Interim Implants for Immediate Loading of Temporary Restorations

Dr. P.I. Brånemark first described the surgical and prosthetic principles of osseointegration more than 35 years ago.[1] These principles included the use of a biocompatible material (eg, titanium), an atraumatic surgical technique under sterile operating room conditions, the avoidance of crestal incisions or radiographs during the healing period, and the use of acrylic occlusal materials. To minimize the risk of damaging sensitive tissues, implant placement was only recommended between the mental foramina in the lower jaw and the anterior recesses of the maxillary sinus in the upper jaw. An empirical no-loading healing period of 3 months in the mandible and 6 months in the maxilla, and a two-stage surgical protocol was developed to allow for implant osseointegration in the absence of functional loads. And to avoid transmucosal loading of the implants during the early healing period, patients were required to not wear their removable interim prosthesis for at least 2 weeks after implant placement.

Advances in the understanding of host healing and implant materials have led to modifications of some of these original principles of treatment. The one-stage implant system was successfully introduced,[2] and two-stage systems have been used in a one-stage approach (non-submerged placement).[3] Implant placement is now commonly performed in standard treatment room conditions,[4] radiographs are routinely taken to evaluate implant position and monitor healing, and restorations are fabricated of various restorative materials including metal and porcelain. Dental implants are now routinely used to restore the posterior dentition[5-7] and, although originally intended for fully edentulous patients, dental implants are now being used to restore partially edentulous patients as well.[8-10] In addition, where there is insufficient bone for implants, bone grafting materials are being routinely used to augment implant sites before or during implant placement.[11-16]

While the original Brånemark protocol has continued to evolve, the avoidance of implant loading during osseointegration has remained a prerequisite with all implant manufacturers. Until recently, the 3 month/6 month implant loading protocol has remained unchanged. To avoid direct forces on the implants during the healing period, tooth-supported provisional prostheses have been recommended. In addition, when there are insufficient abutments for a fixed provisional prosthesis, removable dentures have to be worn.

New implant surfaces have now allowed for earlier loading of implants, and therefore shorter temporization periods. The Osseotite™,[a] surface implants can be loaded as

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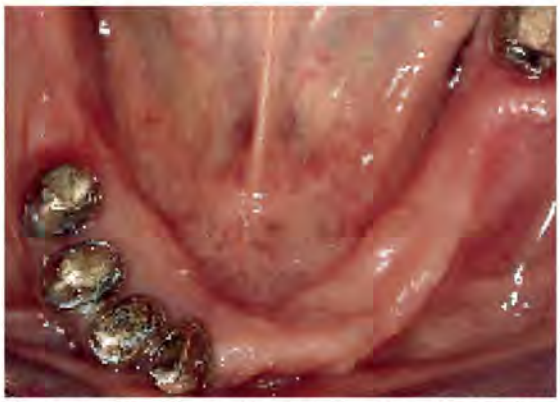

Figure 1A—This patient had insufficient number of natural abutments on the mandibular left quadrant to hold a fixed provisional restoration during the osseointegration of conventional implants.

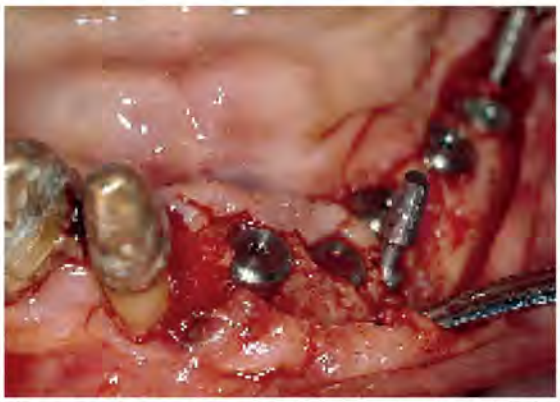

Figure 1B—Five conventional implants were placed to satisfy the requirements of the final restoration. Two IPI implants were placed 2 mm to 3 mm from the conventional implants to help support the provisional restoration during healing.

