Immediate Loading with Fixed Screw-Retained Provisional Restorations in Edentulous Jaws: The Pickup Technique

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Purpose: *This article describes (a) an immediate loading technique in the treatment of edentulous arches with screw-retained provisional restorations and (b) the effort to determine whether the described technique is compatible with the predictable achievement of osseointegration.* ***Materials and Methods:*** *Eight patients with either 1 or 2 edentulous arches were treated. A diagnostic tooth arrangement was carried out for each patient and was then duplicated twice to fabricate a provisional template and a surgical guide. Six to 10 solid-screw ITI implants were placed around the dental arch to reach the first molar regions. On the same day, all patients received splinted metal-free screw-retained provisional restorations according to the pickup technique. The provisional prostheses were retrieved every 2 weeks during the healing phase.* ***Results:*** *Seventy-eight implants were placed in 11 edentulous arches. Two implants were not immediately loaded because of inadequate primary stability. In an 8- to 20-month follow-up period (mean 14 months), two 8-mm implants were lost after 5 weeks of functional loading, resulting in an overall survival rate of 97.4%. All implants were assessed by resonance frequency analysis. After 4 months of functional loading, the mean implant stability quotient was 60 ± 4.1 units (range 51 to 72 ISQ units) for maxillary implants and 65 ± 6.5 units (range 47 to 74 ISQ units) for mandibular implants.* ***Discussion and Conclusion:*** *The immediate loading of implants placed in edentulous arches with screw-retained 1-piece (cross-arch) provisional restorations does not appear to jeopardize the achievement of osseointegration. Neither the metal-free design of the provisional prostheses nor the removal of the provisional prostheses during the healing phase adversely affected osseointegration. The pickup technique for immediate provisionalization represents a reproducible treatment option.* INT J ORAL MAXILLOFAC IMPLANTS 2004;19:524–533

Key words: *dental implants, immediate loading, pickup technique, provisional template, surgical guide, titanium copings*

Implant-supported fixed restorations have been a popular treatment for edentulism, since long-term studies have demonstrated that dental implants can be used successfully for the rehabilitation of edentulous jaws.[1–4] Several protocols for the treatment of edentulous maxillae and mandibles have been proposed,[5–7] presenting a variety of options, primarily regarding the number of implants to use, their strategic distribution, the use of a transitional prosthesis, and the design of the definitive prosthesis. One of the most controversial issues in implant dentistry, however, is the provisional phase. It has been recommended that clinicians allow a healing period of 2 weeks between the placement of implants and the delivery of a provisional removable prosthesis[8,9] in edentulous patients. Although the hope of rehabilitation motivates these patients to comply with their oral surgeon's recommendations, adaptation of the provisional complete denture after surgery is often complex and can jeopardize subjective comfort and expose the implants to uncontrolled premature loading.

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The immediate loading concept, which was first successfully applied to overdentures,[10–13] has also been used for fixed full-arch provisional prostheses in an attempt to solve the aforementioned problem. Two alternatives have been proposed: *(1)* placing a larger number of implants[14–17] and using some as abutments for the transitional fixed prosthesis while allowing others to heal passively and *(2)* loading all implants immediately with a provisional restoration.[14,17] The term "micromotion"[18–21] refers to implant motion; if the critical amount of micromotion (somewhere between 50 and 150 μm) is reached, fibrous encapsulation can prevail over osseointegration. Animal and human histologic studies[22–26] of immediately loaded implants have demonstrated that osseointegration can indeed be reached with a percentage of bone-to-implant contact that is similar to or even higher than that found with unloaded implants. These findings have led to the assumption that the inclusion of all implants in a splinted provisional cross-arch restoration would allow for a better force distribution and prevent deleterious micromotion.

