Modular Transitional Implants to Support the Interim Maxillary Overdenture

CE 4

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Abstract: *It has been reported that for implants to become osseointegrated, they must heal in the absence of functional loads for 4 to 6 months. To address the need for undisturbed healing and patient demand for uninterrupted immediate function and esthetics, the Modular Transitional Implant™ and Prosthetic System has been developed. This case report describes the use of transitional implants to support a removable maxillary overdenture, including methodology and the advantages and disadvantages of the system. The histomorphometric analysis of one of these transitional implants and its surrounding osseous tissue showed a 45% bone-to-implant interface after 6 months of functional loading. The transitional implant system is a sound and economical method of immediate patient restoration that allows for the protected healing of submerged implants.*

Learning Objectives:

After reading this article, the reader should be able to:

- describe a case using transitional implants to support a maxillary overdenture.
- discuss other potential uses for transitional implants.
- describe the bone-to-implant interface of transitional implants.

According to the literature and the documented surgical and restorative protocols for submerged and nonsubmerged implants, healing in the absence of functional loads for a period of 4 to 6 months is necessary to achieve osseointegration.[1-4] In addition, a 2-week healing period is recommended before placing a removable prosthesis in the edentulous area, and the prosthesis must then be relined with a soft-tissue liner every 3 weeks until placement of the definitive prosthesis. For most edentulous patients, the extended wait creates discomfort and inconvenience. As a result, some patients might be reluctant to pursue implant therapy.

To overcome this problem, some clinicians advocated connecting and loading the implants immediately after surgery. This technique is well documented for the implant-retained mandibular overdenture and for the mandibular fixed prosthesis. In addition, several long-term clinical studies support a change in the protocol.[3,5-12] However, despite the presence of case reports and animal studies on immediate loading of free-standing implants in partially edentulous patients and in edentulous maxillae, long-term clinical data supporting this approach have not been reported. In these situations, clinicians should be cautious when electing to deviate from the present protocol (eg, 4 to 6 months of undisturbed healing).[12-20]

To address the need for undisturbed healing and patient demand for uninterrupted immediate function and esthetics, the Modular Transitional Implant™ (MTI) and Prosthetic System[a] has been developed. This system uses commercially pure titanium transitional implants and can be used in conjunction with the common screw-type implant.

This article describes the use of transitional implants to support a maxillary overdenture and presents a histomorphometric analysis of the interface between a functionally loaded transitional implant and its surrounding osseous tissue. The methodology, advantages, and disadvantages of the system are discussed.

Case Report

A 45-year-old woman presented with a maxillary removable partial denture retained by periodontally hopeless canines opposing natural dentition (Figures 1

[a] Dentatus USA, Ltd, New York, NY 10016

CE 4

Quiz 4

This article provides 1 hour of CE credit from Dental Learning Systems, Co., Inc., in association with the University of Southern California School of Dentistry and the University of Pennsylvania School of Dental Medicine, representatives of which have reviewed the contents of these articles for acceptance. Record your answers on the enclosed answer sheet or submit them on a separate sheet of paper.

1. **According to conventional surgical and restorative protocols, submerged and nonsubmerged implants must heal in the absence of functional loads for how long to achieve osseointegration?**
   a. no time required
   b. 1 to 3 weeks
   c. 4 to 6 months
   d. 1 year

2. **In this case, when were the 15 mm × 3.75 mm implants placed after extractions?**
   a. immediately
   b. after 3 weeks
   c. after 6 months
   d. after 1 year

3. **In this case, where in relation to the definitive implants were the six MTI 17 mm × 1.8 mm implants placed?**
   a. 2 mm to 3 mm palatally
   b. 2 mm to 3 mm facially
   c. 3 mm to 4 mm buccally
   d. 1 mm to 2 mm supracrestal

4. **The implants were inserted with the MTI R/A driver operated at:**
   a. 150,000 rpm.
   b. 15,000 rpm.
   c. 1,500 rpm.
   d. 15 rpm.

