Reconstruction of damaged fresh sockets by connective-bone sliver graft from the maxillary tuberosity, to enable immediate dentoalveolar restoration (IDR)—A clinical case

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_Abstract

This paper describes a procedure for immediate loading of an implant following tooth extraction, in a socket presenting severe damage to the vestibular bone plate and gingival recession in the region of the upper central incisors. The procedures of extraction of the tooth, immediate insertion of the implant, connective-bone graft from the maxillary tuberosity and immediate restoration were shown to be a predictable treatment alternative. These procedures led to restoration of the tooth, bone and gingival structures in a single surgical stage and to maintenance of the favorable esthetic and functional result 24 months afterwards.

_Introduction

The situations in which immediate loading of implants following tooth extraction is indicated are expanding. Maintaining the integrity of the support tissues during a tooth extraction procedure is an indispensable requirement for indicating immediate loading (Tarnow DP 1997, Brånemark P-I 1999, Buser D 1999).

When a tooth presents endodontic or periodontal damage, fractures or root reabsorption, some of the bone framework may be compromised and may require surgical techniques to restore its anatomy, prior to implant insertion. When the bone damage is extensive, with changes in the level of the gingival margin, the esthetic risk increases and thus, immediate loading is contraindicated (Polizzi G 2000, Chen ST 2004, Lindeboom JA 2006, Schropp L 2008).

The aim of this paper is to describe a technique for immediate loading of an implant following tooth extraction, in a socket presenting severe damage to the vestibular bone plate and gingival recession in the region of the upper central incisors.

_Literature review

The finding of the phenomenon of integration between bone and titanium changed the course of dentistry. However, to promote osseointegration for a titanium fixture, it would be necessary to bury the implant in order to avoid premature loading, thereby requiring two surgical stages before inserting the prosthesis (Brånemark P-I 1977).

The development of studies aimed at diminishing the waiting period for prosthetic restoration has ensured the use of implants involving a single surgical stage and has imposed changes in the principles of osseointegration (Tarnow DP 1997, Brånemark P-I


Fig. 1

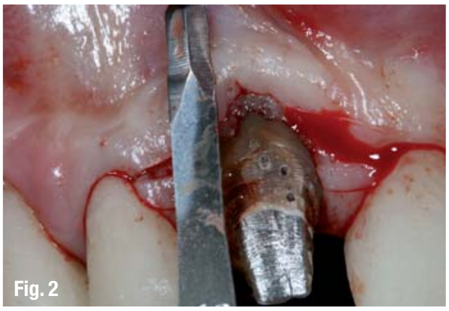


Fig. 2


Fig. 3


Fig. 4

1999, Buser D 1999). It has been shown that certain forces are important for triggering a series of biological reactions that accelerate the bone repair process, thus encouraging the use of implants for immediate loading (Romanos G 2001, Isidor F 2006).

The possibility of immediately replacing a damaged tooth has led to the achievement of success rates greater than 90 per cent in studies on immediate loading of implants following tooth extraction (Worhle PS 1998, Gomez-Roman G 2001, Hui E 2001, Kan JY 2003, Glauser R 2003, Malo P 2003, Tupac RG 2003, Schropp L 2005, De Kok IJ 2006, Barone A 2006, Degidi M 2007, Crespi R 2007, Canullo L 2007, Villa R 2008).

Primary stability is the most important factor in indicating that an implant can be brought into immediate functioning. This is associated with the quantity and quality of the bone material, the geometry of the implant and the surgical technique used (Polizzi G 2000, Covani U 2003, Hamerle CH 2004, Covani U 2007, Canullo L 2007, Schropp L 2008).

Implants of conical design are the type most indicated for receiving immediate loading following tooth extraction. They promote greater lateral bone compaction, thereby increasing the bone density; they adapt better to the socket; and they have a greater contact surface with the bone. These characteristics increase the initial stability and enable better spreading of occlusal loads (Gomez-Roman G 2001, O'Sullivan D 2000, Abbou M 2003, Friberg B 2003, O'Sullivan D 2004, Glauzer et al 2007).

The presence of local infection due to disease or trauma in the damaged tooth interferes directly with the quantity and quality of the soft and hard tissues. It may change the alveolar architecture at the potential site for implant insertion. Additional loss of these esthetically important tissues may occur while treating the local infection, thereby increasing the involvement of esthetics. One or more socket walls may be impaired, with or without gingival recession, and surgical techniques may be needed to restore their anatomy, thus contraindicating implants with immediate loading (Polizzi G 2000, Chen ST 2004, Lindeboom JA 2006, Schropp L 2008).