Although several techniques for immediate provisionalization[17,27–31] have been proposed, opinions differ about the use of prefabricated provisional templates versus complete denture conversion; about the making of intrasurgical impressions versus direct relining; and about whether cementation or screw retention of provisional restorations is preferable. Complete denture conversion has been proposed for use in combination with either intrasurgical impressions or direct relining.[29–31] Another possibility is the utilization of a prefabricated provisional prosthesis to be adapted either in the mouth by direct relining[17,27] or in the laboratory on a working model obtained from an intrasurgical impression.[28]

The aim of this article is to describe *(a)* an immediate loading technique in the treatment of edentulous arches with provisional implant-supported fixed restorations and *(b)* the effort to determine whether the described technique is compatible with the predictable achievement of osseointegration. With this approach, the authors intend to facilitate the same-day adaptation of a splinted, screw-retained, full-arch provisional prosthesis, using a design that is in accordance with the definitive restoration, in terms of major esthetic parameters and other aspects.

MATERIALS AND METHODS

Patient Selection

In 2001 and 2002, 8 patients with either 1 or 2 edentulous arches were treated at the University of Geneva School of Dental Medicine according to the aforementioned protocol. All patients were in optimal condition for treatment with implant therapy. More importantly, the patients exhibited adequate anatomic conditions (ie, maxillomandibular relationship, alveolar ridge volume, and facial tissue support). After clinical and radiographic examinations, a complete implant-supported fixed restoration approach,[32] including immediate loading, was proposed.

Two patients had edentulous or almost edentulous maxillae, 2 presented with edentulous or almost edentulous mandibles, 3 were completely or almost completely edentulous, and 1 patient had a hopeless fixed full-arch mandibular ceramometal restoration; 11 edentulous or or almost edentulous arches in total. One patient was referred for maxillofacial surgery to re-establish the appropriate maxillomandibular relationship, and 4 patients had remaining teeth or roots that were considered hopeless from a prosthetic perspective. Extractions of roots, teeth, and prostheses were performed during implant surgery, which resulted in an immediate placement approach when the extractions coincided with the sites selected for implantation.

Diagnostic Planning, Laboratory Procedure, Surgical Procedure, and Provisionalization—The Pickup Technique

After mounting the diagnostic casts in an articulator, a diagnostic tooth arrangement was carried out for each patient (Fig 1a). Care was taken to adjust the prosthetic acrylic resin teeth to the cast without waxing the labial or buccal flange so as to establish the appropriate emergence profile. The palatal and lingual aspects were created using the same method used for complete denture preparation for support and retention of prosthetic teeth.

The diagnostic waxup was used to clinically assess occlusion, esthetic parameters, and the relationship between teeth and the alveolar ridge (emergence profile) (Fig 1b). Before continuing with the treatment, patient approval was requested, especially regarding esthetic aspects. Subsequently, the diagnostic waxup was duplicated twice, first to fabricate a provisional template using the stratification technique (Figs 2a and 2b), and then for the fabrication of a surgical guide in transparent heat-processed acrylic resin (Fig 2c).

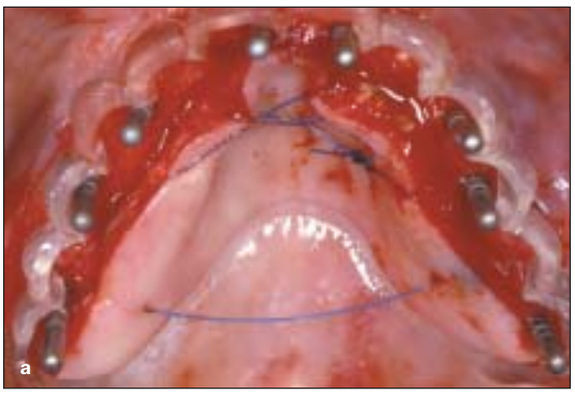
Early in the morning, the implant beds were prepared and solid-screw ITI implants (Straumann, Waldenburg, Switzerland) were placed. The preparation axes were controlled by paralleling gauges, and a surgical guide was used in between drill changes (Fig 3a). With the placement devices attached to the