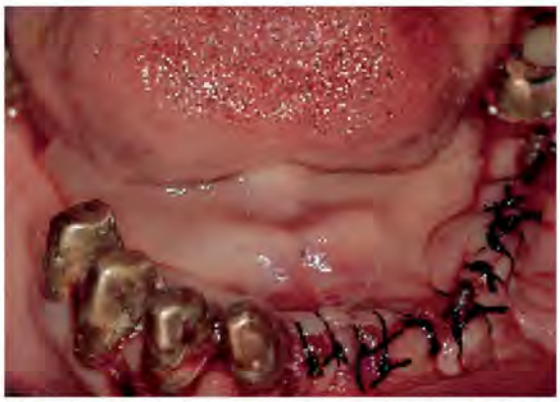

Figure 1C—The gingival flaps were reapproximated and sutured, allowing the abutment portion of the IPI implants to remain exposed.

Figure 1D—The provisional restoration remained in function for 6 months. After flap closure, the existing restoration was relined to include the IPI implants as abutments for the left side.

early as 6 weeks after placement[17] and the ITI® SLA[b] (sand-blasted large grit acid-etched) surface has had favorable outcomes with 6 weeks loading.[18]

More recently, reports have indicated that under certain specific indications immediate loading of implants may be possible,[19-23] especially when at least four or five implants are placed in the anterior mandible and are bilaterally splinted. The risk of implant overload is reduced by the design of the prosthesis and the sharing of occlusal forces through multiple, splinted implants during the critical phase of early osseointegration.

Early and immediate loading of implants has improved patient satisfaction by allowing for earlier restorations, a decreased number of surgical procedures, and reducing or eliminating the need to wear a removable prosthesis. It has been shown that osseointegrated implants can have a more positive psychological effect on well-being than denture treatment.[24]

[b]Straumann USA, Waltham, MA 02154

There are situations when immediate loading of implants is not indicated (ie, when there are not enough abutments or there is poor bone quantity or quality), and immediate provisionalization is required. To address the need for uninterrupted healing as well as patients' demands for immediate functional and esthetic fixed restorations, temporary implants were developed. Temporary implants can be used with conventional implants and can serve as fixed abutments for a provisional esthetic and functional fixed prosthesis during the osseointegration of the definitive implants (Figures 1A through 1D). The patients' expectations are satisfied by providing a fixed restoration the day of surgery. The temporary implants eliminate the transmucosal load that a removable prosthesis can place over the conventional implants or augmented bone, allowing for improved healing. Transitional implants can also be used in 'rescue and repair' situations. When conventional implants cannot be placed because of inadequate bone quantity

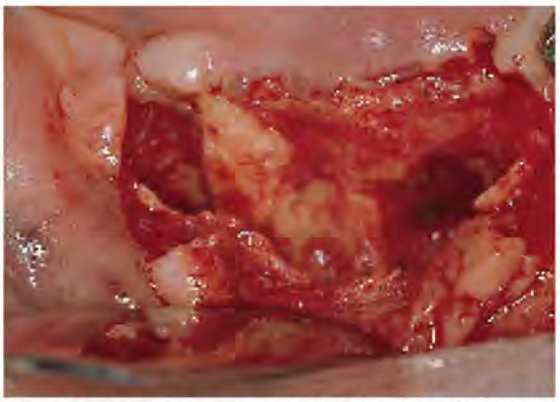

Figure 2A—This case was treated with IPI implants after the failure of conventional implants left a large bone defect.

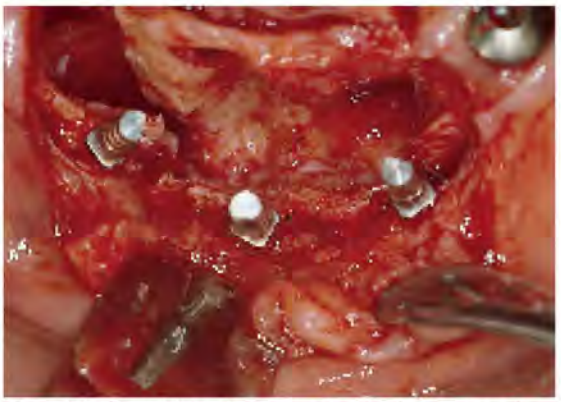

Figure 2B—Three IPI implants were placed to help support the fixed provisional restoration and protect the graft site from transmucosal loading.