5. **The primary function of the MTI system is to do what during the healing phase?**
   a. activate the complement system
   b. absorb masticatory stress
   c. decrease asteolytic activity
   d. test the titanium for stability

6. **Other appliations for the MTI system include:**
   a. stress-free maturation of bone grafts.
   b. provisionalization of edentulous patients.
   c. temporary repairs of failing key abutments.
   d. all of the above

7. **If the MTIs are not perfetly aligned, what is used to correct the misalignment?**
   a. high-speed drill
   b. low-speed drill
   c. bending instrument
   d. cannot be done

8. **Histologically, the vitality of the bone is substantiated by the presence of:**
   a. osteocytes in the lacunae.
   b. osteoclasts.
   c. undifferentiated mesenchchymal cells.
   d. histiocytes.

9. **The histomorphic analysis shows how much bone-to-implant interface?**
   a. 2%
   b. 15%
   c. 45%
   d. 95%

10. **Advantages of the transitional implant system include:**
    a. the patient leaving the office with a stable prosthesis.
    b. no urgent timetable to complete the permanent restoration.
    c. patient compliance and oral hygiene can be evaluated.
    d. all of the above

Please see tester form between pages 992 and 993.

transitional implant system is a sound and economical solution. It allows the patient to leave the office with a stable prosthesis that neither loads nor interferes with the maturation and osseointegration of the implants. In addition, there is no urgent timetable to complete the permanent restoration, which can be planned to accommodate office schedules and patient availability. In the authors' experience, patients restored with transitional implants are more compliant and satisfied, and they are appreciative of the professional effort that provided them with a comfortable provisional restoration. Finally, it allows the clinician to test the form and function as well as the esthetics and phonetics of the definitive prosthesis early in the provisional phase. Patient compliance and oral hygiene can be evaluated to provide important information regarding the design and the prognosis of the final restoration.

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Figure 15—The denture is hollowed out to allow sufficient space to place a soft-tissue liner, which stabilizes the overdenture on the bar.

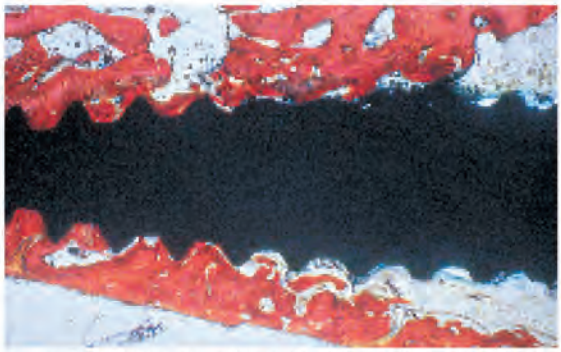


Figure 16—The histomorphometric analysis shows a 45% bone-to-implant interface.

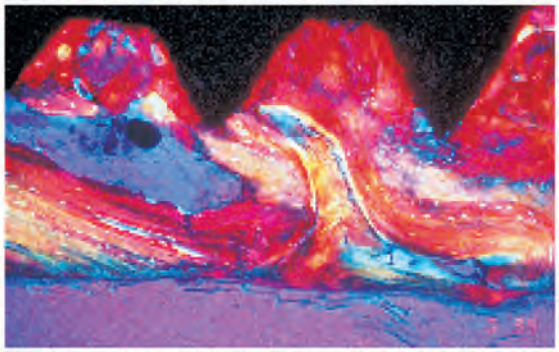


Figure 17—The polarized view presents the lamellar structure of the bone and emphasizes the different remodeling pattern.