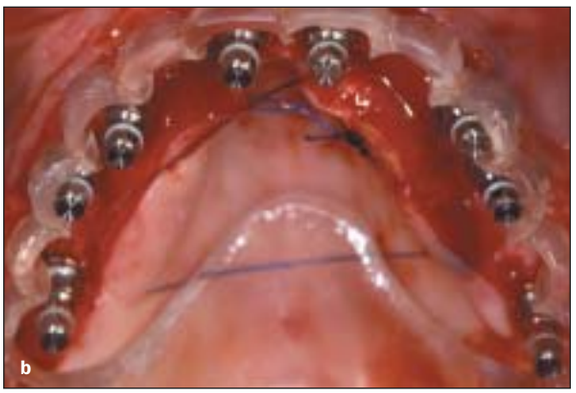
Figs 1a and 1b Diagnostic waxup. *(a)* Frontal view of the diagnostic waxup on the cast. The anterior teeth were adjusted to the alveolar ridge without vestibular flange. *(b)* Frontal view of the diagnostic waxup during clinical assessment of the occlusion, maxillomandibular relationship, emergence profile, and esthetic aspects. During this clinical step, the patient's opinion is important, particularly in regard to acceptance of the esthetic aspect.

Figs 2a to 2c Provisional template and surgical guide (a duplicate of the diagnostic waxup). *(a)* Occlusal view of the provisional restoration. The palatal/lingual part was fabricated as a complete denture and later served for repositioning the provisional restoration in the mouth. *(b)* Frontal view of the provisional restoration. Note the labial aspect of the teeth, which determine the ideal emergence profile. Using a layer of dentin acrylic resin followed by a layer of enamel, stratification of the acrylic resin was performed. *(c)* While the palatal aspect allows for repositioning of the surgical guide, the labial/buccal aspect sets the vestibular limit on where implants can be placed, provides 3-dimensional orientation of implant axes, and determines the implants' final vertical position in accordance with the cervical aspect of the pre-established tooth positions.

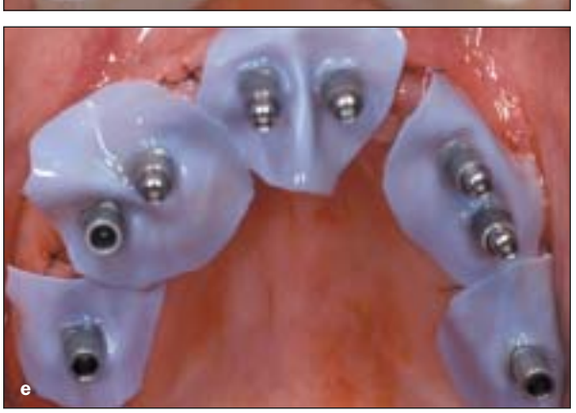
implants, the parallelism was checked one last time with the surgical guide (Fig 3b). The placement devices were then retrieved, and the healing caps were connected to each implant. Wound closure was performed around the titanium healing caps in a nonsubmerged approach with interrupted sutures.

At midday, the patients were transferred from the surgical room to the regular clinic, where adaptation of the provisional template was carried out. Because all implants were placed and controlled with a surgical guide (which was a duplicate of the waxup), perforations were made on the provisional template (also a duplicate of the waxup) to match their position (Fig 4a). After removal of the titanium healing caps, screw-retained titanium provisional copings (Straumann) were connected to each implant (Figs 4b and 4c). The template perforations were sufficiently widened to avoid any contact with the titanium copings; thus, exclusively mucosal support was achieved at the palatal/lingual aspect. The template was then brought into centric occlusion with the opposing arch, and the height of the titanium coping was reduced if necessary (Fig 4d). The titanium copings were then removed and sandblasted in the laboratory with the Rocatec System (3M ESPE, Minneapolis, MN) and subsequently reseated in the





Figs 3a and 3b Control of the implant axes was maintained during surgery with the assistance of the surgical guide. *(a)* The surgical guide and 2.2-mm paralleling gauges in place. The surgical guide was used between pilot drill changes to verify implant axes. *(b)* Implants in place with the placement devices still attached. Parallelism was checked one last time with the surgical guide before the placement devices were removed.



