Fixed Temporization and Bone-Augmented Ridge Stabilization With Transitional Implants

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Utilization of dental implants in full-mouth restorations is now a well-accepted treatment modality, with numerous modifications and implant systems documented in the literature. The efficacy of the treatment procedure generally requires an extended postplacement healing period prior to loading the implant fixture with the stress of mastication. Until recently, clinicians have not been able to address patient comfort requirements during the healing period. The teaching objective of this article is to present and evaluate a transitional implant system used to provide function during the healing phase. The system consists of thin titanium transitional implants and a three-component overdenture that is intended to absorb the pressure during function and protect the augmented implant site and the definitive implant fixtures from the stress of immediate loading. Treatment objectives for the transitional and definitive implants are made during the initial treatment planning. Three cases are presented to document and illustrate the clinical procedure.

The evolution of implant-supported rehabilitation of the edentulous patient is well documented in the dental literature.[1-5] The submerged screw-type implants of the Brånemark system[1,2,6] replaced all previous technology. In accordance with the surgical and restorative protocol, the submerged implants are placed in a two-stage surgical sequence. At the initial procedure, the implants are placed, covered, and stabilized. The implants and the adjacent tissues are allowed to mature and integrate over a period of 4 to 6 months. At the second-stage surgery, the fixture is exposed, fitted with a healing cap, and resutured to promote soft tissue healing. Abutment extensions are placed subsequently in preparation for precise fabrication of the definitive prosthesis.

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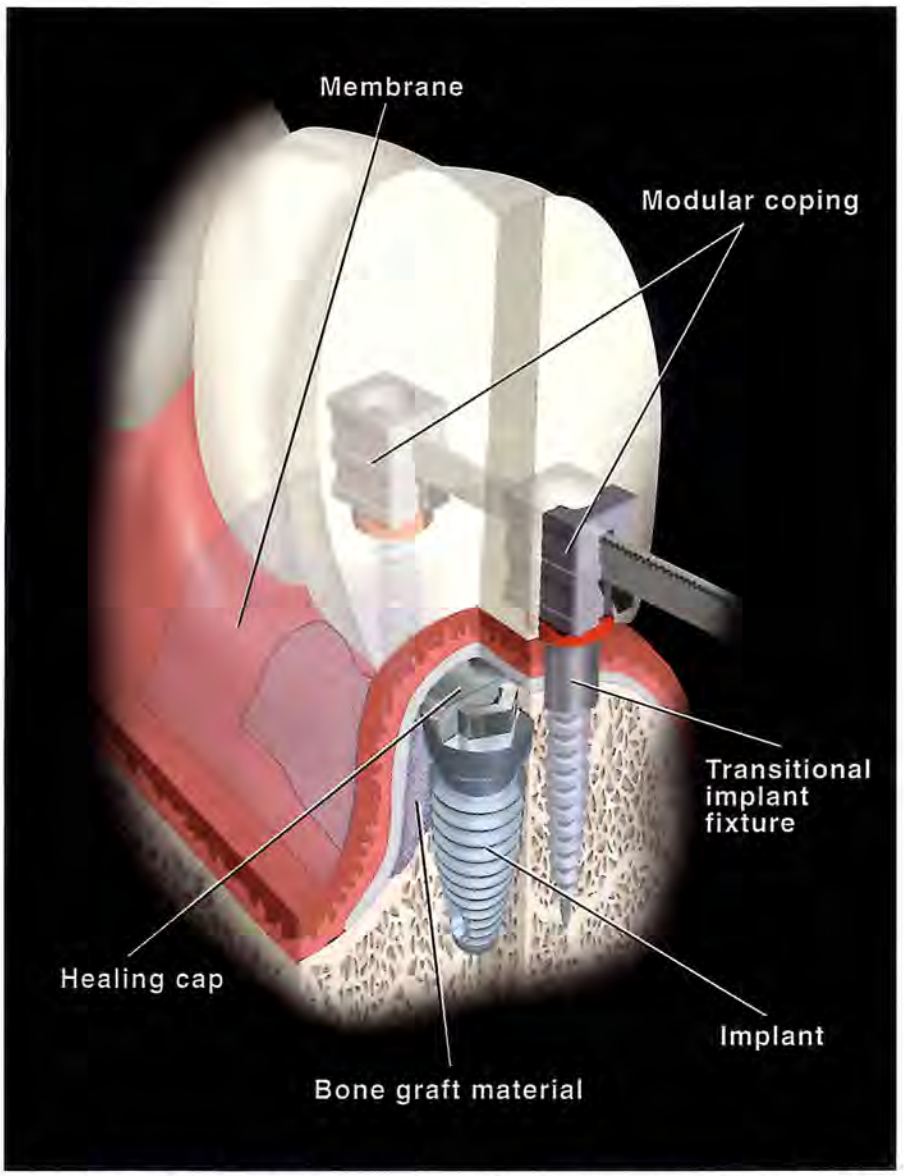

Figure 1. Illustration depicting placement of provisional implants, restorations, and modular bar assembly in relation to the definitive implant fixtures.

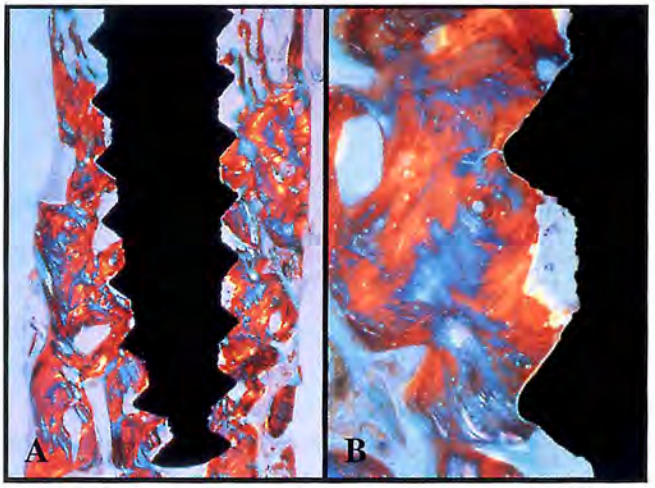

Figure 2A. Histological view of transitional implant. **2B.** Histological close-up (courtesy: Dennis Tarnow, DDS, New York, NY).

