Optimal placement of osseointegrated implants

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INTRODUCTION

*The recent introduction of the osseointegrated technique for dental implants has been a major advance in clinical dentistry.[1] With this modality in particular, meticulous attention to the proper diagnosis, treatment plan, and treatment itself is critical for long-term success. When dental implant patients are treated by the "team approach" (i.e., surgical specialist and restorative dentist), there must also be excellent communication and coordination on the "team" in order to achieve optimal results (**Tables I** and **II**). Interested readers are referred to an article by this author on the subject of diagnosis, radiographs, and treatment planning of implant patients.[2] The present article will discuss and illustrate how to achieve optimum placement of osseointegrated implants with the aid of various types of "surgical" and "radiographic correction" acrylic intraoral stents.*

AVANT-PROPOS

*En implant dentaire, l'ostéointégration est une technique relativement récente qui a fait faire un grand pas à la dentisterie clinique[1]. Pour assurer à long terme le succès des implants ostéointégrés, une méticuleuse attention doit être apportée au diagnostic, au plan de traitement et au traitement. Lorsque le patient ayant besoin d'un implant est traité par une équipe (i.e. un chirurgien dentaire et un spécialiste en restauration), la communication entre les membres et la coordination de leur travail doivent être excellentes afin d'obtenir les meilleurs résultats possible (**tableaux I** et **II**). Les lecteurs intéressés sont invités à consulter un article de l'auteur portant sur le diagnostic, les radiographies et le plan de traitement pour les patients ayant besoin d'implants[2]. Quant à cet article-ci, il explique et illustre comment placer le mieux possible les implants ostéointégrés à l'aide de divers dispositifs de "rétention chirurgicale" et de "correction radiographique" en matière acrylique.*

The optimal placement of osseointegrated dental implants is extremely important in order that the final restorative result satisfies the patient's need for comfort, function, esthetics and ease of maintenance. This is particularly important with crown and bridge-implant supported applications in the partially edentulous patient. During the initial surgical phase, it is often difficult for the surgical specialist to accurately identify the ideal implant positions (i.e. in all three dimensions relative to other implants and/or the natural dentition) without the aid of a "surgical stent" or guide. The restorative dentist and surgical specialist must cooperate to design and prepare the stent pre-operatively.

Stent Fabrication Technique

A wax trial set-up is made on study models that have been mounted on an appropriate articulator. After the patient has approved the try-in, an impression of the wax-up is made and poured in stone. The stone cast is now utilized to fabricate an omnivac acrylic matrix. It is advisable to fabricate a prosthetic matrix (0.020 inch thickness) and a surgical matrix (0.060 inch thickness). A silicone or plaster index can then also be taken of the wax-up, to be used later as a guide to tooth placement for the final prosthesis. Next, the wax-up is removed from the original model and the omnivac acrylic matrix is positioned on the case. Although the matrix can be utilized in this form as a surgical stent, in the opinion of this author, this may provide an inaccurate guide (**Fig. 1**) and it is better to fill in the dentulous areas of the matrix with (clear) cold-cure acrylic. Once the acrylic sets, the restorative dentist should accurately locate and angle a 2 mm. diameter drill hole into the acrylic in the anticipated ideal implant locations. The drill should penetrate the acrylic and lightly score the model. The end result is a tunnel-like preparation in the acrylic, into which an appropriately sized drill or paralleling tool can be securely inserted to indicate the desired position (in all 3 dimensions) of the future implant (**Figs. 7-10**).

In cases where the implant location is less critical, the stent can be modified with bar-overdenture or overdenture application. The stent should be fabri-

TABLE 1

Pre-surgical responsibilities

Restorative Dentist	Surgical Specialist
– prosthetic evaluation	– medical and dental evaluation
– prosthetic treatment plan	– radiographs
– surgical, prosthetic and radiographic correction stents	– implant type, number, and position

TABLE 2

Post-surgical responsibilities

Restorative Dentist	Surgical Specialist
– interim prosthetic alterations	– soft tissue evaluation
– final prosthetic fabrication	– hard tissue evaluation
– maintenance	– radiographic evaluation
	– maintenance