Figs 4a to 4e "The pickup technique" for the adaptation of a screw-retained immediate provisional restoration. *(a)* The provisional template was a duplicate of the diagnostic waxup. Perforations were made to match the implant positions. *(b)* Titanium copings, which were sandblasted with the Rocatec System, were attached to the implants. *(c)* The implants were isolated from the fresh wound with rubber dam. *(d)* The provisional template in the mouth. Perforations were sufficiently widened to achieve only mucosal contact at the palatal/lingual aspect. This permitted repositioning of the provisional template in accordance with the pre-established tooth location and occlusion. *(e)* During connection of the titanium copings and the provisional template, the wound was protected with rubber dam to avoid any contact with nonpolymerized acrylic resin.

Figs 5a to 5d *(a)* The provisional template–titanium copings complex was unscrewed and retrieved from the mouth. *(b)* Inner view of the provisional template–titanium copings complex showing the remaining gaps, which were later filled in with acrylic resin. *(c)* After final fixation of the titanium copings, the palatal aspect was cut off, leaving a continuous palatal rafter to serve as reinforcement. *(d)* Screw-retained provisional restoration after characterization and glazing.

mouth (Figs 4d and 4e). The surrounding soft tissue was protected with rubber dam (Figs 4c and 4e). While the provisional template was held in place manually, light-curing acrylic resin (Unifast; GC Corporation, Tokyo, Japan) was used to connect the template to the coronal part of the titanium copings. The provisional template–titanium coping complex was unscrewed for finishing in the laboratory (Figs 5a to 5d). While the laboratory procedures were being carried out, the healing caps were reseated to prevent the mucosa from covering the implants.

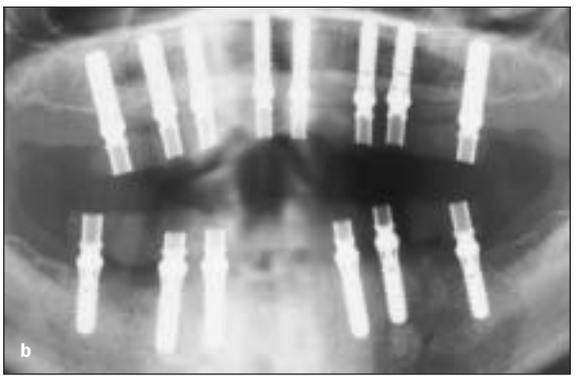
In the laboratory, the remaining gaps between the titanium copings and the provisional template were filled in with acrylic resin, creating an appropriate emergence profile at each abutment site. Once the titanium copings were completely fixed to the provisional restoration, the palatal/lingual aspect of the template was cut off (Figs 5a to 5d). A continuous rafter was created at the palatal/lingual aspect of the full-arch screw-retained provisional prosthesis to serve as reinforcement.

Late in the afternoon, after characterization and glazing of the provisional prosthesis, the titanium healing caps were retrieved and the provisional prosthesis was screwed in place manually (Fig 6a). Occlusion was assessed again, and marginal adaptation of the titanium copings was checked from a panoramic radiograph (Fig 6b). This approach provided the patients with a fixed implant-supported provisional restoration the same day that the implants were placed.

RESULTS

Seventy-eight implants were placed in 11 edentulous jaws (Table 1). Two implants were not immediately loaded because of questionable primary stability. The implants were followed up for 8 to 20 months (mean 14 months). Two 8-mm implants placed in maxillary right first molar and maxillary left first molar positions in the same patient were lost after 5 weeks of functional loading and replaced after an additional 3-month healing period, resulting in an overall survival rate of 97.4%.

