

Transitional Implants: A Solution for Patient Satisfaction

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During the past few years, ideal implant placement has become the norm, the state of the art. Placing implants in their appropriate location is not easy as clinicians are confronted, more often than not, with reduced or atrophied alveolar ridges. Predictable ridge augmentation procedures have been developed using autogenous bone (symphysis, external oblique ridge, hip) to restore the alveolar ridge to almost ideal pre-extraction dimensions.¹ Although bone augmentation techniques are advantageous to both the clinician and

the patient because long term predictability of form, function, and growing esthetic demands are met, they do however increase the total procedure time from the moment one first meets the patient to the final fixation of the definitive restoration.

This increased time delay is often times a deterrent to treatment because patients are often asked to refrain from wearing their removable partial or complete denture for a few weeks followed by monthly soft denture relines (which are costly to the clinician).

Patients must also comply with the not so popular liquid or soft diet necessary to avoid stresses on the underlying bone graft or definitive implant(s). Furthermore, because of the sudden increase in volume of the alveolar ridge following bone augmentation, removable partial or complete dentures must be trimmed substantially to avoid pressure on the surgical site. Removing the buccal flange over the grafted area inevitably leads to a loss of retention and as a result the patient inherits a looser denture than before the procedure. Not

Table 1

Company	Name	Diameter	Lengths	Interocclusal space requirement
Dentatus USA Ltd.	Modular Transitional Implant (MTI)	1.8 mm	7 mm 10 mm 14 mm	7 mm
Nobel BioCare	Immediate Provisional Implant (IPI)	2.8 mm	14 mm	7 mm
IMTEC Corporation	Mini Dental Implant (MDI)	1.8 mm	10 mm 13 mm 15 mm 18 mm	4 mm
Bicon Inc.	Bicon Temporary Implant (BTI)	2.0 mm	8 mm 12 mm	2 mm

only is the risk of micro-movement on the graft increased, which may lead to failure, but the confidence or satisfaction level of the patient decreases adding a burden to the clinician/patient relationship.

Transitional, provisional, mini, interim, or temporary implants are all synonymous with a solution to the above dilemmas and define a type of implant that can be used during the healing period. This period varies in length from four months to more than a year if bone grafts are performed followed by implant placement. Transitional implants (TIs) have been used successfully to restore all aspects and types of edentulism ranging from complete arches to single teeth (Fig. 1).^{2-4,9,12-13,15,17,20-31}

THE HOW, WHY, AND WHEN OF TRANSITIONAL IMPLANTS (TIs)

At least four systems are currently available (Table 1): The Immediate Provisional Implant (IPI from Nobel Biocare), the Modular Transitional Implant (MTI from Dentatus), the Mini Dental Implant (MDI from Imtec corp.), and the Bicon Temporary Implant (BTI). The IPI is 2.8 mm in diameter and 14 mm long, the MTI is 1.8 mm in diameter and varies in length (7 mm, 10 mm, 14 mm), and the MDI is 1.8 mm in length and also varies in length (10 mm, 13 mm, 15 mm, 18 mm). The BTI is 2.0 mm in diameter and come in two lengths (8 mm, 12 mm).²

TIs have a very small diameter and are loaded immediately with non axial forces. Clinicians therefore defy the existing paradigms for successful osseointegration when placing TIs.^{1,3} Even though this is the case, TIs are successful during the short period of time they are used.

Regular monitoring is recommended as it has been noted that TIs may encapsulate and become

The authors recommend seeing the patient regularly when TIs are used to assess the underlying gingival healing and intercept any definitive implant exposure.

loose.⁴ If this happens the success of the underlying graft or implant could be compromised. However, most studies agree that, after at least six months of full loading, TIs had a 35% to 60% area contacting bone, especially in the apical portion (Fig. 2).

The coronal portion was surrounded by connective tissue,⁵⁻⁷ a finding that does not seem to negatively affect the success rate of TIs. The authors have found that at the time of removal, usually six to twelve months post-insertion, some TIs were removed with light counter twisting pressure but others needed a relatively strong finger force.

At times though, a ratchet was necessary to remove the TI and a piece of the apical portion of the TI broke off and remained lodged in the bone. The piece was left in the bone and healed without causing any disturbance. This anecdotal evidence supports some form of osseointegration.

Their use should however be limited to the treatment period. Just as they could, at times, strongly osseointegrate they could also be expected to loosen during the temporization period. Studies have shown that immediate loading of multiple implants rigidly splinted together can lead to long term osseointegration.^{8,9}

One can extrapolate that the

same results can be expected of TIs and that they can osseointegrate even if submitted to immediate stresses of normal function if splinted together. Let us not forget that the overall treatment goal of TIs is not to osseointegrate but rather to stay stable just like a screw anchored in wood. Clinicians should evaluate each case for parafunction and plan the provisional restoration accordingly because excessive stresses will likely loosen the screw.⁴

The occlusal scheme should be adapted to the situation at hand. In complete edentulism, even contacts throughout the posterior with proper incisal guidance increases the chances of success. One should avoid contacts on pontics and cantilevers. In short span edentulism one should elect to relieve the provisional restoration so that it is just out of occlusion especially in excursive movements.