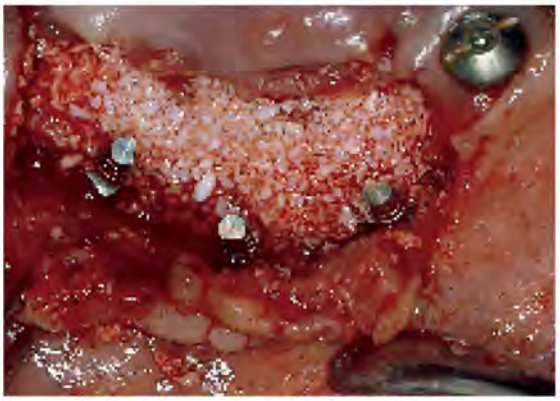

Figure 2C—For guided bone regeneration and implant site development, a bone graft was used to fill the defect.

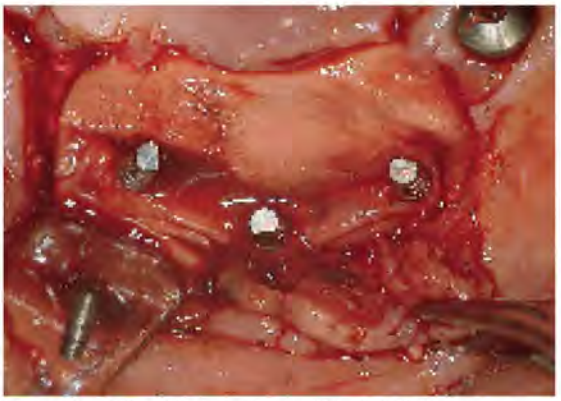

Figure 2D—A Bio-Gide® membrane (Osteohelath Company, Shirley, NY 11967) was fitted with holes punched through to allow for adaptation around the IPI implants. Primary flap closure was obtained, allowing for abutment portion of the IPI implants to be exposed and used to support the temporary prosthesis.

and guided bone regeneration procedures are required for future implant site development, transitional implants can be used during bone healing to support a temporary prosthesis and remove transmucosal loads from the regenerating tissues (Figures 2A through 2D).

Transitional implants can be used in the mandible or the maxilla. They are suitable for partially or fully edentulous patients and are intended to provide temporary support for provisional restorations for a period of several months during conventional implant healing (3 to 6 months).[25,26] As opposed to conventional implants, osseointegration is not expected from transitional implants and if used for long-term loading, these implants can be susceptible to fatigue fracture because of their small diameter.

Immediate Temporary Implant Systems

There are three systems of immediate temporary implants currently available (Table 1): the Immediate Provisional Implant[c] (IPI), the Modular Transitional Implant[d] (MTI), and the Mini Dental Implant[e] (MDI). The IPI are 2.8 mm in diameter and 14 mm in length. The MTI are 1.8 mm in diameter and come in three lengths: 7 mm, 10 mm, and 14 mm (the prosthetic abutment portion is an additional 7 mm). The MDI are 1.8 mm in diameter and come in four lengths: 10 mm, 13 mm, 15 mm, and 18 mm. The prosthetic abutment portion of the MDI implants is 4 mm. Although the manufacturer's instructions vary with each system, the foremost advantage of all these implants is the delivery of a more stable, temporary fixed prosthesis at the time of implant placement.

Surgical Technique

Conventional patient selection and evaluation protocols need to be completed.[1,27]

[c]Nobel BioCare USA, Yorba Linda, CA 92887
[d]Dentatus USA, Ltd, New York, NY 10016
[e]IMTEC Corporation, Ardmore, OK 73402

Table 1—Commercially Available Transitional Implants

Company	Name	Diameter	Lengths	Prosthetic Neck and Connected Abutment Head
Dentatus USA Ltd	Modular Transitional Implants (MTI)	1.8 mm	7 mm 10 mm 14 mm	7 mm
IMTEC Corporation	Mini Dental Implants (MDI)	1.8 mm	10 mm 13 mm 15 mm 18 mm	4 mm
Nobel BioCare USA	Immediate Provisional Implant (IPI)	2.8 mm	14 mm	7 mm

Diagnostic casts mounted in centric relation are required to complete a diagnostic wax-up for the fixed temporary prosthesis. The wax-up can be duplicated to create the surgical template, the radiographic template (with radiopaque markers such as gutta percha), and the temporary prosthesis. The temporary prosthesis can be laboratory-processed, an acrylic shell, or a vacuform for chairside preparation of the fixed provisional restoration.

The foremost advantage of all these implants is the delivery of a more stable, temporary fixed prosthesis at the time of implant placement.