As a donor area, the maxillary tuberosity has a limited quantity of bone material available and presents low bone density and the difficulty of surgical access. Its advantages are the excellent postoperative recovery, better graft repair and the ease of harvesting the graft material and adapting it to the receptor region, because of the bone malleability (Rosa JCM 2008).

Anatomical and functional recovery of the hard and soft tissues surrounding the pos-extration immediate loading implant was achieved by means of the technique of connective-bone sliver graft, as a single specimen harvested from the maxillary tuberosity.

_Clinical case report

The patient was a 50-year-old woman with a high smile line who came for treatment because of gingival recession in the region of the upper right central incisor.

At the clinical examination, periodontal probing of the compromised tooth showed severe damage to the vestibular bone plate, with gingival recession of 4 mm combined with vestibular bone loss to a depth of 10 mm, without apparent fistula.

Radiographic examination showed the presence of endodontic treatment, a short cast metal core, a metal/ceramic crown, bone height of 8 mm above the root apex and thickening of the hard layer in the region of the compromised tooth. Good bone material availability in the maxillary tuberosity was observed.

The treatment proposed consisted of extraction of the compromised tooth, curettage of the region, implant insertion, recovery of the socket defect by connective-bone sliver graft from the maxillary tuberosity and immediate temporary restoration. It was suggested to the patient that she might wish to replace the metal/ceramic crowns with metal-free crowns on the anterior teeth of the maxilla.

The following medications were prescribed:

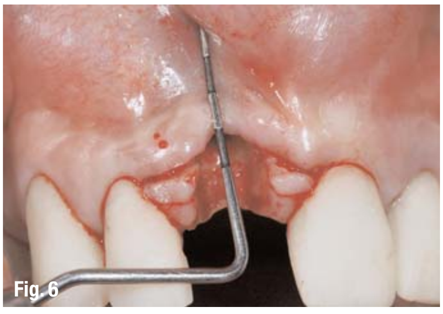
_Amoxicillin 500 mg, taken as one capsule every eight hours, for seven days starting one hour before the procedure.

_Dexamethasone 4 mg, taken as one dose of 8 mg one hour before the procedure and then 4 mg per day for two more days.

_Paracetamol 750 mg, taken as one pill every six hours while in pain, beginning one hour before the procedure.

For better comprehension, the steps in the procedure will be described in detail in the following.

Fig. 5



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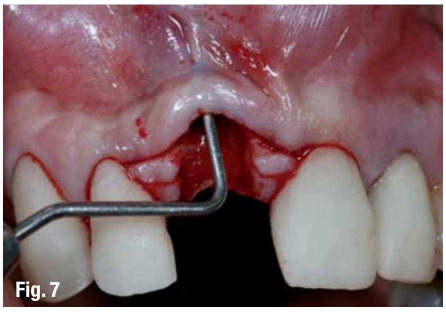

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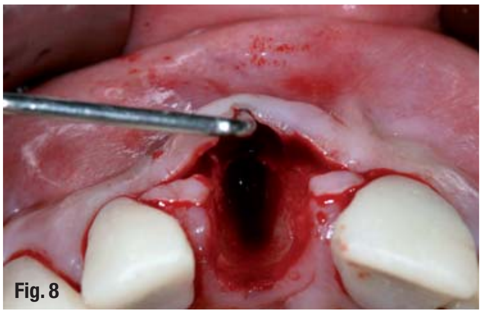

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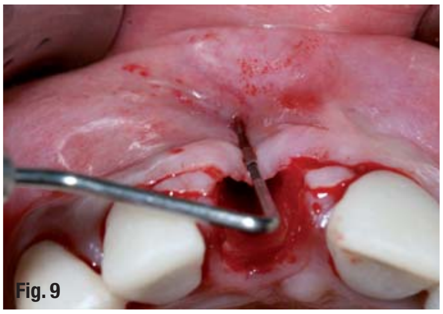

Fig. 9

Fig. 10

Sequence of procedures:

® **Tooth extraction and implant insertion**

1. Infiltrative anesthesia of 2% mepivacaine, with norepinephrine, at the base of the vestibule, in the palate and near the papillae adjacent to the compromised tooth.