It is generally recommended that at least one more TI than the number of definitive implants be used to increase stability (Case 1). However, if bone thickness allows it, a tripod or zigzag approach can be used to offer more stability. In this approach TIs are placed buccal and lingual between two definitive implants, another implant is placed mesio-lingual and another disto-buccal to the definitive implants.¹⁰ TIs should be placed at least two millimeters from

Table 2

TIs placed	Loose TIs	Broken TIs	Total failed TIs	% success TIs	%success of the provisional restoration
271	15	7	22	91.88%	100%

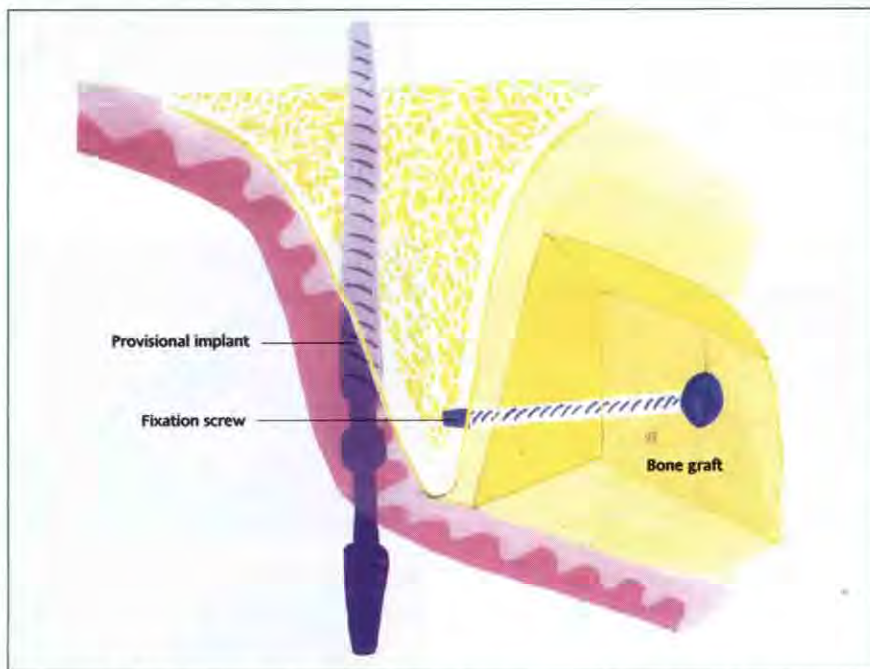


ILLUSTRATION 1 TIs cannot always be placed at the crest of the ridge. Nevertheless, sufficient anchorage can be achieved even if a few coronal threads are not engaged in bone. In the above situation one can appreciate that the provisional restoration, even when cantilevered substantially towards the buccal over the bone graft, functions very well. Bone grafts are well protected in this manner.

The authors have found that at times one implant less than the amount of definitive implants is used because of constraints in available bone volume

adjacent implants.

When five millimeter diameter definitive implants are used then three millimeters of spacing are recommended to allow for proper blood supply and to prevent bone loss. The authors have found that at times one implant less than the amount of definitive implants is used because of constraints in

available bone volume. Although limited in the number of cases performed this way, TIs were successful in fulfilling their mandate without any complication.

The authors do recommend seeing the patient regularly when TIs are used to assess the gingival healing under the temporary prosthesis and intercept any definitive

implant exposure. One should evaluate patients once a month for TI mobility, debonding or fracture of the provisional restoration, and to clean the area.

Note that the same temporary restoration can be used from start to final prosthesis placement. Sufficient spacing should be considered between the temporary and the gingiva in order to allow for adequate cleaning with an interproximal brush and patients should be instructed so that proper hygiene can maintain the TIs healthy thus preventing periimplantitis.^{11,12}

When seeing the patient during the healing phase for TI maintenance one can evaluate the level of commitment of the patient to keeping the TIs clean. Clinicians now have several months to teach patients proper hygiene so that when the final prosthesis is delivered they will already know how to clean it.

Advantages include:

1. Stability of the provisional restoration which protects the incision line and underlying graft material (no micro-movement transferred to graft or implants).
2. Gives confidence and comfort to the patient early on in the treatment phase as temporary denture is no longer loose.
3. Evaluation of phonetics and esthetics at an early stage.
4. One temporary is used throughout the treatment case.
5. Can be used to evaluate sufficient graft thickness.
6. Can be used as a surgical guide during definitive implant placement.
7. Is economical and relatively