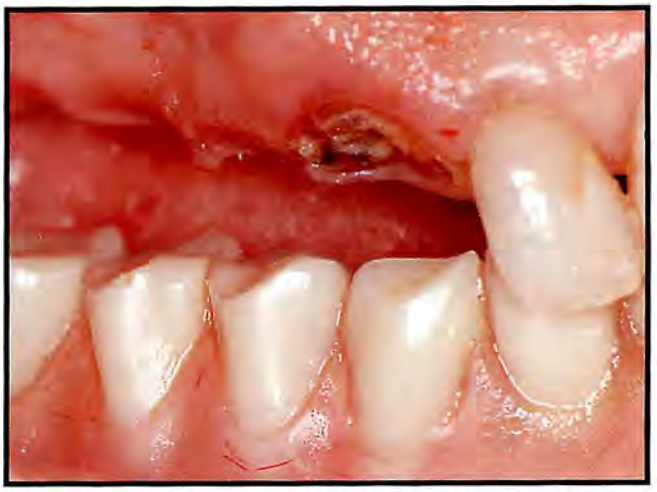

Figure 3. Case 1. Preoperative buccal view of the sites of the right region of the maxilla, tooth #3 through tooth #6.

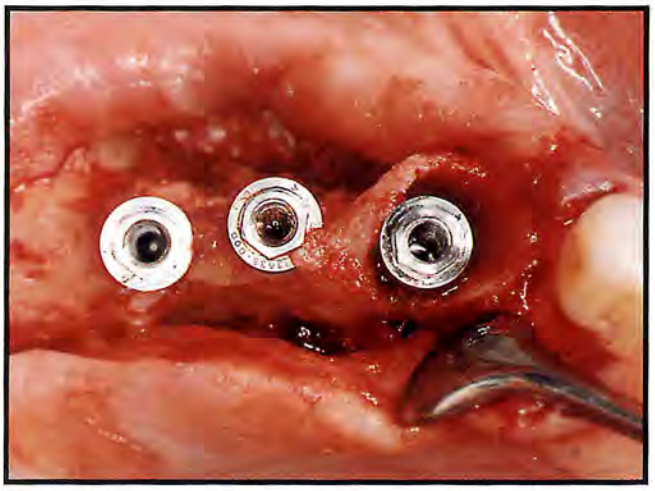

Figure 4. Remnants of periodontal ligament fibers in the extraction socket are carefully removed, and 3 implants are placed.

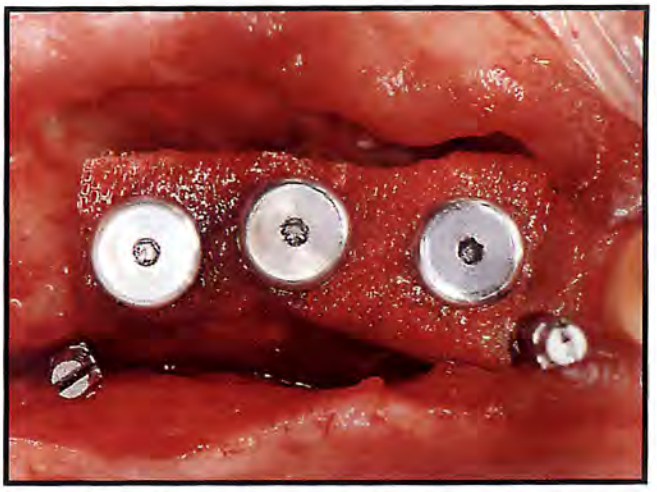

Figure 5. A barrier membrane is placed and secured by the cover screws and the placement of 3 transitional implants.

The need for precision is evident, since the superstructures are assembled with miniature screws that are expected to withstand considerable masticatory forces and secure the position of the components for the life of the restoration.

In the early development of dental implant technology, insufficient quality or volume of bone in the alveolar arch precluded implant therapy. Today, bone and soft tissue augmentation materials and techniques are available to repair defects that, conventionally, would have compromised an implant site. Surgical techniques have been developed to augment inadequate ridge formations,[7,8] elevate the sinus level,[9-11] and create natural emergence profiles for optimal aesthetic results. With function routinely achieved, the focus in implantology has been shifted to patient comfort and the aesthetics of the soft tissue architecture and the definitive prosthesis.

Until recently, clinicians were unable to address the need for undisturbed healing of the treatment site in conjunction with aesthetics and comfortable dental function during the integration period. The prospect of a 4- to 6-month edentulous period was met with patient apprehension, followed by a resistance to implant therapy. Patients often declined comprehensive implant therapy, not as a result of the expense involved, but due to the substantial discomfort and uncertainty associated with the procedure. This apprehension was accompanied by instructions to refrain from wearing full or partial dentures for 7 to 14 days. Loss of the implant and sloughing or migration of the graft material or supporting membrane were frequently initiated by premature pressure placed on the submerged implants, particularly when combined with guided bone regeneration procedures.[2,7]

THE TRANSITIONAL IMPLANT SYSTEM

To address the need for undisturbed healing, a transitional implant system has been developed that is compatible with the common screw-type systems. The purpose of this article is to describe the use of titanium transitional implants (MTI-MP, Dentatus USA, New York, NY) in fixed temporization and bone-augmented ridge stabilization. The system consists of small-diameter titanium transitional implants that support an overdenture of three prefabricated components — the gingival protective sleeves, connective bars, and modular