All implants were assessed by resonance frequency analysis (RFA) (Osstell/Integration Diagnostics, Göteborg, Sweden) after at least 4 months of functional loading and before the final impressions were made. The mean value was 60 ± 4.1 implant stability quotient (ISQ) units (range of 51 to 72 ISQ units) for maxillary implants and 65 ± 6.5



Figs 6a and 6b *(a)* Frontal view of maxillary and mandibular immediate provisional restorations placed the day of surgery. *(b)* Radiograph obtained after placement of the provisional restoration. Careful attention should be paid to verification of the precise fit between titanium copings and implants.

Table 1 Summary of Patient Data, Including the No. of Implants Placed and Loaded, Implant Type, Length, and Survival Rate

			Implants placed (n = 78)*							
			Maxilla (mm)			Mandible (mm)				
Patient	Age	Gender	8	10	12	8	10	12	Type	Survival rate (%)
AJ	57	F	2	4	4	–	–	–	ITI SS	100.0
CM	45	F	–	2	8	–	–	–	ITI SS	100.0
MM†	54	F	2	6	–	–	2	2	ITI SS	83.3‡
MR	63	M	–	–	–	–	4	2	ITI SS	100.0
PC	57	M	–	–	–	–	1	5	ITI SS	100.0
BM†	57	M	–	2	6	–	–	6	ITI SS	100.0
PJ†	60	F	–	–	8	–	–	6	ITI SS	100.0
SR	60	M	–	–	–	–	3	3	ITI SS§	100.0
Total			4	14	26	–	10	24		97.4

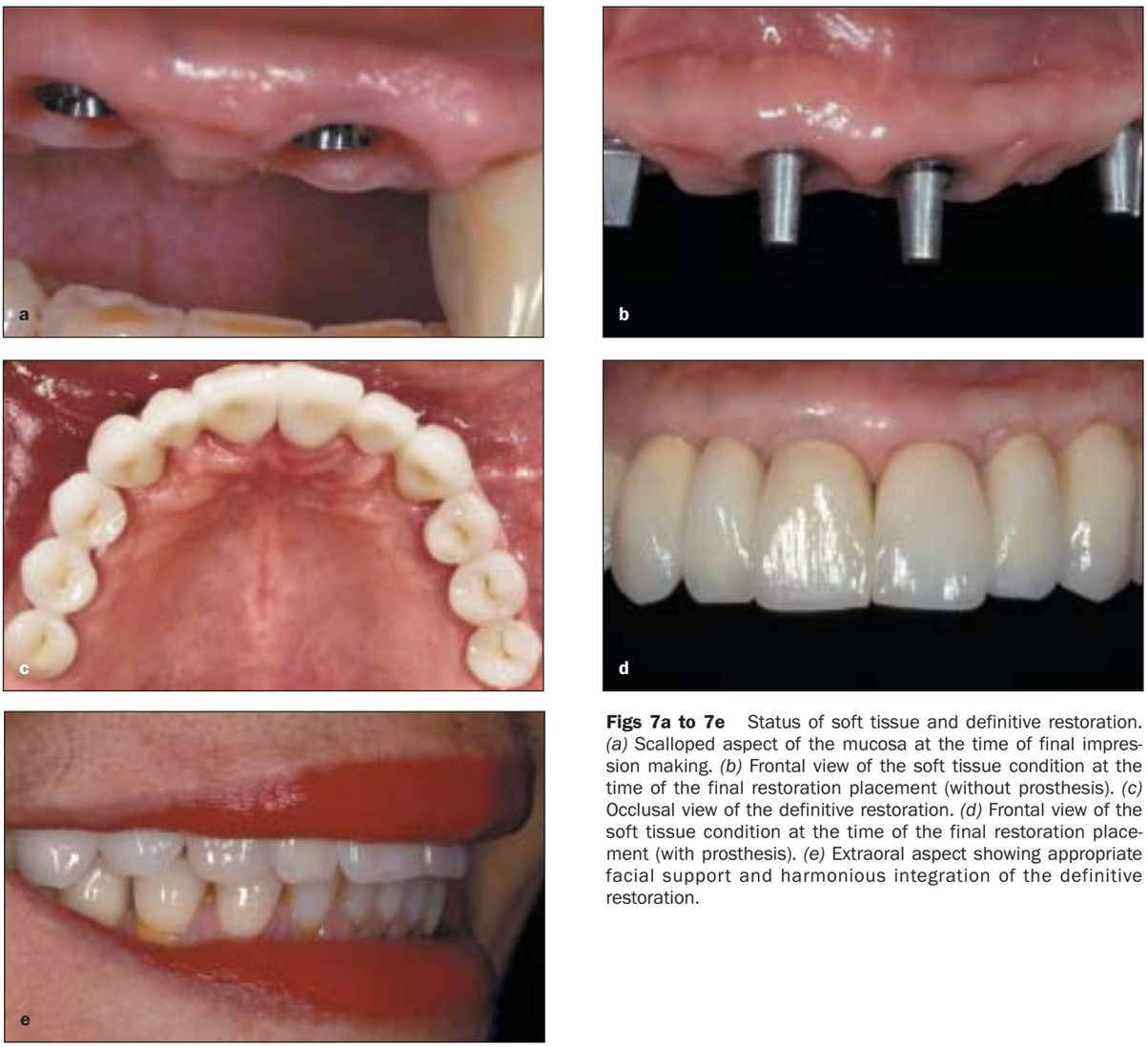
ITI SS = Solid-screw ITI implant.
*Two implants were not immediately loaded—an 8-mm maxillary implant in AJ and a 12-mm mandibular implant in MR.
†Patients receiving same-day simultaneous immediately loaded implants in both the maxilla and mandible.
‡MM lost 2 8-mm maxillary implants.
§Tapered.