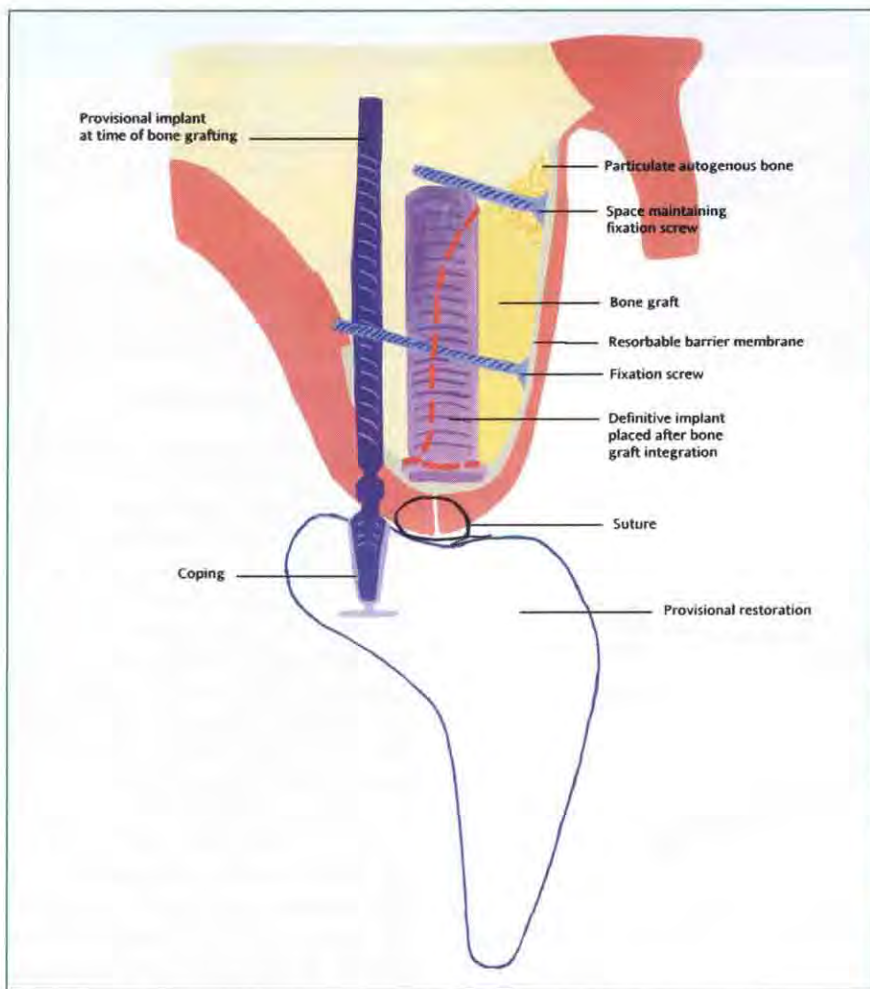


ILLUSTRATION 2 It becomes imperative to plan the placement of the different screws into a limited space. Fixation screws are placed first followed by transitional implants. Note that the transitional implant is placed almost parallel to the future definitive implant which is inserted four months after graft placement. Ideally the TI must not interfere with the placement of the definitive implant. The TI should stay in place for another four to eight months while the definitive implants integrate. When properly placed the first time around additional procedure time and trauma to bone can be reduced.

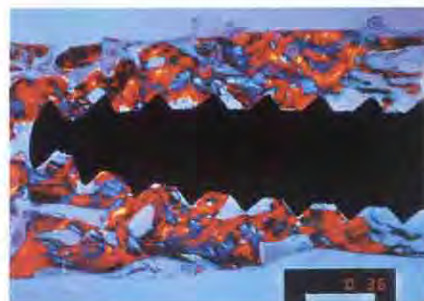
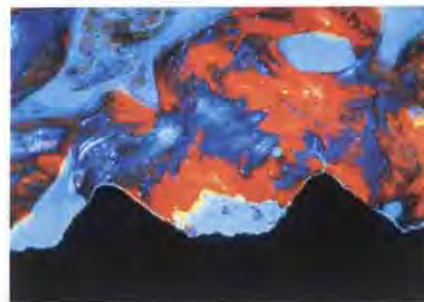
- easy to use.
- 8. Eliminate the urgency of completing treatment because patients are comfortable. Office schedule and patient availability can be accommodated.⁵
- 9. TIs can be placed if definitive implant placement must be delayed but patient satisfaction must be assured.
- 10. They can maintain a stable vertical dimension and reduce the number of visits during healing, graft integration and during implant integration (soft denture relines are eliminated).¹³

Contraindications include insufficient bone height and insufficient inter-occlusal space.

It was noted that retentive elements are sometimes lost due to excessive masticatory forces. However the success of TIs seems to be near 100% during short or prolonged treatment phases.¹⁴ No definitive implant migration has been noted when TIs were used in conjunction with a transitional prosthesis.¹⁴ The authors have found that even though a TI can be lost during the treatment phase, not a



FIGURE 1 TIs are used to fixate the provisional restoration after a bone augmentation procedure or following the placement of definitive implants.



FIGURES 2 TIs have a 35% to 60% area contacting bone (red areas) especially in the apical portion. (Courtesy of Dentatus USA.)

case so far has been compromised as the success rate of the provisional restoration remained 100% (Table 2.).