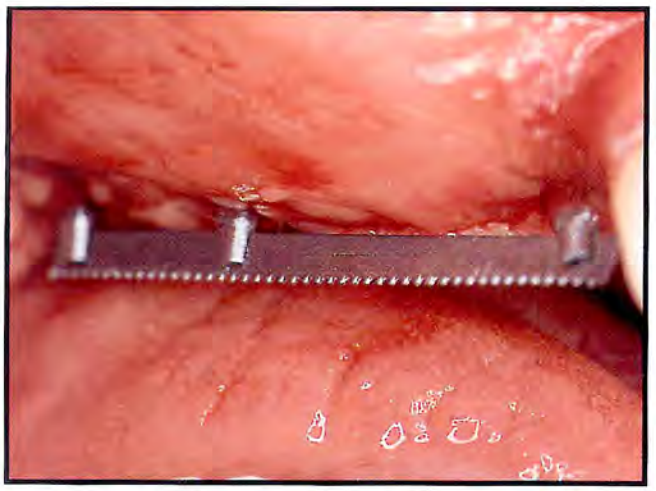

Figure 6. Titanium connective bar, cut to the proper length, joining the transitional implants.

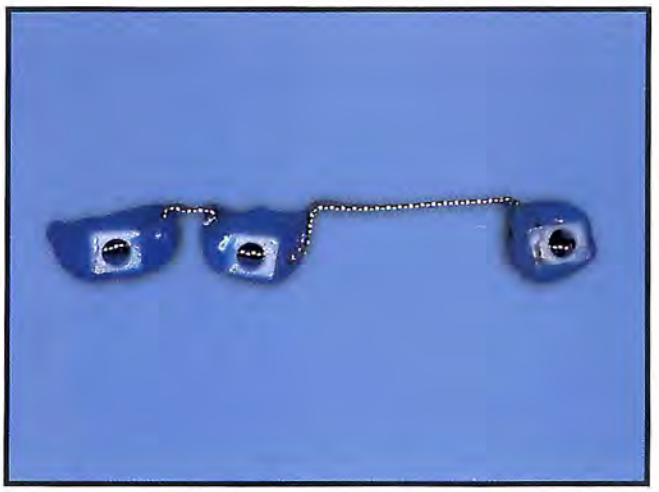

Figure 7. Undersurface of the temporary implants displays the modular copings embedded in the provisional acrylic material.

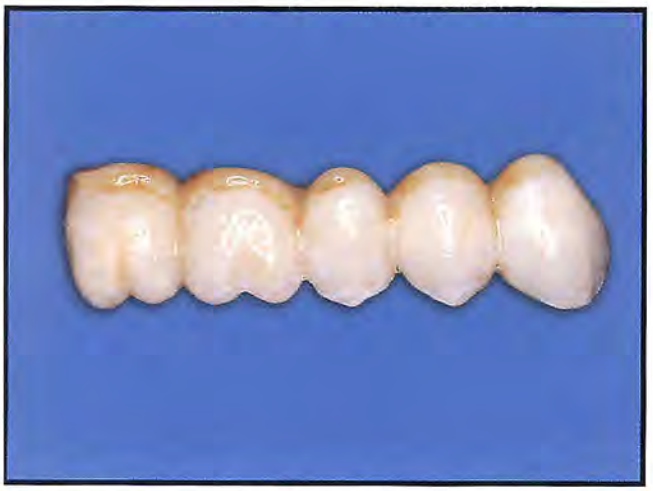

Figure 8. Facial view of the fabricated maxillary provisional restoration.

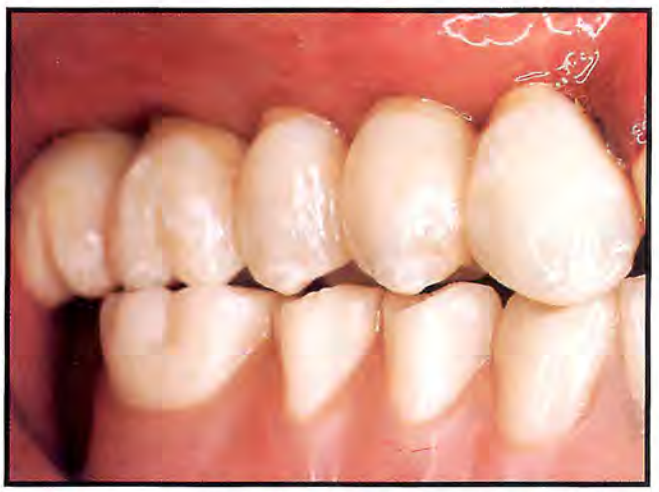

Figure 9. Postoperative clinical view of the provisional maxillary restoration.

copings (Figure 1). The system is designed for chairside fabrication, and its purpose is to provide an interim prosthesis that absorbs the mastication stress during the healing phase, ensuring stress-free maturation of the submerged implants and/or the newly regenerated bone. The thin transitional implants (anchors) are placed next to the definitive implant fixtures, and the elevated overdenture is assembled. Arrangements for the immediate provisional and the eventual definitive prostheses are made simultaneously during treatment planning.

Advantages

Use of transitional implant fixtures affords the following benefits:

- Provides uninterrupted healing of the implant site and/or bone grafted ridge.
- Prevents the premature loading of the definitive implant fixtures.
- Eliminates the requirement of removable appliances during the healing phase.
- Permits the patient to utilize a provisional restoration with form and function similar to those of the definitive prosthesis.
- Allows the marking and transfer of jaw dimensions and measurements from the patient to the articulator in a precise and stable manner.
- Provides a stable resting position for the implant surgical template.