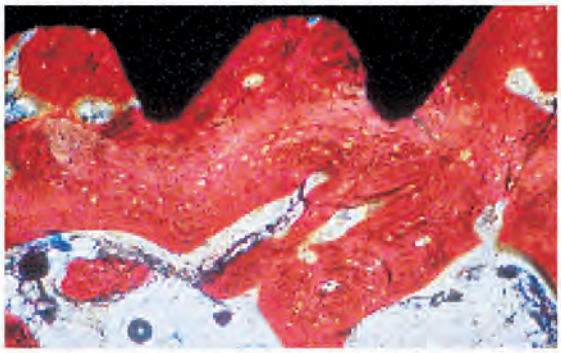


Figure 18—The vitality of the bone is substantiated by the presence of osteocytes in the lacunae.

the misaligned implant using the singular coping or to fabricate two individual bars that do not cross the midline.

In this case, the patient had some difficulty inserting her prosthesis, and on several occasions she bent the slot that allows the insertion of the titanium connective bar. To avoid this problem and to prevent macromovements of the MTIs a titanium bar is cemented to the implants with zinc polycarboxylate cement (Durelon®,[h]) (Figures 13 and 14). The bar is embedded in autopolymerizing resin and shaped with a moderate ovoid cross section. The denture is hollowed out to allow sufficient space to place a soft-tissue liner (Viscogel®,[i]) (Figure 15). The liner is used to frictionally retain the denture over the bar.

A fixed provisional MTI restoration is an alternative. However, this option would not simulate the final restoration in cases of a removable implant overdenture.

Histologic Observations

The specimen harvested after implant removal was stained with Stevenel's blue and van Gieson's picric fuschin. The apical portion of the implant demonstrated excellent bone-to-implant interface, and the coronal portion was surrounded with connective tissue (Figure 16). The polarized view presents the lamellar structure of the bone and emphasizes the different remodeling pattern (Figure 17). The vitality of the bone is substantiated by the presence of osteocytes in the lacunae, shown at high magnification in Figure 18.

The histomorphometric analysis shows a 45% bone-to-implant interface. Tarnow and Froum reported similar findings on the MTI system in function and fully loaded for 8 months.[24] Histologic studies with nonhuman primates presented similar results.[30]

Conclusion

Histologic observations show that the earlier concerns of safety and efficacy of immediate provisional restorations after implant placement can be clinically addressed with the use of transitional implants. Healthy soft tissue and good bone adaptation consistently seen around the transitional implants support this conclusion.

Until further studies demonstrate that immediate loading is a predictable and practical approach in every clinical situation, the

[h] ESPE, Norristown, PA 19404
[i] DENTSPLY® Preventive Care, York, PA 17404

Figure 11—Facial view of the final restoration.

Figure 12—Panoramic radiograph 1 year after insertion of the final prosthesis.

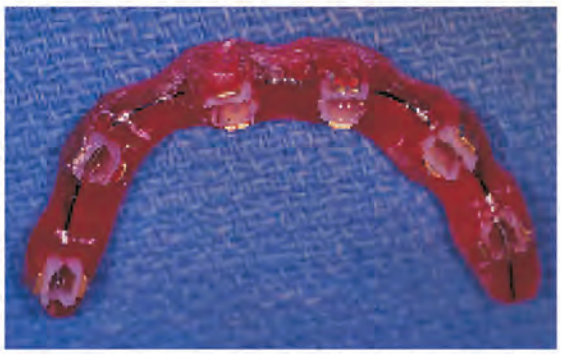


Figure 13—Another alternative to stabilize the denture with the transitional implants is to fabricate a custom acrylic bar.

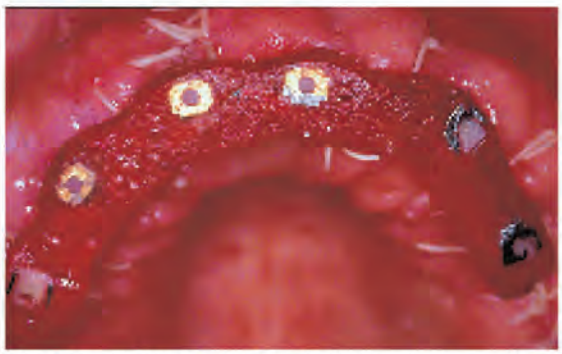


Figure 14—The titanium bar is embedded in autopolymerizing resin and cemented on the MTIs with polycarboxylate cement.

ed and tried in the patient's mouth (Figure 9).