TIs' CLINICAL PROCEDURE

A complete intraoral dental exam with radiographs and study models is first completed. Each case should be mounted on a semi or fully adjustable articulator and a diagnostic wax-up of the final condition should be accomplished (bone and teeth) in order to view the placement of the definitive implants and the amount of bone grafting neces-

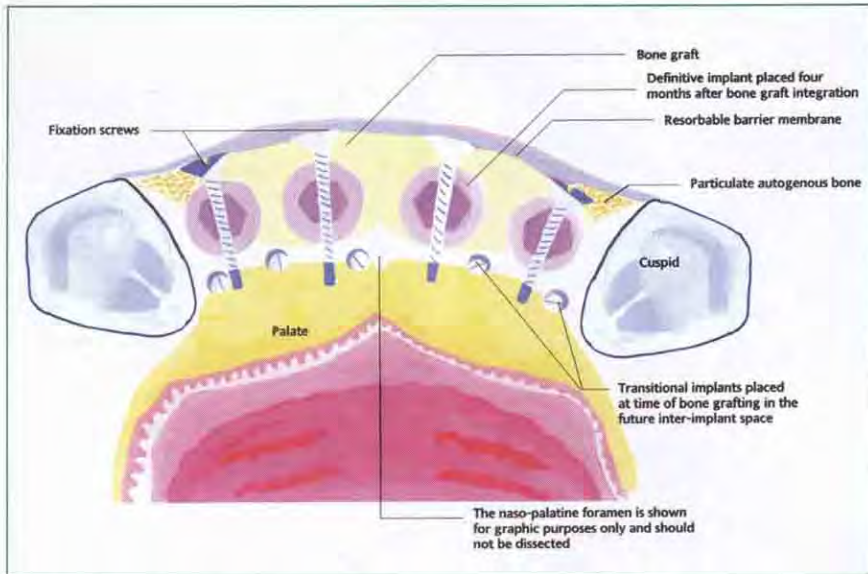


ILLUSTRATION 3 Fixation screws can be placed in the middle of the future location of the definitive implant. Temporary implants are then placed in a location that will be at least 2 mm away from the definitive implants four months down the road. If the opposite is done and the fixation screws are placed between the sites of the definitive implants or are placed at random then the TIs could end up too close to the definitive implants compromising blood supply and increasing the odds of complications. TIs will then have to be unscrewed and re-drilled into a new site causing further trauma and lengthening procedure time.

sary prior to surgery. A radiographic guide and a surgical guide are fabricated.

The steps and clinical procedures described hereafter can be applied to almost any situation be it completely or partially edentulous.

If the ridge is narrow and the buccal and lingual wall are parallel then TIs cannot be placed and their use becomes contraindicated. In areas where crestal bone thickness is insufficient but the buccal and lingual walls diverge TIs can still be placed and provide a good foundation (Illustration 1).

When placing TIs in the premaxilla (palatal aspect) certain locations can be preferred in order to ease the flow of procedures during the entire treatment phase (Illustration 3).^{15,16}

CASE 1



FIGURE 4 Mouth condition before extraction.



FIGURE 5 Poor ridge thickness following tooth extraction.



FIGURE 6 The placement of TIs is done palatally between the sockets, and between the future permanent implant positions.



FIGURE 7 The transitional implants are placed almost parallel to the future definitive implants.



FIGURE 8 The ten TIs are surrounded by the soft tissues with sutures.



FIGURE 9 Fabrication of temporary restoration is done by the lab technician and relined chair-side.

CASE 1 (continued)



FIGURE 10 The use of a piece of alcohol sterilized rubber dam over the flap before relining.

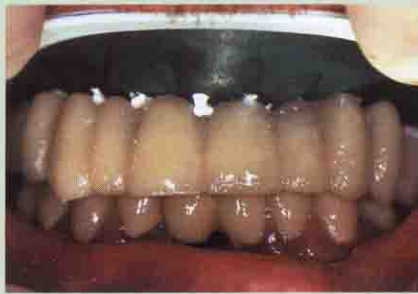


FIGURE 11 Final cementation with temporary cement is recommended with Vaseline painted on the temporary bridge to help in the removal of excess cement.

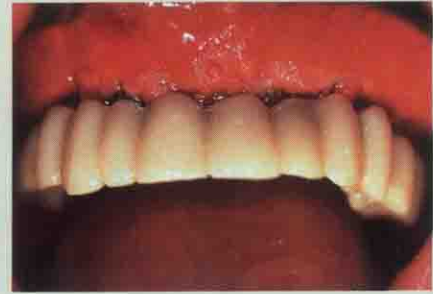


FIGURE 12 After the surgery, the patient can enjoy the benefit of a fixed restoration which protects the site of surgery.

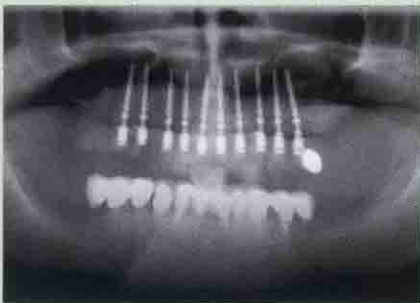


FIGURE 13 Occasionally, as for this case, fewer TIs are used than the number of definitive implants planned.