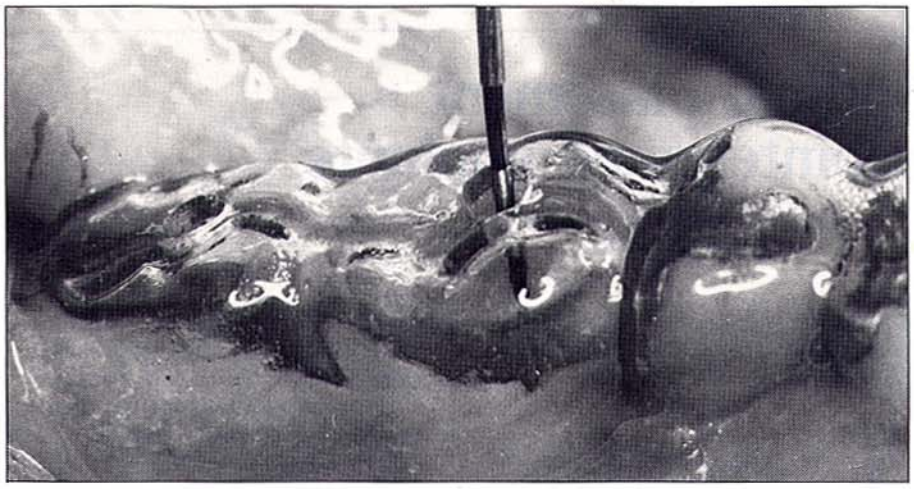

Fig. 1 – An omnivac acrylic matrix (or stent) demonstrating a periodontal probe inserted through the central fossa area. Although the holes in the acrylic can be placed in the ideal position, this type of stent does not prevent inadvertent probe angulation. When transferring from the occlusal aspect of the clinical ridge, significant inaccuracies may occur.

Fig. 2 – Occlusal view of a surgical stent designed for the completely edentulous mandible where implant placement is anticipated mesial to the molar areas. Note the coverage of the retromolar pad areas for stability. Also note the labial aspect of the stent, which represents the idealized final prosthetic tooth positions. The labial aspect will act as a guide for the implant site selection.

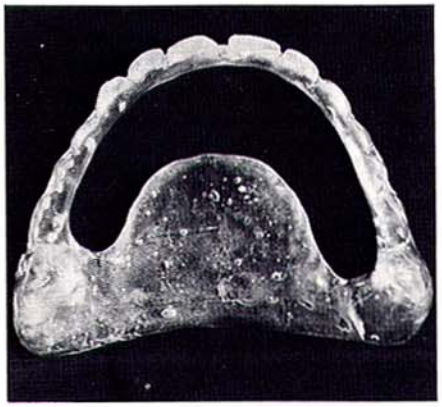

Fig. 3 – Occlusal view of a surgical stent designed for the completely edentulous maxilla where implant placement is anticipated mesial to the molar areas. Note the coverage of the tuberosity and posterior palatal areas for stability. Also note the labial aspect of the stent which represents the idealized final prosthetic tooth positions. The labial aspect will act as a guide for the implant site selections.

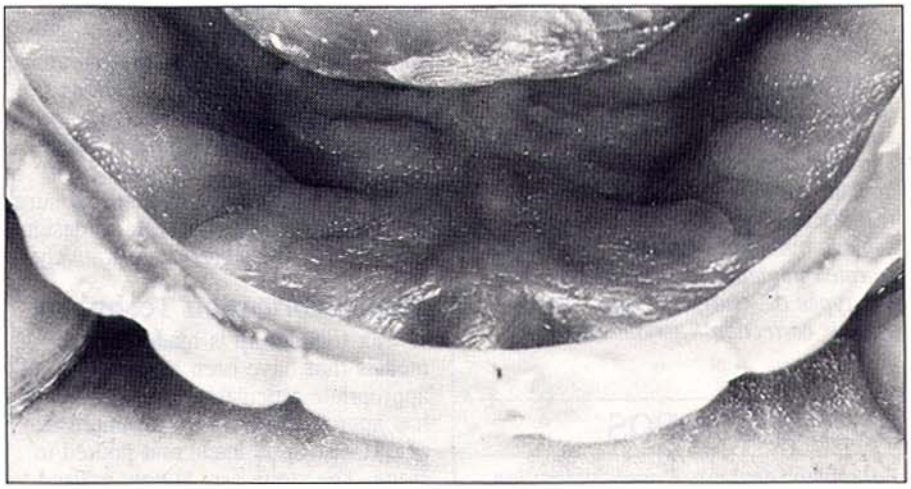

Fig. 4 – Occlusal view of the surgical stent seen in Fig. 3 . Note the generous portion of acrylic that has been removed between the palatal acrylic and labial aspect of the stent. This design allows for unobstructed access to the surgical area when a flap is raised from the palatal aspect out to the labial.

cated so that it seats securely in the mouth after the flaps have been raised. This can be accomplished by having intimate and generous tissue contact on the retromolar pads (**Fig. 2**) or tuberosity and post-palatal seal areas (**Fig. 3**). In all situations, a generous area of the stent must be cut out in the anticipated areas where the implants are to be placed (**Figs. 2,3,4**). Additionally the stent should provide an indication of where the prosthetic teeth will be placed. This can be accomplished by incorporating the vestibular portions of the "teeth" part of the stent (**Figs. 2,3,4**).