With adequate support from the implants, the patient's comfort could be enhanced with a "palateless" overdenture. The patient was satisfied with the function and esthetics of her new denture (Figures 10 and 11). The panoramic radiograph taken 1 year after insertion of the definitive prosthesis demonstrates the osseointegrated implants (Figure 12).

The primary function of the MTI system is to absorb masticatory stress during the healing phase, ensuring stress-free maturation of the bone surrounding the submerged implants.

Discussion

The primary function of the MTI system is to absorb masticatory stress during the healing phase, ensuring stress-free maturation of the bone surrounding the submerged implants.[22-29] The system continues to expand broadly into diverse applications, such as stress-free maturation of bone grafts, provisionalization of fully and partially edentulous patients, temporary repairs of failing key abutments, and as anchors for orthodontic treatment.

In addition to permitting uninterrupted healing of the implant site and/or bone-grafted ridge, the transitional support allows the patient to enjoy a stable prosthesis that will mimic the final restoration. The MTI system is designed to allow the chairside fabrication of restorations for immediate function and patient comfort. The procedure is fairly simple, but it is paramount that practitioners master the detailed sequence of the procedure. One of the disadvantages of the technique is the amount of chair time required, especially with an inexperienced operator. However, the system provides components for fabrication of the provisional restoration in the laboratory, thus reducing chair time.

In the case presented, the failure of the distal right implant may have been the result of misalignment, which induced excessive forces during the fitting of the titanium connecting bar into the slotted heads of the implant. If the MTIs are not perfectly aligned, the manufacturer provides a bending instrument to correct any misalignment. However, excessive bending may cause fatigue failure of the implant material and/or loss of the initial primary stability. In such cases, it may be wiser to bypass

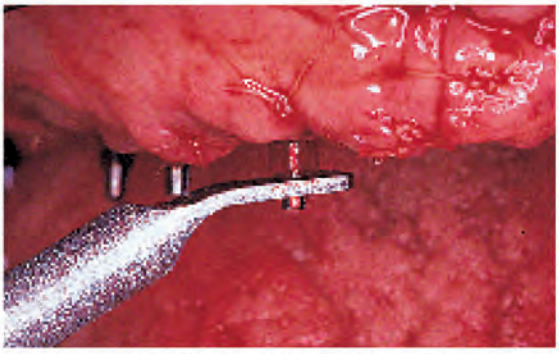


Figure 5—Plastic protective spacer adapted over the square implant heads to prevent resin from locking the assembly.

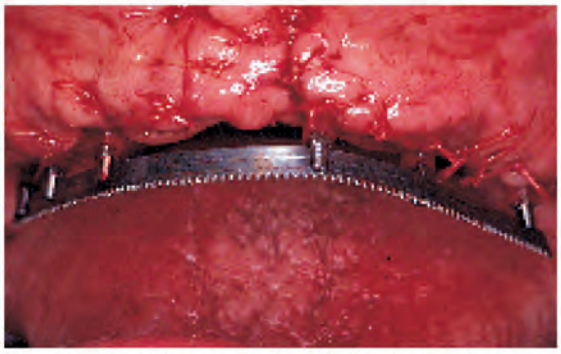


Figure 6—Titanium connective bar with the serrations facing occlusally, and passively seated on the MTIs.

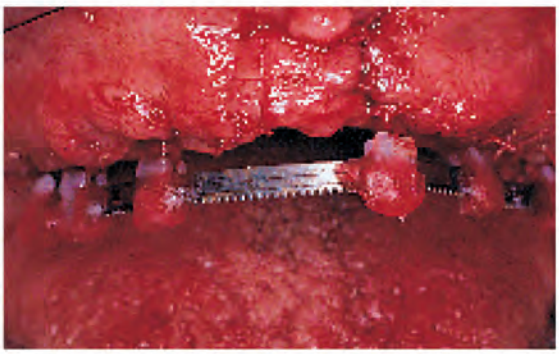


Figure 7—The expandable modular copings carefully attached to the bar with a small amount of autopolymerizing resin.