After flap reflection and site preparation, the conventional implants are placed in the ideal position. The conventional implants must be placed 6 mm to 8 mm apart to allow room for the transitional implants. The position of the conventional implants must be ideal to satisfy the needs of the final restoration. The transitional implants can then be placed at a minimum distance of 2 mm to 3 mm from the conventional implants or from teeth. As many temporary implants as possible must be used to support a temporary restoration. A wide anterior-posterior distribution of transitional implants will help better support the temporary prosthesis. All required bone augmentation procedures can be performed in the customary way.

To prepare for the placement of the temporary implants, the cortical crestal bone is penetrated with the twist drill and prepared to the desired length. The transitional implants are then placed according to the manufacturer's instructions with the recommended insertion tool. For primary implant stability, it is recommended that the transitional implants engage the cortical bone.The implants must be stable at the time of placement. Parallel pins are available to help ensure parallelism and a path of insertion for the temporary restoration. After implant placement, slight corrections in angulation can be achieved by using the available bending tools. After the transitional implants are placed, the tissues are sutured, leaving the abutment portion of the transitional implants exposed.

Prosthetic Technique

The temporary restoration can be fabricated directly chairside (direct technique) or in the laboratory (indirect technique). A processed acrylic shell or the patient's existing denture can be used as temporary restorations. When the patient's denture is used, the flanges need to be removed and the denture hollowed before picking up the temporary implant copings in the reline procedure. For stability and support, it is recommended that the provisional restorations be reinforced with fibers, orthodontic wire, or a metal undercasting.

Direct Procedure—After placing the copings recommended by the manufacturer on the temporary implants, blocking out any exposed undercuts and lubricating the soft tissue and

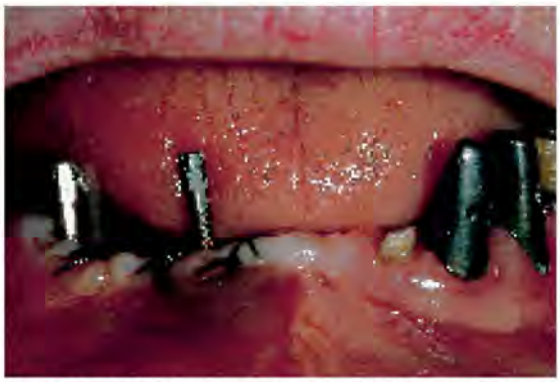

Figure 3A—In this case, the patient was deficient of abutments for a fixed restoration on the mandibular right side. Without the use of temporary implants, the patient would have to wear a removable partial denture for 3 to 4 months to allow for osseointegration of the conventional implants. Because this was unacceptable to the patient, and to help support a fixed interim prosthesis, two MTI implants were placed.

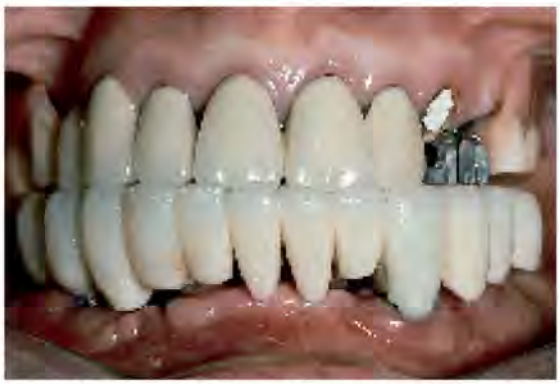

Figure 3C—The provisional was delivered on the day of surgery, and the patient was satisfied by an immediate fixed restoration.

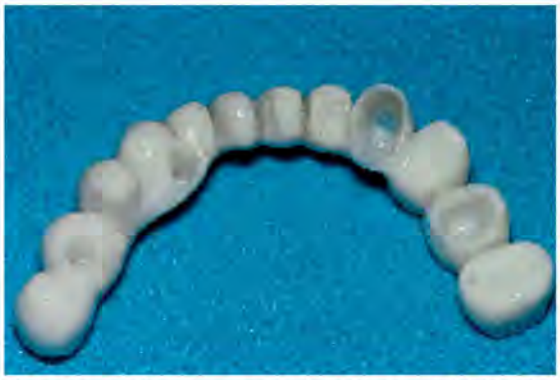

Figure 3B—A laboratory-processed provisional was fabricated and relined directly on the MTI implants.

sutures with petroleum jelly, the processed acrylic shell can be used to pick up the copings with autopolymerizing acrylic in a reline procedure. The patient must be instructed to close in centric relation occlusion. After the material has set, the temporary can be removed, and the excess material trimmed. The occlusion can then be refined and the restoration shaped and polished. The temporary restoration can be cemented with temporary cement (Figures 3A through 3C).