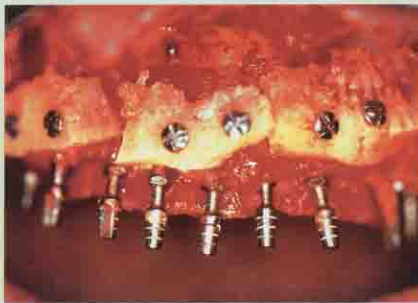


FIGURE 14 Six weeks later, after soft tissue healing and once infection control has been established, the bone graft procedure from the external oblique ridge and the ascending ramus is performed.



FIGURE 15 Four months after the bone graft procedure.



FIGURE 16 Resorption is kept to a minimum as the TIs protect the bone graft.

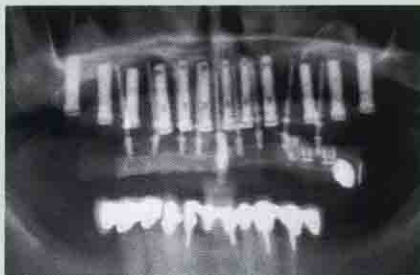


FIGURE 17 The provisional restoration can be used as a surgical template for the definitive implant placement.



FIGURE 18 Because TIs have been placed between the sockets they allow the proper placement of definitive implants without any interference with the two millimeter space needed for safety.

FIGURE 19 The fixed reinforced temporary restoration is held on the TIs which are placed palatally between the definitive implants. One TI was lost (see Figure 13) but the temporary prosthesis remained functional.



First, the symphysis or external oblique ridge bone graft is screwed into place. We recommend placing the first fixation screw straight through the middle of the future location of the definitive implant and to choose a screw that will protrude by a millimeter or two toward the

palate. Then two TIs can be placed on either side aimed at the future inter-implant location. TIs can be placed palatally, easily avoiding the fixation screws as they are visible coming through the bone in the palate. There are several drilling techniques to choose

from when placing TIs.

The first, used in denser bone, is the manufacturer recommended protocol where a pilot drill (each system has only one drill in the treatment sequence which makes the placement procedure very easy) is used to complete

CASE 2



FIGURE 20 Resorption of the ridge 3 years after the extraction of teeth #11 and #21.

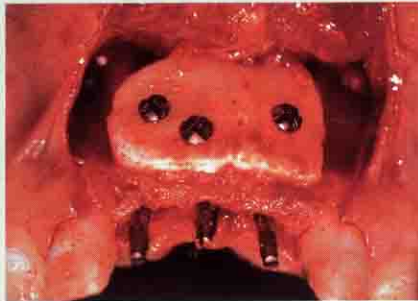


FIGURE 21 Symphysis graft and TIs. The fixation screws are placed right through the future position of the definitive implants allowing TIs placement in between. These same TIs can be used for the entire procedure.

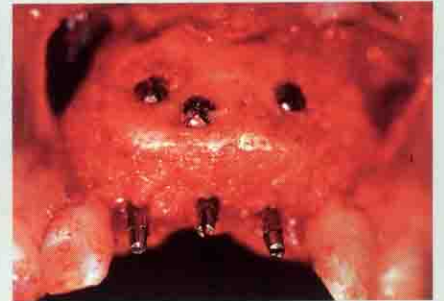


FIGURE 22 Autogenous bone particles around the onlay bone block.



FIGURE 23 A barrier membrane is perforated and placed over the site.



FIGURE 24 The rubber dam can protect the incision line and the sutures from acrylic and temporary cement invasion.



FIGURE 25 The confidence and comfort for the patient early on in the treatment phase eliminates the urgency of completing treatment.

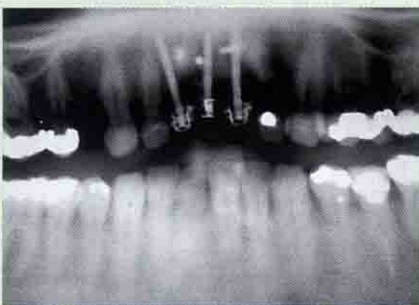


FIGURE 26 TIs do not interfere with the fixation screws.



FIGURE 27 Four months later at the time of implant placement.

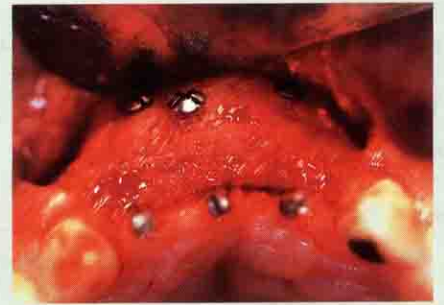


FIGURE 28 A slightly overcontoured bone augmentation offers good latitude for ideal implant placement.

the osteotomy to the desired length and then the TI is screwed into place manually with a hand wrench or mechanically with a latch wrench at a maximum of 50 rpms. The second technique is used in softer bone. A partial depth osteotomy is performed to about the half way mark and then the TI is

screwed to the full length. This technique will increase stability in softer bone.

Finally, no osteotomy is performed when in soft or D4 bone and only the TI is used as a self drilling and self screwing entity thus maximizing stability. Align the pilot drill so that the TI will

be almost parallel to the future definitive implant (Illustration 2) so as to avoid having to reposition the TI during the phase two surgery. Perform the osteotomy at low speed (800-2000 rpm) with irrigation. A paralleling guide can then be placed into the osteotomy and the subsequent sites can be prepared.