Disadvantages

Utilization of this implant system includes the following disadvantages:

- Excessive loading or placement of the transitional implant fixtures in bone of inadequate volume may result in potential fracture or premature loss of the implant fixture.
- Placement of transitional implants in close proximity to the definitive implant fixtures may prevent complete integration with existing hard tissues.
- Longitudinal studies must be completed before the system can become a universal treatment modality.
- The technique sensitivity of chairside provisionalization may limit application of the system.

Histological Findings

Of particular significance to the definitive restoration is the histological examination of the implant/bone interface

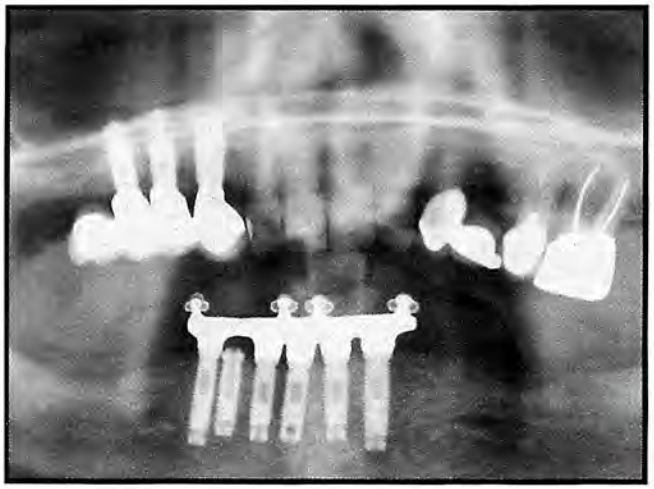

Figure 10. Postoperative radiograph, taken at 1 year, demonstrates implant stability.

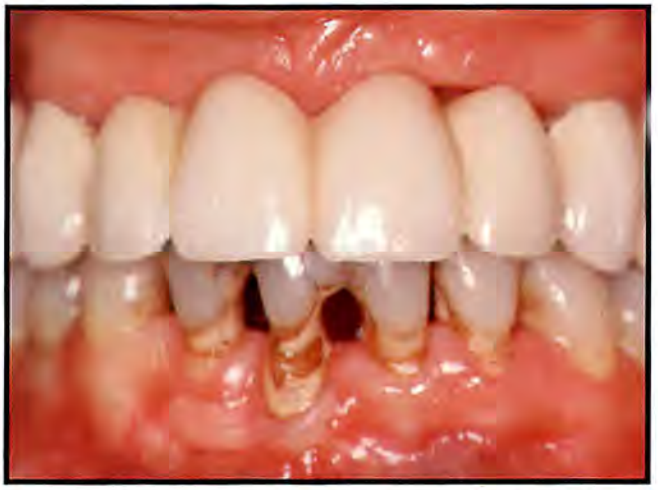

Figure 11. Case 2. Preoperative anterior view of the patient's dentition at presentation.

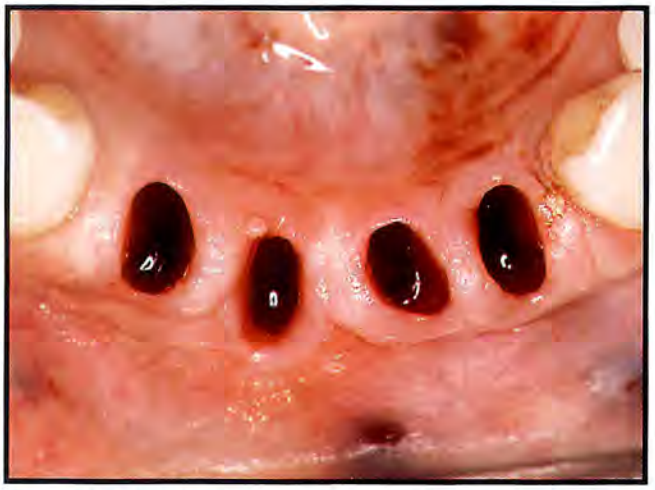

Figure 12. Clinical appearance of the mandibular preimplant sites, immediately following extraction of teeth #23 through #26.

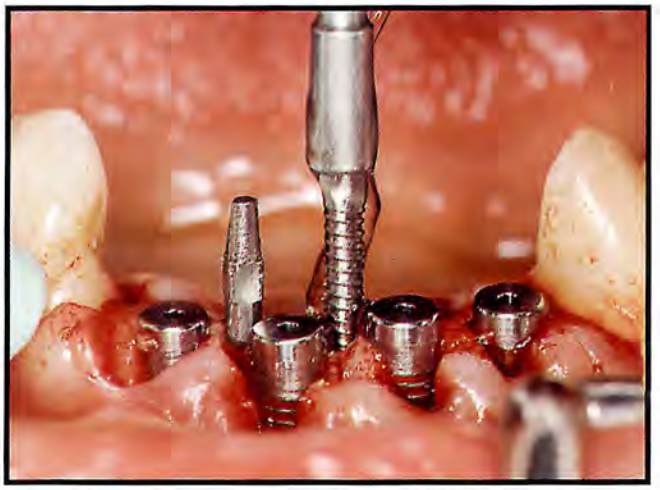

Figure 13. Initiation of transitional implant placement.

specimens at the removal of the transitional implants. Tarnow and Froum have reported preliminary findings from histological studies.[12] Excellent bone adaptation/osseointegration and healthy surrounding bone and normal soft tissue conditions were observed at the site of implant fixtures that were placed in function and fully loaded for a period of 8 months (Figure 2).[12] The apical half of the implant site exhibited 50% implant surface osseointegration, with consistent dense trabecular bone growth at the fixture's interface and new bone formation in the coronal aspects (Figure 2). The transitional implant fixtures were retrieved following 8 months of complete loading; the inflammatory response was virtually undetectable. Histological studies conducted in Argentina with nonhuman primates obtained similar results.[13]

TREATMENT PLANNING

The decision of whether to utilize transitional implants is made during the initial phase of treatment planning with the patient and the restorative team. Comprehensive medical and dental history is recorded, including any physical deficiencies and functional and aesthetic expectations. Clinical and radiographic examinations are completed, and an accurate diagnosis is established. These procedures include diagnostic casts, face-bow transfers, diagnostic waxing of the hard and soft tissues, periodontal assessment, tomographs, and panoramic radiographs, all of which are used for the selection of the optimal site or sites for the proposed implant placement. Classification of the bone quality and dimension is established and integrated in the diagnostic procedures.