The ideal implant position, from a restorative point of view, will usually be parallel to the adjacent implants and adjacent tooth roots, as well as directed toward the occlusal centre of the tooth, i.e. the cingulum for anteriors and central fossa for posteriors. Where possible, this should also correspond to the contact point of the opposing tooth. The placement must also take into account the amount of restorative material that will surround the framework to assure not only sufficient bulk for strength, but also proper hygienic contours and esthetics.

The surgical stent may also function as a "radiographic-correction-stent". Radiopaque markers (eg. 5 mm. diameter metal balls) can be secured within the acrylic at the pre-selected strategic locations. The markers preferably should be located as close to the clinical ridge as possible and coincide with the preferred implant locations (**Fig. 5**). The "radiograhic-correction-stent" is then seated in the patient's mouth while a panoramic film is taken (**Fig 6**). With this technique, the surgical specialist during the implant placement, can accurately correlate the optimal locations clinically and radiographically. (**Figs. 5 and 6**).

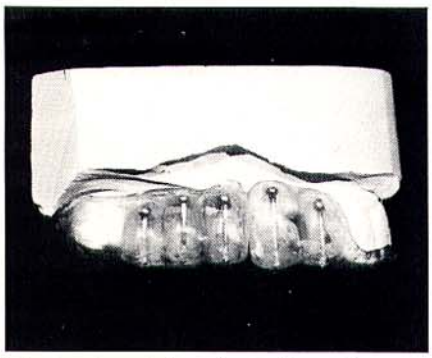

Fig. 5 – Buccal view of a "radiographic correction stent". Although 5 mm diameter metal balls can be used as "radiopaque markers", in this case orthodontic ball clasps were utilized. The markers should be positioned mesiodistally to correspond to the pre-selected implant locations. See Fig.6 for the panoramic view with this appliance seated "in the mouth".

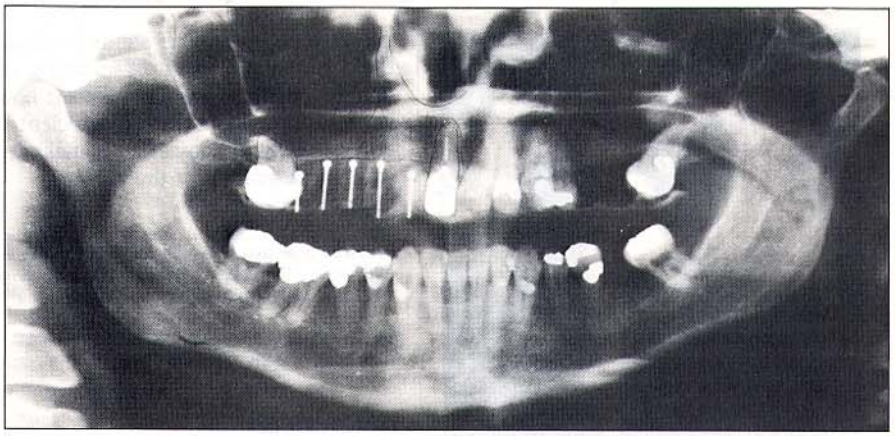

Fig. 6 – Panoramic radiograph of the appliance (as seen in Fig. 5) taken after securely seating it in the patient's mouth. With this appliance and radiograph, the surgical specialist can accurately relate any location on the osseous crest with the radiographically available bone height. This in turn allows the more precise selection of proper implant lengths and mesio-destal positioning.

Pre-surgically, once the radiographs have been completed, the stent may be strategically sectioned. During the initial implant surgery, either section of the stent can be easily removed (**Figs. 7 and 8**). This could be done after all the "starting points" have been transferred from the tunnel preparations in the stent to the crest of the bone via a coloured marker or a small notch made in the bone. Now with only one portion of the stent in the mouth, the appropriately-sized drill or guide is placed in the tunnel prepared in the acrylic that is adjacent to the edentulous area where the first bone preparation is to be made (**Fig. 9**). Now the surgical specialist has the ideal implant angulation indicated by the adjacent "guide" and with the previously made starting notch, can accurately angle the drill (assuming the available bone will allow this) in all three dimensions. Once the first site has been prepared, an appropriately-sized drill or guide is placed in the prepared bone site (**Fig.10**), the other portion of the stent removed, and the remaining bone preparations carried out in a similar fashion. In the event that the osseous anatomy of the patient does not allow ideal implant placement, the stent may still be valuable as a guide during surgery in making a strategic implant positional change.