Indirect Procedure—In the indirect (laboratory) procedure, an impression of the copings on the implants must be taken with a resilient impression material. A bite registration and an impression of the opposing arch is also required. Temporary implant analogs are available for cast fabrication, which must be placed into the copings and poured in hard stone. After separating the cast from the impression and mounting it on the articulator, the provisional prosthesis can be fabricated on the cast. It can then be tried-in the mouth and cemented as in the direct procedure technique.

As with all implant treatments, routine clinical and radiographic follow-up should be completed to evaluate the ongoing bone and soft tissue health. If there are signs of implant failure, mobility, fracture, or infection, the implants must be removed as soon as possible and the site treated accordingly.

When no longer functionally required, the transitional implants can be removed with minimal discomfort to the patient. The provisional implants are unscrewed by applying torque in a counter clockwise direction. The associated granulation tissue must be curetted. The soft-tissue opening can be expected to heal similarly to a tooth extraction site.

Disadvantages

Depending on the system used, transitional implants require at least 7 mm of bone (14 mm for IPI and 10 mm for MDI) and are therefore contraindicated where there is inadequate bone depth. In addition, because the prosthetic abutment is incorporated in the implant design, the amount of interocclusal space cannot be less than 6 mm to 7 mm (4 mm for the abutment component and 2 mm for the coping and restorative material). The prosthetic abutment portion of the IPI and MTI systems is 7 mm and therefore require more interocclusal allowance.

To provide for the initial stabilization of the transitional implant, the bone quality must be adequate (type I or type II bone) and there must be sufficient cortical bone for the implant to engage. Transitional implants are con-

traindicated where a sufficient number cannot be placed in conjunction with conventional submerged implants to adequately support the desired temporary prosthesis.

Transitional implants can satisfy patients' demands by providing an esthetic, fixed provisional

Because provisional implants are intended for interim support for a period of 3 to 6 months and their ability to withstand occlusal loads can be expected to decrease with time, treatment plans requiring long-term provisional restorations may exceed the time limits of temporary implants. Implants that become mobile while supporting a restoration should be removed as soon as possible. Associated granulation tissue and infection must be treated immediately.

Conclusion

Transitional implants can satisfy patients' demands by providing an esthetic, fixed provisional prosthesis the day of surgery. Immediate fixed prostheses have helped improve patient comfort and have reduced postoperative complaints. They are psychologically more appealing, and therefore, have helped increase treatment acceptance. From the dentist's point of view, the use of transitional implants to support immediate fixed temporary restorations helps protect conventional implants from transmucosal and premature loading. They can also help protected guided bone regeneration sites and help plan esthetic and functional definitive restorations.

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References

1. Brånemark P-I, Zarb GA, Albrektsson T: *Tissue-Integrated Prosthesis*. Chicago, IL, Quintessence Publishing Co, Inc, 1985.
2. Buser D, Weber H, Bragger U, et al: Tissue integration of one-stage ITI implants: 3-year results of a longitudinal study with hollow-cylinder and hollow-screw implants. *Int J Oral Maxillofac Implants* 6:405-412, 1991.