Placement Protocol

Using a diagnostic waxup, jaw dimensions and intraoral relationships are studied to determine the quantity of bone that requires replacement, and surgical templates are prepared and marked for transitional implant location. For visual orientation, the transitional implants can be placed strategically in shallow prepared sites; angulation can be corrected when drilling the channels. A protective spacer is placed on the drill shank as a marker for the intended depth, and the osteotomy is created with the profile drill. The transitional implant may be placed initially with a right angle handpiece and driver, and the fixture is tightened with a manual socket key. The transitional implant fixtures can be adjusted chairside and visually aligned.

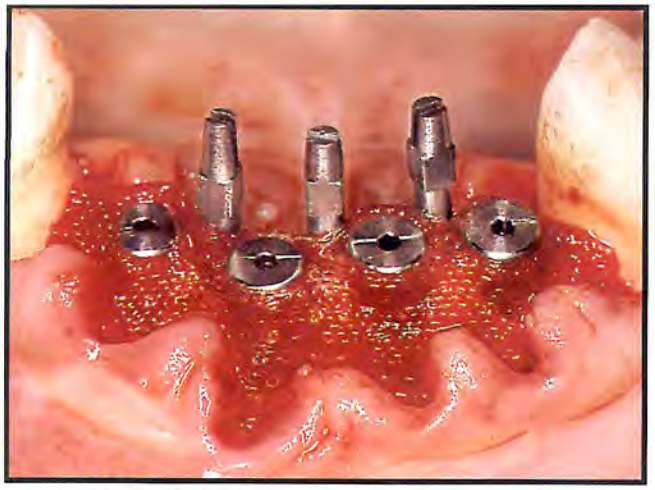

Figure 14. Facial view of the mandible. The transitional implants aid in the stabilization of the barrier membrane.

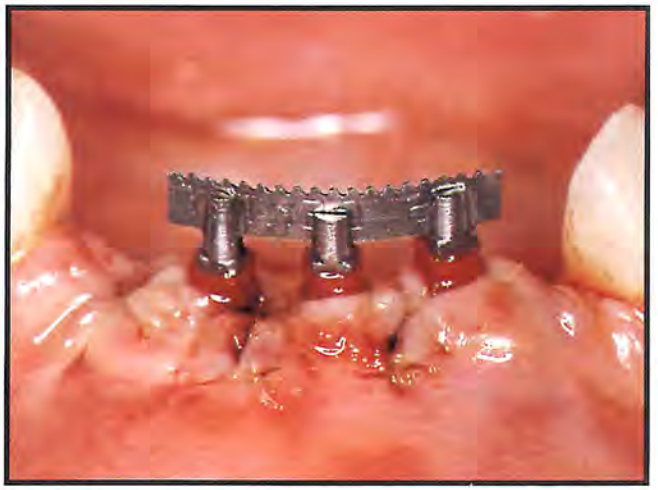

Figure 15. Three transitional implants, placed to the lingual aspect of the 4 permanent implants.

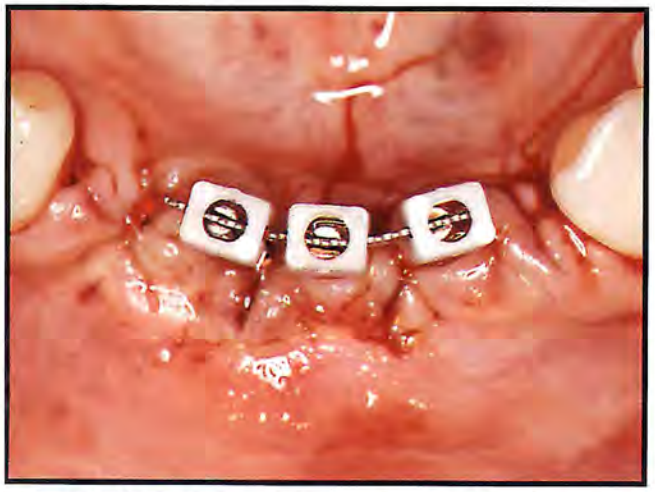

Figure 16. Occlusal view of the transitional implant placement with modular copings seated.

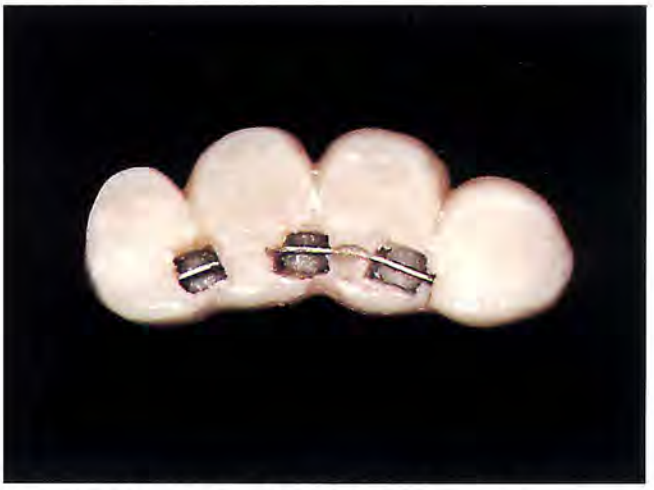

Figure 17. Lingual view of the 4 fabricated mandibular provisional restorations.