There may be cases where the patient is already wearing an interim fixed bridge that is bridging the implant area. In this situation, a second "bridge-like" surgical stent can be fabricated in a similar manner to the technique for the provisional fixed bridge. This stent or "duplicate acrylic bridge" is modified in the same way, i.e. drill holes placed in the appropriate pontics for the anticipated implant positions. At the time of surgery, the patient's interim bridge is removed for access, thus allowing the seating of the stent.

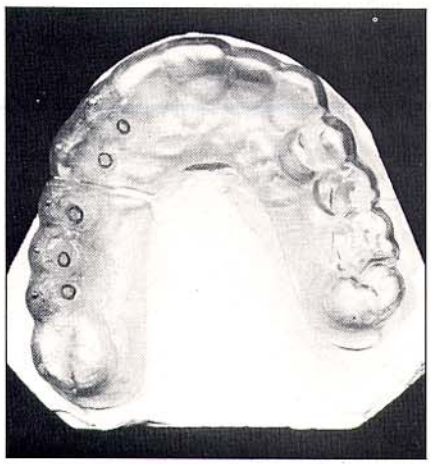

Fig. 7 – Occlusal view of the surgical stent (as seen in Figs. 5 and 6). This view demonstrates the tunnel-like preparation made through the acrylic, indicating the ideal implant positions. Note also that the stent has been strategically sectioned, thus allowing independent use of either portion after all the implant "starting points" have been transmitted from the appliance to the osseous crest.

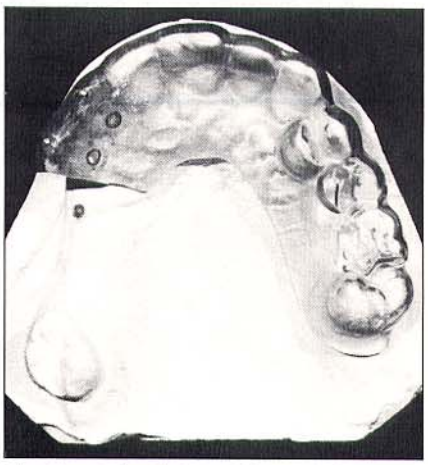

Fig. 8 – Occlusal view of the surgical stent (as seen in Figs. 5, 6 and 7), with one portion removed. This design allows the placement of an appropriate bur that can be securely fitted into the acrylic tunnel-like preparation prior to the initial osteotomy. This bur would act as a three-dimensional guide while preparing the initial implant site.

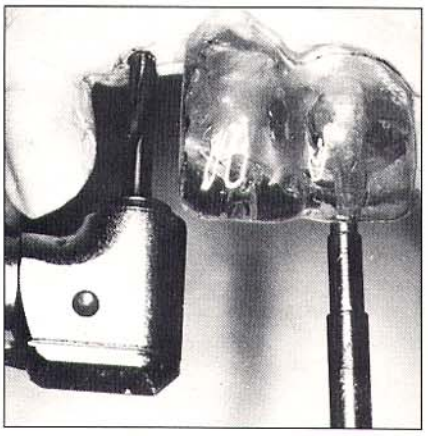

Fig. 9 – Labial view of the surgical stent with a "paralleling tool" (Core-Vent Corporation) acting as a guide, for correct bur angulation when preparing the initial implant site.

Summary

In summary, there is no substitute for thorough diagnosis, treatment planning, and meticulous surgical and prosthetic treatment. Proper utilization of surgical and radiographic correction-stents is one of the important aspects of the

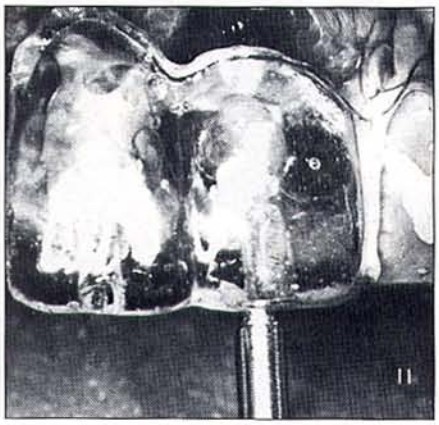

Fig. 10 – Labial view of the seated surgical stent after completion of the first osteotomy site. Note the paralleling tools (Core-Vent Corporation) in the stent and osteotomy site. The stent can now be removed and the paralleling tool in the osteotomy site can function as the guide for the subsequent osteotomies.

presurgical phase. The stents facilitate the accurate placement of implants in optimal positions where sufficient bone is present. In cases with insufficient bone, the stents may help in making a strategic alteration of the chosen implant site.

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