3. Becker W, Becker BE, Israelson H, et al: One-step surgical placement of Brånemark implants: a prospective multicenter clinical study. *Int J Oral Maxillofac Implants* 12(4):454-462, 1997.
4. Scharf DR, Tarnow DP: Success rates of osseointegration for implants placed under sterile versus clean conditions. *J Periodont* 64(10):954-956, 1993.
5. Laney W, Jemt T, Harris D, et al: Osseointegrated implants for single-tooth replacement: progress report from a multicenter prospective study after 3 years. *Int J Oral Maxillofac Implants* 9:49-54, 1994.
6. Schmitt A, Zarb G: The longitudinal clinical effectiveness of osseointegrated dental implants for single-tooth replacement. *Int J Prosthodont* 6:197-202, 1993.
7. Minsk L, Polson AM, Weisgold A, et al: Outcome failures of endosseous implants from a clinical training center. *Compend Contin Educ Dent* 17(9):848-859, 1996.
8. Ericsson I, Lekholm U, Brånemark P-I, et al: A clinical evaluation of fixed-bridge restorations supported by the combination of teeth and osseointegrated titanium implants. *J Clin Periodontol* 13:307-312. 1986.
9. Jemt T, Lekholm U, Adell R: Osseointegrated implants in the treatment of partially edentulous patients: a preliminary study on 876 consecutively placed fixtures. *Int J Oral Maxillofac Implants* 4:211-217, 1989.
10. van Steenberghe D: A retrospective multicenter evaluation of the survival rate of osseointegrated fixtures supporting fixed partial prostheses in the treatment of partial edentulism. *J Prosthet Dent* 61:217-223, 1989.
11. Dahlin C, Sennerby L, Lekholm U, et al: Generation of new bone around titanium implants using a membrane technique: an experimental study in rabbits. *Int J Oral Maxillofac Implants* 4:19-25, 1989.
12. Buser D, Bragger U, Lang N, et al: Regeneration and enlargement of jaw bone using guided tissue regeneration. *Clin Oral Implants Res* 1:22-32, 1990.
13. Dahlin C, Gottlow J, Linde A, et al: Healing of maxillary and mandibular bone defects using a membrane technique. An experimental study in monkeys. *Scand J Plast Reconstr Surg Hand Surg* 24:13-19. 1990.
14. Becker W, Becker B: Guided tissue regeneration for implants placed into extraction sockets and for implant dehiscences: surgical techniques and case report. *Int J Periodontics Restorative Dent* 10:377-391, 1990.
15. Becker W, Becker B, Handlesman M, et al: Bone formation at dehisced dental implant sites treated with implant augmentation material: a pilot study in dogs. *Int J Periodontics Restorative Dent* 10:93-101, 1990.
16. Caudill R, Meffert R: Histologic analysis of the osseointegration of endosseous implants in simulated extraction sockets with and without e-PTFE barriers. 1. Preliminary findings. *Int J Periodontics Restorative Dent* 11:207-215, 1991.
17. Lazzara R J, Porter SS, Testori T, et al: A prospective multicenter study evaluating loading of Osseotite implants two months after placement: one-year results. *Int J Periodontics Restorative Dent* 10(6):280-289, 1998.
18. Cochran DL, Schenk R, Lussi A, et al: Bone response to unloaded and loaded titanium implants with a sandblasted and acid-etched surface: A histometric study in the canine mandible. *J Biomed Mater Res* 40:1-11, 1996.
19. Chiapasco M, Gatti C, Rossi E, et al: Implant-retained mandibular overdentures with immediate loading. A retrospective multicenter study on 226 consecutive cases. *Clin Oral Implants Res* 8:48-57, 1997.
20. Schnitman P, Wohrle P, Rubenstein J, et al: Ten-year results for Brånemark implants immediately loaded with fixed prostheses at implant placement. *Int J Oral Maxillofac Implants* 12:495-503, 1997.
21. Schnitman P, Wohrle P, Rubenstein J: Immediate fixed interim prostheses supported by two-stage threaded implants: methodology and results. *J Oral Implantol* 16:96-105, 1990.
22. Tarnow D P, Shahram E, Classi A: Immediate loading of threaded implants at stage-1 surgery in edentulous arches: Ten consecutive case reports with 1- to 5- year data. *Int J Oral Maxillofac Implants* 12:319-324, 1997.
23. Balshi TJ, Wolfinger GJ: Immediate loading of Brånemark implants in edentulous mandibles: a preliminary report. *Implant Dentistry* 6:83-88, 1997.
24. Kent G, Johns R: Effects of osseointegrated implants on psychological and social well-being: a comparison with replacement removable prostheses. *Int J Oral Maxillofac Implants* 9:103-106, 1994.
25. Froum S, Emtiaz S, Bloom MJ, et al: The use of transitional implants for immediate fixed temporary prostheses in cases of implant restorations. *Pract Periodontics Aesthet Dent* 10(6):737-746. 1998.
26. Zubery Y, Bichacho N, Moses O, et al: Immediate loading of modular transitional implants: a histologic and histomorphometric study in dogs. *Int J Periodontics Restorative Dent* 19(4):343-353, 1999.
27. Rose LF, Salama H, Bahat O, et al: Treatment planning and site development for the implant-assisted periodontal reconstruction. *Compend Contin Educ Dent* 16(8):726-742. 1995.