Protective spacers are adapted over the square implant head, and the connecting bar is placed with grooves facing upward; modular copings are attached to the bar with resin. The provisional restoration can be customized to suit individual sites, and it can be removable or fixed. The slot alignment tabs and modular transfer copings are placed, and an impression is taken. Transfer posts are carefully placed and luted in indexed positions, and the master cast is fabricated.

FABRICATION AND INTRAORAL ASSEMBLING

Fabrication of the Titanium Bar/ Modular Coping Assembly

The following steps are required to complete the fabrication of the titanium bar that is used to support the provisional restoration:

- To prevent the acrylic resin from locking around the transitional implants while setting, a red protective sleeve is placed over each implant to the level of the tissue. The sleeves are removed prior to cementation of the provisional restoration.
- A titanium connective bar is cut to the proper length to join the transitional implants. The serrated edge of the connective bar should extend 2 mm to 3 mm from the proximal aspects of each of the terminal abutments. The titanium bar becomes embedded in the acrylic and has a definitive seat on the slotted occlusal portion of the transitional implants when the provisional restoration is cemented.
- A white modular coping is placed over each implant to stabilize the titanium bar in its proper orientation. Acrylic material is placed in a "dotted" fashion (as opposed to a solid layer) around each modular coping to lute them to the titanium bar. Light-cured provisional materials like BIS-GMA may also be used for this step. Once set, the titanium bar with modular copings embedded within should be supported by the transitional implant abutments.

Fabrication of the Provisional Restoration

A procedure similar to that used for completion of conventional crown and bridge provisional restorations is used:

- Following lubrication with mineral oil, methylmethacrylate material (or BIS-GMA material) is placed in the provisional template.

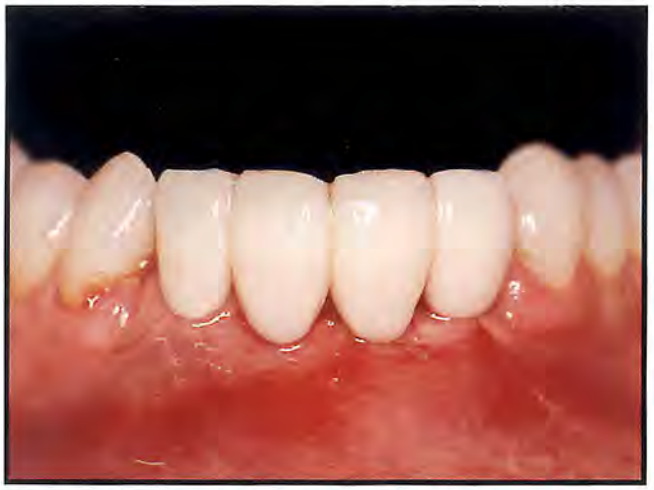

Figure 18. Postoperative clinical view of the 4 provisional mandibular restorations, seated without any pressure on the tissue.

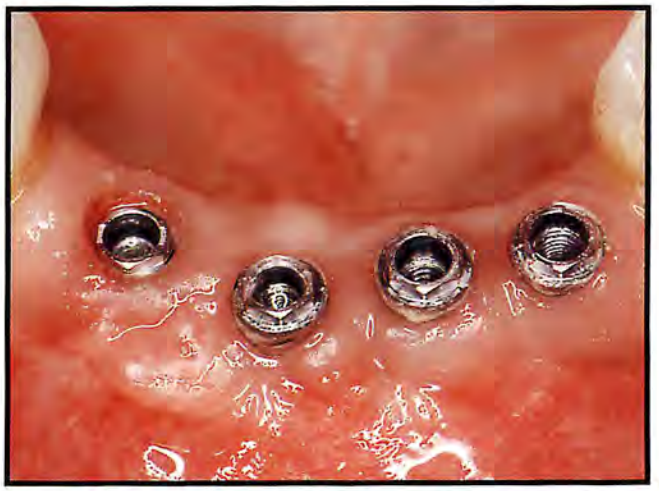

Figure 19. Posthealing occlusofacial view of the augmented tissues exhibits excellent gingival health.

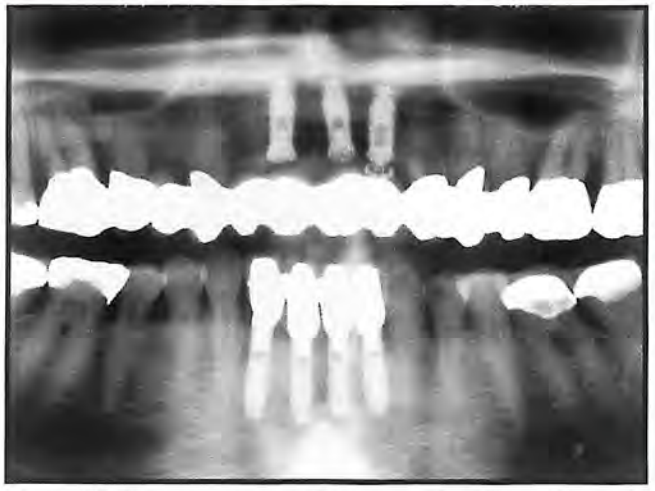

Figure 20. One-year postoperative panoramic radiograph reveals the osseointegration of the permanent and implant fixtures.