ISQ units (range of 47 to 74 ISQ units) for mandibular implants.

During the healing phase (up to 4 months) the screw-retained provisional prostheses were retrieved every 2 weeks for suture removal, implant stability assessment, and soft tissue healing evaluation. Subsequently, the provisional restoration was reseated using a torque of 15 Ncm. At the first removal of the provisional prosthesis (2 weeks after placement), screw loosening was found in all patients. This was not the case 15 days later, when the provisional prostheses were removed for the second time. Soft tissue healing was achieved by second intention within the first month following placement of the provisional restoration, and the interimplant space was mostly filled in (Fig 7).

Radiographic follow-up was carried out at baseline (ie, on the day of implant placement) and prior to impression making. No significant bone loss patterns were detected, with the exception of 2 patients (1 with maxillary implants, 1 with mandibular implants) who showed slightly higher marginal bone loss bilaterally around the 2 most posterior implants.

Generally, the treatment was well tolerated by the patients. Only 1 patient manifested a postsurgical facial hematoma. No patient suffered notable pain or discomfort, and subjective patient satisfaction was achieved from both the functional and esthetic points of view. All patients ultimately received the final restorations, and no additional implants were lost at the 1-year follow-up (Figs 7c to 7e).



Figs 7a to 7e Status of soft tissue and definitive restoration. *(a)* Scalloped aspect of the mucosa at the time of final impression making. *(b)* Frontal view of the soft tissue condition at the time of the final restoration placement (without prosthesis). *(c)* Occlusal view of the definitive restoration. *(d)* Frontal view of the soft tissue condition at the time of the final restoration placement (with prosthesis). *(e)* Extraoral aspect showing appropriate facial support and harmonious integration of the definitive restoration.

DISCUSSION

The need for adaptation of laboratory-prepared (prefabricated) provisional restorations arises from the radical change between the pre- and postimplant surgery situation, and this has led to several proposals regarding immediate fixed provisional restorations.[17,27–31] The diversity of options and clinical maneuvers proposed seems to result from the fact that clinical expertise in conventional treatment has had to be adapted to a completely new situation.