CASE 2 (continued)



FIGURE 29 The provisional restoration can be used as a guide for the surgery.

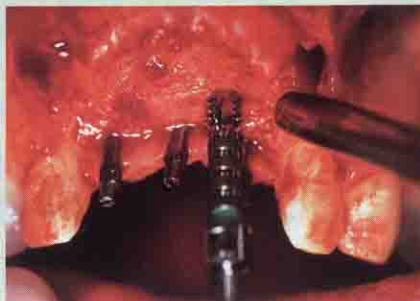


FIGURE 30 The complete manufacturing surgical protocol is performed.



FIGURE 31 Definitive implants are placed in the ideal position between the TIs.

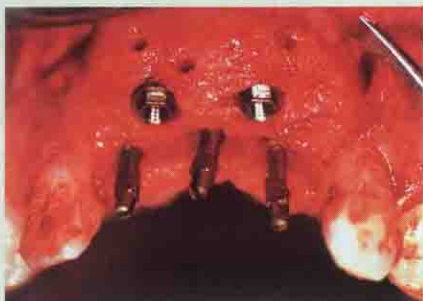


FIGURE 32 When TIs are well positioned from the start they are still at the minimum of two millimeters from the definitive implants and can be used again for the same provisional restoration.



FIGURE 33 The same temporary restoration is used after each surgery and continues to protect the site from any pressure while offering good comfort for the patient.

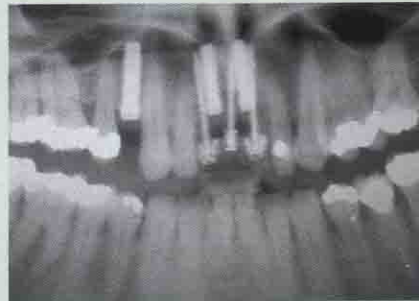


FIGURE 34 TIs are protecting definitive implants from any unwanted deleterious forces.



FIGURE 35 Four months after the bone graft procedure.

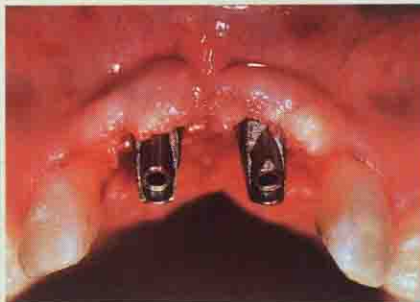


FIGURE 36 The fixation of abutments and TI removal.

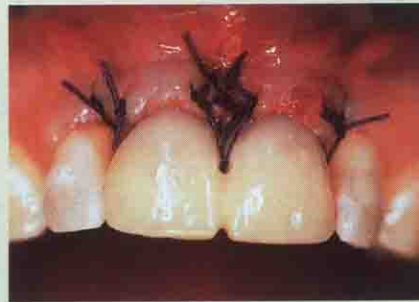


FIGURE 37 The Sutures around the final abutments and the temporaries are done in a way to promote soft tissue healing in the respect of Tarnow's rules. This will promote papillary regrowth.

At this stage of the procedure re-evaluate the position of the TIs relative to the future location of the definitive implants making sure to place the TIs in the inter definitive-implant location.

If a TI should fracture in the bone, retrieval of the remaining

metallic fragment will not be necessary. If, however, the TI is placed in the location of the definitive implant and it fractures, excessive bone removal will be necessary to remove the fragment. If retrieval of the fragment is impossible then the entire case becomes compromised because the definitive im-

plant's ideal location is no longer available. If the positioning of the paralleling guide pins is adequate then one can proceed and insert the TIs with a motor at very slow speed (15-50 rpm) and adjust their final position manually. If some TIs are not parallel some degree of bending can be achieved with

CASE 3



FIGURE 38 After twelve years of function this six unit bridge became loose.

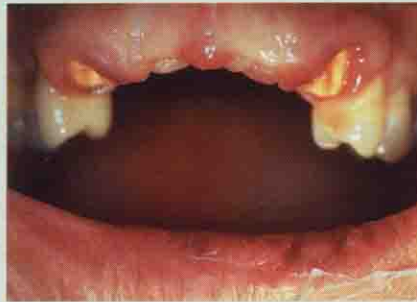


FIGURE 39 The two canines have to be removed.

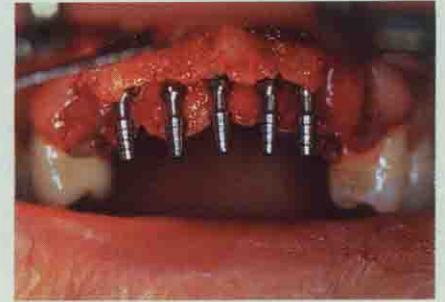


FIGURE 40 Five TI's are placed and the two teeth are extracted during the same procedure.



FIGURE 41 TI's are placed in the cortical bone palatally to the crest of the ridge.