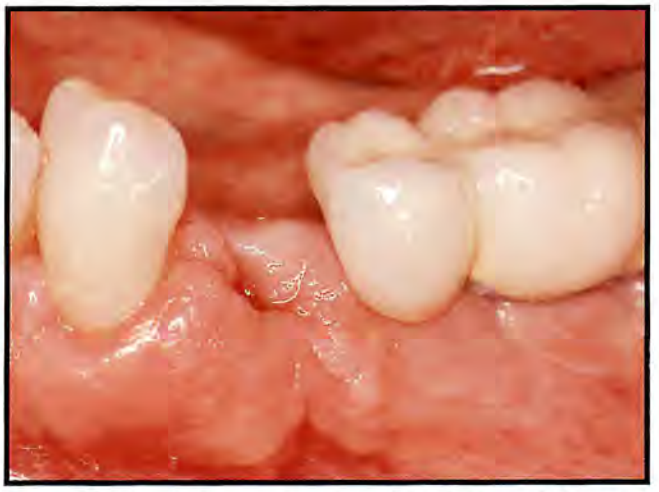

Figure 21. Case 3. Preoperative view of the right mandible with the site of recently extracted tooth #21.

- The template is placed in proper orientation over the seated titanium bar/modular coping assembly.
- When using methylmethacrylate or BIS-GMA provisional materials, the template is removed 3 minutes subsequently. The provisional restoration is carefully removed from the template while in a "softened" condition. Excess material can be quickly removed using a sharp iris scissors. (Care should be exercised to prevent the distortion of the restoration when handling.) The provisional restoration is placed back on the implant fixtures, ensuring support and function, and is allowed to set or is light cured.
- Flame-shaped acrylic burs are used to complete gross contouring of the provisional restoration. Fine garnet plastic discs (Moore's 3/4, EC Moore, Dearborn, MI) are used to refine buccal, lingual, and interproximal contours; a 557 straight fissure bur is used to carve occlusal morphology.
- Once carving is completed and the occlusion is adjusted, the restoration is polished with medium grade pumice on a chamois wheel.
- Color correction is accomplished with a dental stain (George Taub Minute Stains, Jersey City, NJ) and the final glaze (Lang's Jet Seal, Lang, Dearborn, MI) is placed.
- Following the glazing process, the completed provisional restoration is cemented with polycarboxylate cement (Durelon, ESPE America, Norristown, PA).

CASE PRESENTATION

Case 1

A 75-year-old female patient presented with an advanced periodontal infection of the maxillary arch at tooth #2 and a horizontal supergingival fracture at tooth #6 (Figure 3). Diagnostic waxing and radiographic analysis confirmed the original treatment plan of removal of teeth #2 and #6, and the placement of 3 implants in the maxillary right posterior region. A midcrestal incision, followed by full-thickness mucoperiosteal flap elevation, revealed an insufficient ridge thickness that required guided tissue regeneration in conjunction with the placement of the implants. Careful elevation and removal of tooth #6 resulted in an intact buccal plate. All remnants of the periodontal ligament fibers in the extraction socket were

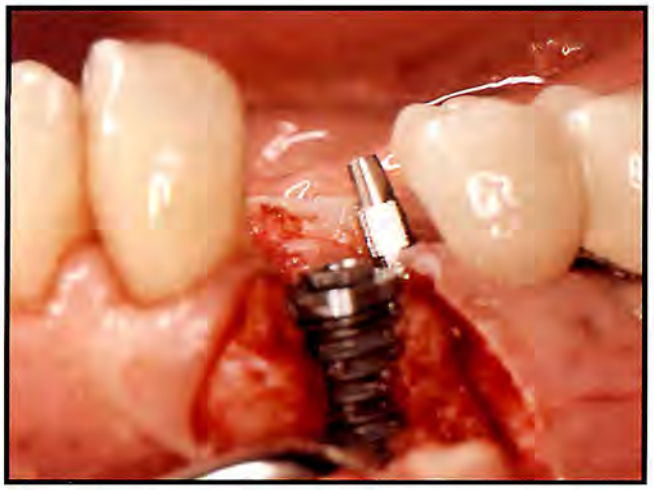

Figure 22. A 13 mm × 5.0 mm implant and a 17 mm × 1.8 mm transitional implant are placed in the mandibular site.

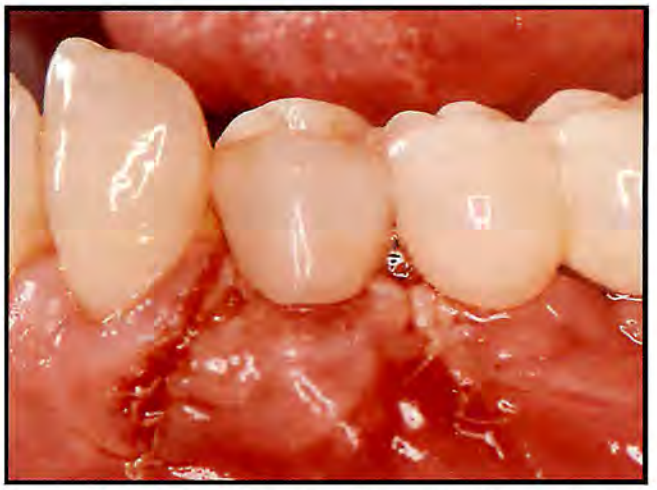

Figure 23. A single-tooth fixed acrylic provisional restoration is fabricated and seated.

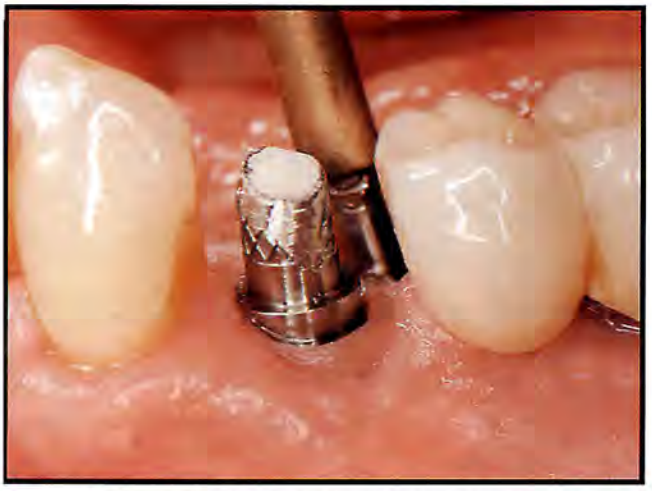

Figure 24. Removal of the transitional implant is accomplished by counterclockwise rotation with slight finger pressure.