Figure 8—Titanium connective bar and modular copings picked up in the "palateless" denture.

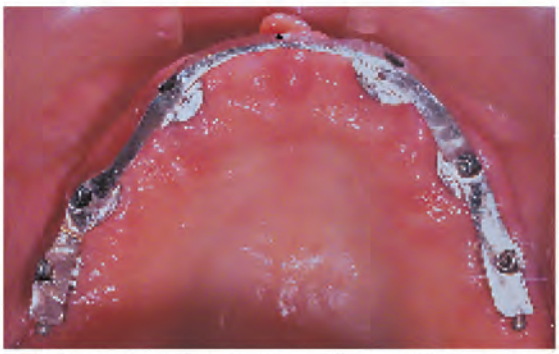


Figure 9—Occlusal view showing a milled bar with two posterior extracoronal attachments and two anterior intracoronal attachments.

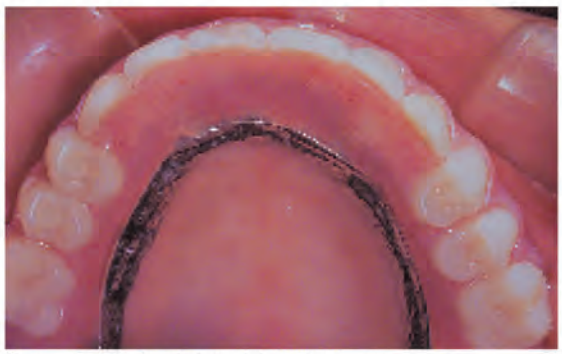


Figure 10—Occlusal view of the palateless denture.

assembly. Autopolymerizing resin (Tru-Liner[e]) was placed, in a doughy consistency, into the prepared space to pick up the bar assembly with the denture in occlusion. The denture was removed and adjusted to relieve internal and occlusal interference (Figure 8). A panoramic radiograph was taken and the patient was dismissed with the same postoperative and oral hygiene instructions given after any implant surgery or immediate denture delivery.

One month after implant placement, the patient reported some tenderness on the most distal right MTI. To avoid potential infection, the implant was removed and the symptoms disappeared completely.

Six months after surgical placement, the submerged implant fixtures were uncovered and the MTIs were removed. For histologic evaluation, a 3-mm trephine was used to harvest one of the anterior MTIs with the surrounding bone. The specimen was rinsed in saline solution, fixed in 10% buffered formalin, dehydrated in alcohol, and embedded in methylmethacrylate resin to be cut according to the protocol described by Donath and Breuner.[21] After 4 weeks of healing, a final impression was made using polyvinylsiloxane impression material (Reprosil®,[b]). A milled bar with two posterior extracoronal attachments (SG Vario Snap®,[f]) and two anterior intracoronal attachments (Ipsoclip RE®,[g]) was fabricat-

[e] Bosworth, Skokie, IL 60076

[f] Bredent, Senden, Germany

[g] Cendres and Metaux, SA, Biel, Switzerland

Figure 1—Patient presented with a maxillary removable partial denture retained by periodontally hopeless canines opposing natural dentition.