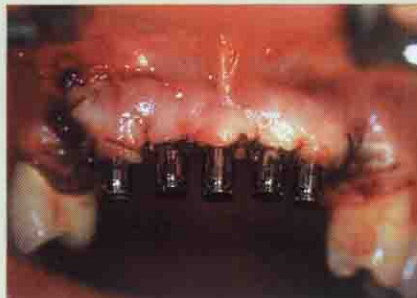


FIGURE 42 After closure the copings are placed to be picked-up into the temporary restoration previously fabricated by the lab technician.



FIGURE 43 TIs are splinted together rigidly with the temporary.



FIGURE 44 A rubber dam protects the surgical site effectively.



FIGURE 45 The relining and the cementation of the temporary are safer with rubber dam protection.



FIGURE 46 Because of their small diameter and their palatal position, a non-functional restoration is done over the TIs.

CASE 3 (continued)

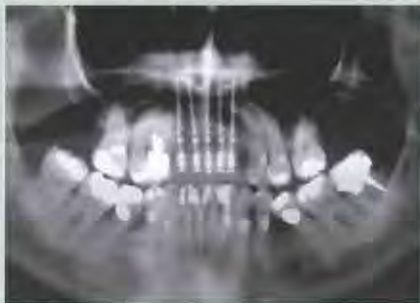


FIGURE 47 TIs in place.



FIGURE 48 Four months later, soft and hard tissue healing.



FIGURE 49 Symphysis graft is performed.



FIGURE 50 Two autogenous onlay grafts in place.



FIGURE 51 Bone particles give the final contour.



FIGURE 52 The barrier placed over the site limits the migration of soft tissue into the bone particles.



FIGURE 53 The same temporary restoration is recemented which reduces chair-side time.

appropriate bending tools. Once all TIs are placed, the patient is asked to close and the inter-occlusal space is checked for sufficient clearance.

If the TIs protrude too much and interfere with complete closure they can easily be screwed in a little more at this point of the procedure. Additional autogenous bone chips (crunched

trephined symphysis bone) and/or bone powder (osteoharvester) are then placed at the graft perimeter together with bone morphogenic proteins when indicated. A barrier membrane is placed over the graft and is slit or, better still, holes can be punched through the barrier membrane with a sterile rubber dam punch so as to slide it over the TIs and stabilize the membrane.

Before suturing, perpendicular slits are incised on the palatal flap so as to surround the TIs and so that primary closure can be achieved after buccal flap periosteal scarification.

Suturing is done first with a few horizontal mattress sutures to quickly approximate the buccal

and palatal flaps. Then, a non locking continuous sling is performed to allow for proper blood supply and approximation of the flap (Misch). Care is taken to place the knot in an area away from the TIs as it may compress the gingiva during the placement of the temporary restoration thereby compromising the blood supply and causing an opening of the incision line.

Fabrication of the temporary restoration can be done chair-side with a vacu-shell or can be prefabricated by the technician and relined chair-side. The latter is the technique of choice as it is faster, offers better precision and avoids the excessive use of acrylic which tends to generate a lot of heat during polymerization. In either case the technician should be instructed to

CASE 4

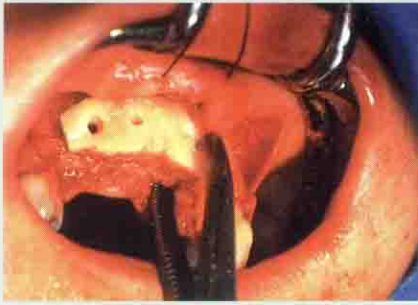


FIGURE 54 Symphysis graft held in place with forceps.

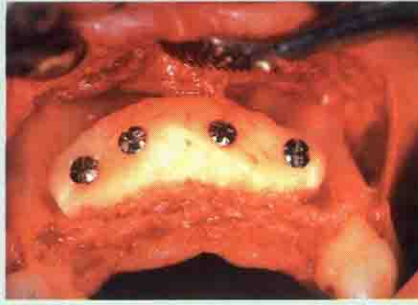


FIGURE 55 A 34 x 12 x 10-mm symphysis graft is anchored with 4 fixation screws.

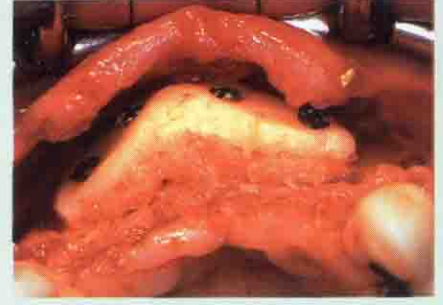


FIGURE 56 The thickness of the two millimeter residual ridge is augmented with a ten millimeters thick bone block.



FIGURE 57 Due to a simultaneous root extraction of #12 a TI was not placed parallel to the others.

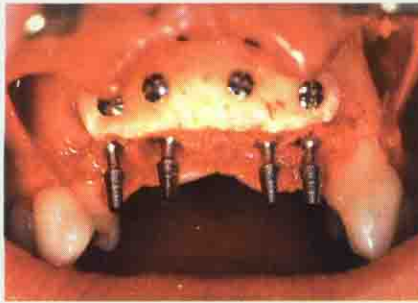


FIGURE 58 After bending of the #12 TI all are parallel and ready to be restored.