Careful attention should be given to the diagnostic phase, in which feasibility of a desired final outcome is evaluated. Regardless of the immediate provisionalization technique used, the clinical, surgical, prosthetic, occlusal, and esthetic aspects and, most importantly, the patient's expectations, must be assessed before proceeding. A diagnostic waxup is necessary to evaluate all of these parameters. Furthermore, the replication of a provisional template and a surgical guide from the diagnostic waxup makes it possible to retrieve pertinent information at each stage of the treatment.

Use of complete denture conversion has been proposed for either intrasurgical impression or direct relining,[29–31] allowing for reproduction (impression) or maintenance (relining) of the vertical dimension and occlusal relationship. However, this approach does not allow for prediction of the precise final suprastructure emergence profile in relation to prosthetic teeth, which could affect screw access or esthetics (especially in the maxilla). Conversely, whereas the use of a pre-made provisional restoration[17,27,28] permits the establishment of an appropriate emergence profile, it does not allow for simultaneous recording of the precise

maxillomandibular relationship in either indirect (impression) or direct (relining) procedures.

Use of the palatal/lingual aspect of the provisional templates as a repositioning element as described in this article not only avoids both intrasurgical impression and direct relining, but it also permits preservation of the selected tooth locations and occlusion. Moreover, the connection between the screw-retained titanium copings and the provisional template (brought to centric occlusion by its palatal/lingual aspect) is made at a distance from the freshly created wound. This connecting maneuver permits pickup of the titanium copings from the mouth in the right positions, and it allows for easy finishing of the screw-retained provisional restoration in the laboratory (ie, no need for working cast preparation), which considerably reduces the duration and cost of the entire procedure.

Tarnow and colleagues[17] and Horiuchi and associates[27] have recommended a casting-reinforced provisional restoration to avoid any macromovement and in that way provide resistance to forces in all directions. The provisional design described in the present study is metal-free. The palatal rafter remaining after subtraction of the palatal/lingual aspect gave enough rigidity to the provisional restoration to avoid such macromovement. Seventy-four of 76 immediately loaded implants, which were followed for 8 to 20 months (mean 14 months) of functional loading, achieved osseointegration (a 97.4% survival rate). Two maxillary implants were lost in a single patient. The reason for these failures may be that these implants were 8 mm in length and were placed as terminal abutments in the posterior region of the maxilla opposing a simultaneous ly placed fixed immediate implant-supported prosthesis. This result is in accordance with the aforementioned studies. In each of these studies, 2 posterior implants were lost before the final impressions were made. Therefore, it can be assumed that a metal-free immediate provisional fixed cross-arch restoration with a continuous palatal rafter does not adversely affect the rate of osseointegration around immediately loaded splinted implants.

Jaffin and associates,[32] Horiuchi and coworkers,[27] and Grunder[29] have recommended that the provisional restorations remain in place during the healing phase, especially if they were cemented. All screw-retained provisional prostheses described in this article were retrieved every 2 weeks during the healing period for suture removal, implant stability assessment, soft tissue healing evaluation, eventual modification of embrasure configuration, professional cleaning, and reinforcement of oral hygiene. At the first removal of the the provisional prosthesis 2 weeks after surgery, slight screw loosening was observed in all patients, which was not the case at subsequent removals. This result could be attributed to a combination of 2 factors. The first factor is minor implant movement as a response to tension originating from the seating of the provisional restoration. Since an accurate fit between the titanium copings and implants was radiographically verified, it seems logical to assume that freshly placed implants could respond with minimal displacement to the tensions created by the simultaneous tightening of numerous screws to secure the titanium copings involved (which took place immediately after the placement of the provisional prosthesis). A second factor may be minor gradual wear of the titanium copings in the zones of contact, causing loss of pre-tension in the coping screw assembly and therefore slight screw loosening.