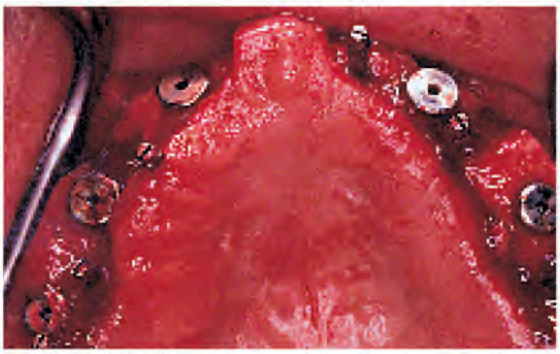
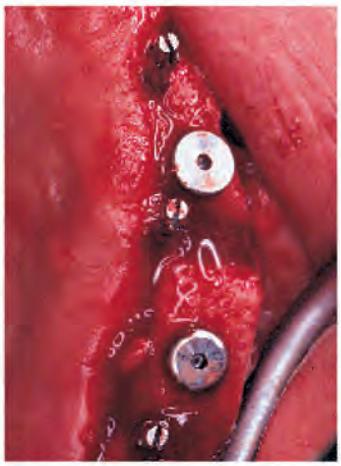


Figure 3—Occlusal view showing the Modular Transitional Implants (MTIs) and their position in relation to the Brånemark implants.

Figure 4—Occlusal view showing alignment of the implant slots with the ridge crest after minor adjustments of the MTI.



and 2). After the extraction of the maxillary canines, an immediate complete denture was placed to provide proper function and esthetics.

To allow the patient to leave the office on the day of the implant surgery with a "palateless" denture and to prevent any transmucosal load during the 6 months of healing, the treatment was planned using MTIs. The maxillary immediate denture was duplicated in Orthodontic Resin®,[b] to be used as a radiographic and surgical template. Six Brånemark MK II 15 mm × 3.75 mm implants[c] were placed 3 weeks after the extractions. Six MTI 17 mm ×

[b] DENTSPLY® Caulk®, Milford, DE 19963

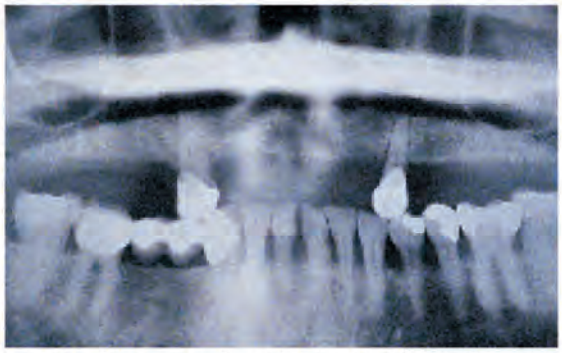


Figure 2—Panoramic radiograph of the remaining dentition.

1.8 mm implants were placed 2 mm to 3 mm palatally to the definitive implants, as recommended by the manufacturer (Figure 3). Because of the poor quality of the maxillary bone, the osteotomy was carried 3 mm shorter than the intended length of the self-threading MTI. The osteotomy was created with the MTI profile drill at low speed (800 rpm) with copious irrigation.

The implants were inserted with the MTI R/A driver operated at 15 rpm. Insertion was completed manually with the winged socket key, which provides better leverage and tactile control than the driver. Minor adjustments were made to align the implant slot with the ridge crest. Implant angulation can be corrected by gently bending the implant with the reciprocating MTI paralleling guide extension rod, which allows the titanium connective bar to fit passively (Figure 4).

Plastic protective spacers were adapted over the square implant heads with the spacer-seating instrument. The spacers protect the slimmer implant necks, preventing soft-flowing resin from locking the assembly (Figure 5).

The titanium connective bar, with the serrations facing occlusally, was aligned to the ridge crest with slight finger pressure and inserted to straddle the slotted heads of the implants (Figure 6). The expandable modular copings were aligned in a parallel position straddling the titanium bar, and the implants were carefully attached to the bar with small amounts of autopolymerizing resin (GC Pattern Resin[d]) (Figure 7). The assembly was tested for easy removal, then carefully replaced in its exact position.

A channel was prepared in the denture base so that it could be seated completely in its proper position without engaging the bar

[c] Nobel BioCare USA, Inc, Yorba Linda, CA 92887
[d] GC America, Inc, Alsip, IL 60803