile Surgical Template

Of all the characteristics outlined above, correct fixation and the possibility of adding an element of contrast for the diagnostic imaging procedures are goals obtained or applied to the majority of surgical template designs for partially edentulous patients. However, it is necessary to combine a good system of orientation with the comfort and freedom of intraoperatory choice required. In an effort to achieve these requirements, the profile surgical template (PST) has been designed to replace the buccal surface of the template by its profile (Fig 4).

To fabricate this template, after the waxing of the missing teeth is made on the diagnostic casts, two lines are drawn on their vestibular and interproximal surfaces. The first is made along the incisal edge and/or the vestibular limit of the occlusal surface, and the second along the gingival margin or the middle part of its buccal surface. These two lines will be a pattern of reference for the fabrication of the template. Two profiles are created, using wire, plastic, or other materials and following the lines described, to mark the vestibular and mesiodistal limits of the teeth (Figs 5a and 5b). These structures are then joined to an acrylic resin block, which makes the template solid and adds a self-retaining feature (Figs 5c and 5d).

It is convenient to test the template before the operation to correct any defects in retention, support, or stability. If these are not suitable, the design may be modified and additional retentive elements, such as clasps or Adam's retainers, may be added.

Since, in partially edentulous patients, it is frequently necessary to place implants close to the remaining teeth, and knowing the diameter of the instruments used for the transport and mounting of drills, screw taps, and implants, it is advisable that the acrylic block should end at the second to last tooth before the edentulous gap. This will prevent its interference during the drilling and placement of the nearest implant (Fig 6).

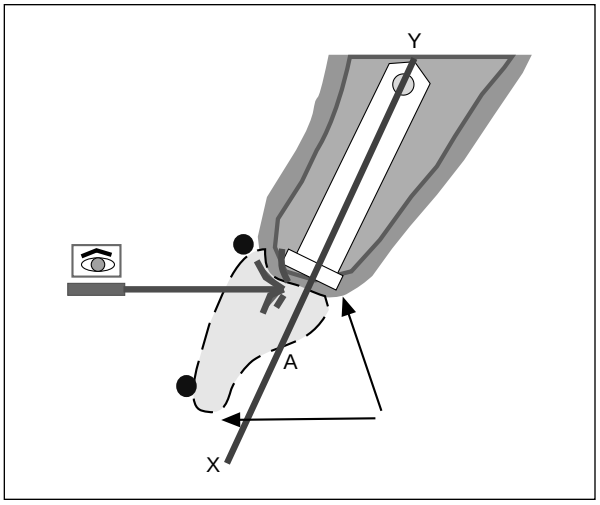
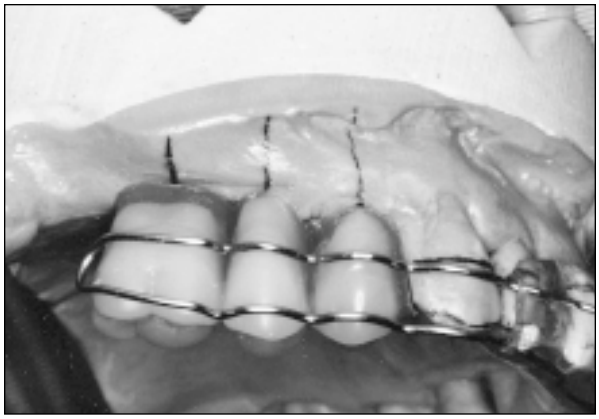
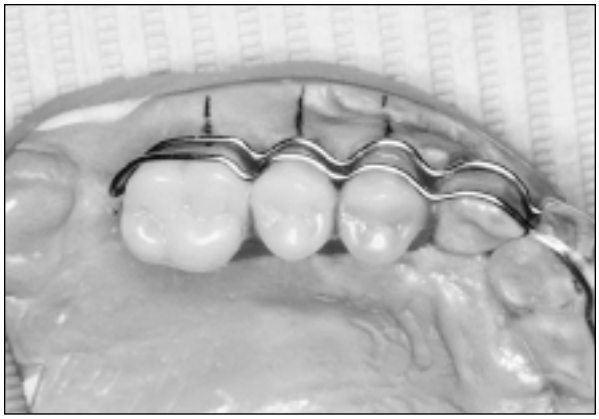


Fig 4 Drawing of a section perpendicular to the alveolar ridge of a patient with a profile surgical template. This presents the advantages of good orientation and the freedom of choice of the vestibular surgical template (Fig 3), and at the same time provides excellent visibility and the possibility of simultaneous external irrigation.