Follow-up of immediately loaded implants during the healing phase is important. In a clinical study, Tarnow and colleagues[17] concluded that the failure of immediately loaded implants in 2 of 10 patients was possibly the result of the removal of provisional restorations to evaluate implant stability. Conversely, in similar clinical immediate loading approaches, Horiuchi and associates[27] and Grunder[29] found mobile implants after 4 to 6 months, when, for the first time after surgery, the provisional prostheses were retrieved so that definitive impressions could be made. In the present study, periodic removal of the provisional restorations did not appear to disturb the bone healing process. Although different provisional prosthesis designs and different approaches during the healing phase were applied in the use of implants immediately loaded with fixed prostheses for the treatment of edentulous patients in these studies, these factors could not be established as the sole cause of implant failure. The failure of immediately loaded implants should be considered a phenomenon that may be caused by multiple factors, such as length, number and location of implants; inadequate bone density; lack of primary stability; inappropriate force distribution; surgical trauma; and pathologic occlusion; all of these play important roles in decision making at the time of loading. In an experimental study in rabbit tibiae, Ivanoff and colleagues[33] demonstrated that implants that have been mobilized by traumatic disruption of the bone-implant interface may reintegrate if allowed to heal passively for at least 6 more weeks. In light of all the factors mentioned, consider that removal of screw-retained provisional restorations can allow early detection of possible complications as well as allow for the subsequent exclusion from occlusal loading of an affected implant, thereby providing favorable

conditions for reintegration. Furthermore, prosthesis removal facilitates suture removal, direct evaluation of the soft tissue healing, and professional prophylaxis and maintenance.

Soft tissue surrounding the implants was completely healed after 4 weeks by second intention. It has been observed that the placement of an immediate provisional restoration slightly displaces the flap edges, leaving an empty space between them. This gap is occupied first by a blood clot and then by granulation tissue, which attains the characteristics of keratinized mucosa after 1 month. Since the flap edges and granulation tissue fill the interdental space, special attention should be given to embrasure shape and size to promote establishment of a scalloped contour in the mucosa. This becomes a particularly important issue in the esthetic zones, where interdental papillae need to be created from a flat mucosa to establish a harmonious integration of the prosthesis and the peri-implant tissues.

In a clinical study, Balleri and colleagues[34] reported data on implant stability measurements using RFA in 45 implants after 1 year of functional loading. The mean value was 69 ± 6.5 ISQ units (range 57 to 82 ISQ units); higher ISQ values were found for mandibular implants than for maxillary implants. The values presented in the present study (60 ± 4.1 ISQ units, range 51 to 72 ISQ units, for maxillary implants and 65 ± 6.5 ISQ units, range 47 to 74 ISQ units, for mandibular implants) are an obvious indicator that, at the time of final impressions, all implants were sufficiently stable to receive the final restoration. One observation worth noting is the case of 1 patient who had 2 osseointegrated implants that retained a mandibular overdenture for a year. In this case the ISQs of the 4 added and immediately loaded implants were higher than those recorded for implants that had been functionally loaded for 1 year. From this it could be hypothesized that immediate loading with splinted implants and bilateral stabilization can stimulate bone remodeling activity if the amount of micromovement is kept within tolerated limits, which would account for the greater implant stability. However, more research needs to be carried out in this field to scientifically affirm this hypothesis.

CONCLUSIONS

The pickup technique for immediate provisionalization in the treatment of edentulous jaws with fixed prostheses described in this study represents a reproducible treatment option. It permits

- Implant placement in relation to future tooth axes
- Avoidance of intrasurgical impressions and direct relining
- Reproducibility of pre-established tooth location and occlusion
- Accomplishment of clinical maneuvers at a distance from the fresh wound
- Reduction of chairside time
- Same-day adaptation of an immediate screw-retained provisional restoration

Furthermore, with this method, there is no need for a working cast.

Neither the metal-free provisional design nor frequent removal of the provisional restorations appeared to jeopardize osseointegration. Follow-up of both implant stability and soft tissue condition during the healing phase is of paramount importance, both for early detection of any complications and for modeling of the scalloped aspect of the mucosa.

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