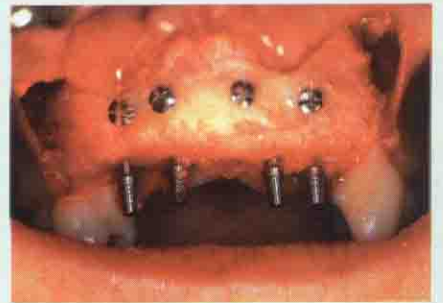


FIGURE 59 Bone particles help to give a smooth contour and pad sharp edges that could perforate the soft tissues.

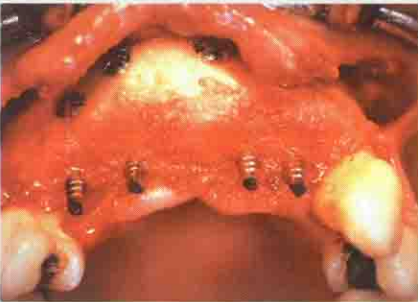


FIGURE 60 The ridge thickness has been augmented significantly.

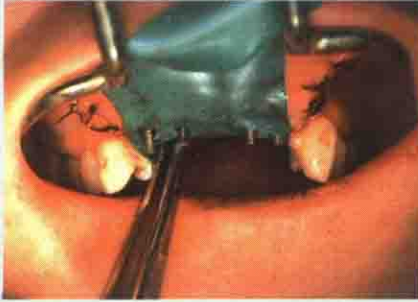


FIGURE 61 After closure, the rubber dam is installed.



FIGURE 62 In this case fewer TIs than the number of definitive implants have been placed.



FIGURE 63 The provisional bridge in place.



FIGURE 64 The provisional restoration must be out of occlusion.



FIGURE 65 Eleven days later at suture removal.

CASE 4 (continued)



FIGURE 66 The X-rays show a misalignment of the TIs that has been corrected by bending the one in the # 12 position.

thicken the palatal/ lingual and interproximal (Fig. 9) (Case 1 & 3) to allow for easy placement over the TIs which are often placed in a palatal position. This step facilitates relining and results in a stronger restoration.

The technician should also be advised to reinforce longer span temporaries with wire to avoid breakage during the healing period as a fracture of the temporary restoration could have destructive effects on the underlying implants or graft material.

When relining, petroleum jelly can be used over the tissues but the authors prefer to stretch a piece of alcohol sterilized rubber dam over the flap before relining. First the rubber dam is perforated over the TIs and stretched over the gums. Then all undercuts are blocked out and the temporary copings are slipped over the TIs.

The temporary shell is filled with acrylic and placed over the TIs and the rubber dam, thus avoiding the possible intrusion of acrylic around sutures or under the flap, which could have serious negative effects on the healing process. Once the acrylic is set, trimming of any excess and polishing of the provisional restoration occurs taking care to relieve the under surface to

allow room for post-operative swelling.

Finally, cementation with a temporary cement such as Improv (Nobel) is recommended. When very short abutments were available Resiment composite cement was found to provide adequate stability.

Whenever possible, suture removal should be done with the temporary in place. Repeated removal of the temporary increases the risk of complications to the underlying structures and should therefore be minimized. When planning the case, if the final prosthesis is removable, then plan a temporary removable (with underlying temporarily fixed wire reinforced acrylic bar). If the final is fixed then plan a fixed provisional restoration.¹⁷

DISCUSSION

Just as G.V. Black laid down the foundation of modern dentistry at the turn of the century, new techniques are carving the way so that implantology becomes predictable and accessible to all by following Black's principles. TIs can help us more than anything during the treatment to manage and ease all aspects of the implantology procedures. The management of the patient's expectations and our expecta-

Other advantages for the use of TIs abound in the literature and clearly demonstrate that with their advent a gap has been filled.

tions of the patient can be monitored and assessed well before the final prosthesis is constructed thus avoiding unsuspected pitfalls.

Patients seeking implant therapy are often times in distress or dissatisfied with their current state and are hoping for prompt relief of their ailing condition (especially recent complete dental amputees). It has been shown that implant retained prostheses can alleviate disabling psychological and functional conditions¹⁸ thereby increasing patient satisfaction and case acceptance.

Practical experience and literature testimonies also support these facts when TIs are used. It should be noted that the cost of TIs can quickly be amortized starting with ones' first case.¹⁹

CONCLUSION

Even though TIs success is not 100%, rarely has their use compromised the success of the underlying graft or definitive implants and in our experience never has it compromised the success of the provisional restoration. On the contrary bone grafts appear to retain more volume as less macro-movement and less micro-movement is exerted onto them.

Patients have even more to gain because of the fixed nature of the provisional restoration.

Other advantages for the use of TIs abound in the literature and clearly demonstrate that with their advent a gap has been filled.

As the field of implantology ages, it evolves, it continuously perfects itself, and new treatment modalities are brought forward as the collective field of intelligence pushes us out of the envelope of our comfort zone. transitional implants are one aspect of implantology that has done just that in a relatively short period of time. There is no doubt that TIs have become part of the standard of care of modern implantology. As Nike's motto goes, "just do it". **OH**

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Oral Health welcomes this original article.

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