Figure 25. One-year postoperative radiograph exhibits the osseointegration and stability of the implants.

carefully removed, and 3 implant fixtures (Osteotite, 3i, West Palm Beach, FL) were delivered (Figure 4). A barrier membrane was affixed and secured by the cover screws and the placement of 3 transitional implants (MTI-MP, Dentatus USA, New York, NY) (Figures 5 through 7); two implants were 21 mm in length, and one was 17 mm. Closure was accomplished with 5.0 monocryl sutures by using a continuous sling and vertical mattress technique. Fabrication of the provisional restoration (Figure 8) was performed according to the procedure described in the foregoing text. The provisional restoration was seated (Figure 9) and cemented with polycarboxylate cement (Durelon, ESPE America, Norristown, PA). A postoperative radiograph at 1 year demonstrates implant stability (Figure 10).

Case 2

A 48-year-old female patient presented with advanced periodontitis and prosthetic concerns (Figure 11). The treatment plan required the extraction of teeth #23 through #26 at the time of implant placement. Periodontal therapy consisted of apically positioned flaps and guided tissue regeneration (GTR) at selected sites. Three months postoperatively, implants were placed in the maxillary and mandibular anterior sextants. Once extraction of teeth #23 through #26 was accomplished (Figure 12), a crestal incision was made from the mesial aspect of tooth #22 to the mesial aspect of tooth #27. A full-thickness mucoperiosteal flap was elevated, followed by the placement of a surgical template. Four implants (Micromini, 3i, West Palm Beach, FL) were placed in the exposed site according to the presurgical treatment plan.

The placement of healing caps was immediately followed by three osteotomies, created slightly to the lingual aspect, which prepared the mandible for the placement of 3 transitional implants (MTI-MP, Dentatus USA, New York, NY) (Figures 13 and 14). The osteotomies were prepared at 800 rpm under copious irrigation. In this case, the transitional implants served as a stabilizing factor for the GTR membrane that was utilized to replace the buccal component of the ridge. Continuous sling suturing was accomplished, and fabrication of the fixed provisional restoration (Figures 15 and 16) followed the steps previously detailed. The restorations were completed on the cast, finalized chairside (Figure 17), and seated

intraorally (Figure 18). The posthealing occlusal view exhibits excellent tissue health (Figure 19). The definitive porcelain restorations were seated, and the postoperative radiograph demonstrates the osseointegration of the permanent and transitional implants (Figure 20).

Case 3

A 66-year-old female patient presented with a noncontributory history and an edentulous site caused by the recent extraction of tooth #21 (Figure 21). Three implants had been placed previously in the region of teeth #18 through #20, and the posterior implant-supported prosthesis was completed. The decision was made to place an additional fixture anterior to the fixed implant-supported prosthesis and to fabricate a single-tooth restoration independent of the implant-supported prosthesis.

A crestal incision was made with two vertical releasing incisions on the buccal aspect and two small vertical incisions on the lingual surface at the edentulous space of tooth #21. The flap displayed an osseous defect and the lack of a buccal plate. A 13 mm × 5.0 mm implant (Osteotite, 3i, West Palm Beach, FL) was placed in the site to the predetermined length and angulation. A 17 mm × 1.8 mm transitional implant titanium anchor (MTI-MP, Dentatus USA, New York, NY) was placed distolingually to the permanent implant (Figure 22). A combination graft and membrane procedure was subsequently performed to resolve the absence of the buccal plate at the implant site. Stabilization was achieved with 6.0 vicryl interrupted sutures, and the single-tooth fixed acrylic provisional restoration was fabricated (Figure 23). By performing this procedure, the desired papillary architecture is allowed to form, and no second-stage surgery is required.

The cover screw was removed, revealing excellent health of the periimplant tissue. Optimal sulcular depth was present around the collar of the implant fixture. Using a "stock" temporary abutment, a new temporary crown was constructed to aid in the implant loading. Removal of the transitional implant was accomplished by counterclockwise rotation with finger pressure (Figure 24). A small, nonhemorrhagic opening in the tissue remained and healed uneventfully. The patient returned 7 days postoperatively for observation of the transitional implant site; excellent tissue health was noted, and a new provisional restoration was seated; the final porcelain prosthesis was completed 3 months subsequently. The 1-year postoperative radiograph demonstrates implant stability (Figure 25).

CONCLUSION

When dental implant technology was initially developed, insufficient quality or quantity of bone precluded implant therapy. Today, bone and soft tissue augmentation materials and techniques are available to create an appropriate implant site. A transitional implant system has been developed, whereby thin transitional implants support an elevated prosthesis that is fabricated chairside. This system is intended to protect the newly augmented site and the osseointegration of the definitive implant during the healing phase while simultaneously providing a functional prosthesis for the patient. Following a period of healing, the transitional fixtures are removed with a simple counterclockwise rotation. Due to the technique-sensitivity of the surgical placement procedure, and the provisionalization phase, a degree of clinical expertise is required, and advanced training in the treatment is advocated by the author. Based on the histological findings,[12,13] other reports in the literature,[14-17] and the clinical experience of the author, the employment of the transitional implant system in modern dentistry appears promising. However, further longitudinal studies and long-term clinical evaluation are required to determine the efficacy and acceptance of the system in the future.

... a transitional implant system has been developed that is compatible with the common screw-type systems.

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