Figs 5a and 5b Diagnostic wax-up with adaptation of the wire profiles that follow the lines previously drawn on the cast.

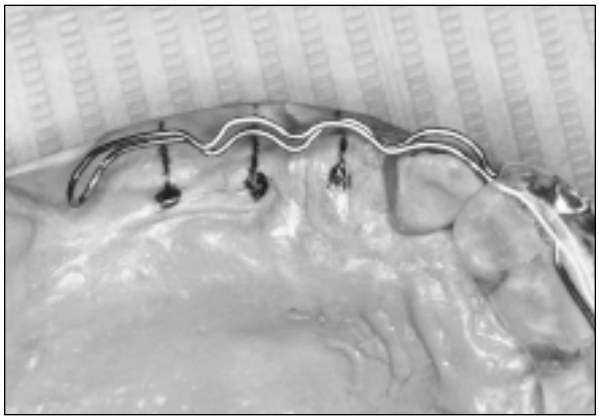


Fig 5c Once the teeth are removed, the profile of the template clearly shows the vestibular and mesiodistal limits for placing the implants.

Fig 5d Aspect of the template when removed from the cast.

Fig 6 *(Above)* The acrylic resin block must not surround the tooth that limits the edentulous part of the ridge. This will provide more access during the drilling of the alveolus of the nearest implant to the remaining teeth.

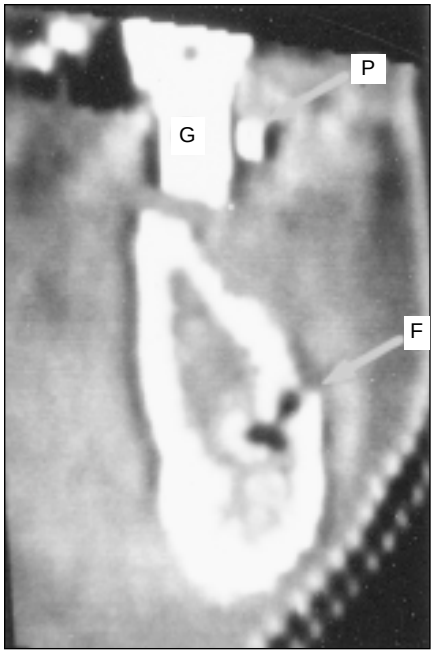


Fig 7 *(Right)* Systems of contrast and guttapercha blocks can be added for use in diagnostic imaging procedures. Visible in this CAT-reformatted image perpendicular to the alveolar ridge are the mental foramen (F), the cylinder of guttapercha that represents the position of the tooth (G), and the section of the profile wires of the template (P).

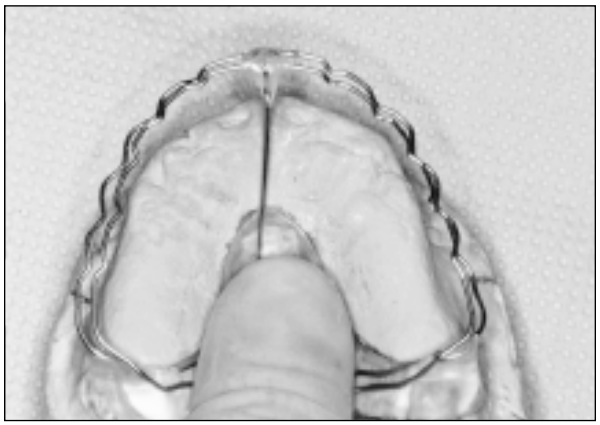


Fig 8a In this example, a fully edentulous patient will be treated with a complete implant-supported dentoalveolar prosthesis; consequently, the fixation system of this patient's profile surgical template will be a reduced prosthetic base.

Fig 8b Employment of the template during surgical procedures in the patient shown in Fig 8a. Note how it can be used even during implant placement procedures.

Use of wire in the fabrication process does not cause noticeable artifacts during radiographic study (Fig 7), and a system of contrast, such as "guttapercha" blocks, may be easily added to identify clearly the position and orientation of future teeth in relation to the remaining alveolar ridge.

The same system of orientation can be used during the treatment of a completely edentulous maxilla with moderate or advanced ridge resorption, but it is necessary to stabilize the template with a removable acrylic resin base. This template can be held in the correct position by having the assistant place a finger in the central zone of the palatal base during surgery. This procedure occupies less space and leaves one hand free for such procedures as irrigation and aspiration. At the same time, if a flap is raised with an incision slightly positioned towards the palate, the surgeon can hold it in the vestibule, thus gaining good access to and visibility of the alveolar bone and having the right hand free for drilling procedures (Figs 8a and 8b).

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