2. Double incision at the level of the mesial papillae and distally to the compromised tooth, using a microblade (69 WS Swann-Morton®, England). The aim of this incision was to reposition the gingival tissue coronally, thereby minimizing the trauma to the tissues and promoting scar-free first-intention healing.

3. Incision in the sulcus, using the microblade, around the tooth that was to be extracted.

4. Non-traumatic extraction of the tooth using a periotome, performing a pendular movement in the mesiodistal direction, with the aim of maintaining the integrity of the remaining bone walls.

5. Careful curettage of the socket, to remove the granulation tissue and the remains of the periodontal conjuntive tissue.

6. Probing of the socket walls to assess the degree of bone damage, in the apical-coronal and mesiodistal directions, and to confirm the anatomical shape of the defect.

7. Insertion of a NobelReplace™ Tapered TiUnite® (Nobel Biocare™, Göteborg, Sweden) implant, of dimensions 16.0 x 4.3 mm, with excellent apical stability and diameter compatible with the socket opening. By means of a surgical guide, the drill bits were directed towards preparing the bone bed, using the palatine wall to ensure adequate bone support and insert the implant in the ideal three-dimensional position. The implant bed preparation was started using the 2.0 cylindrical drill bit and continued using the 3.5 and 4.3 conical-shaped drill bits. The implant was inserted such that the ideal apical-coronal positioning was sought, independent of the abnormality of the gingival level. The implant platform was at a distance of 3 mm from the gingival margin of the homologous tooth. After insertion of the implant, the spirals remained exposed in the socket defect region.

8. Insertion of a temporary titanium abutment, adjustment of the occlusion and opacification of the metallic component by using photopolymerizable opaque resin (Amelogen® Plus OW, Ultradent Products, Inc., USA);

9. Construction of a provisional crown using esthetic facet that was prepared earlier using photopolymerizable resin. The ideal emergence profile was established on the provisional crown, with free space to allow for accommodation of the soft tissues and to promote a thicker and more stable margin of gingival tissue;

10. Insertion of the provisional crown for adjustment of the occlusion in centric, habitual and excursive movements and for clinical confirmation of its adaptation, considering that the implant platform was above the gingival margin.

11. Removal of the provisional crown for finishing and polishing, and to perform the stage of reconstruction of the sockets bone defects.

® **Graft harvesting**

12. Infiltrative anesthesia in the donor area by means of 2% mepivacaine, with norepinephrine, at the base of the vestibule and in the palatine portion of the maxillary tuberosity.

13. Incision following the distal outline of the second molar, to the full depth of the soft tissue, followed by two relaxing incisions in the posterior direction, thus reproducing the shape of the defect in the receptor region.

14. Longitudinal incision dividing the gingival tissue as far as the most posterior portion of the relaxing incisions, while maintaining a thickness of around 1 to 2 mm of connective tissue covering the bone tissue.

15. With the use of a straight chisel, the bone was cut along the relaxing incisions, with the aim of defining the bone fracture line. The chisel was positioned on the incision line surrounding the distal part of the second molar and was driven in deeper, as far as the distal limit of the relaxing incisions, in order to obtain a uniform bone/gingiva sliver. An incision was made in the distal portion of the gingiva to remove the sliver, while taking care to maintain an epithelial pedicle, to ensure better nutrition for the flap that would be used to cover the donor region.

16. Harvesting of bone marrow from the donor region to fill possible spaces between the bone sliver and the exposed spirals of the implant.

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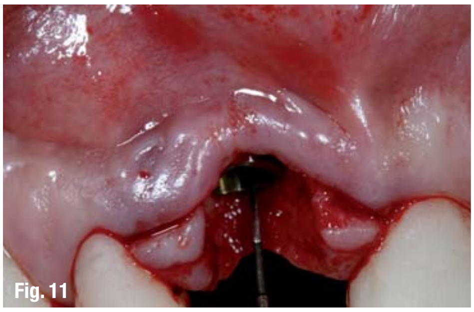
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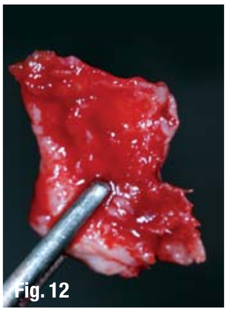
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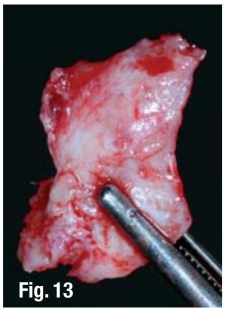
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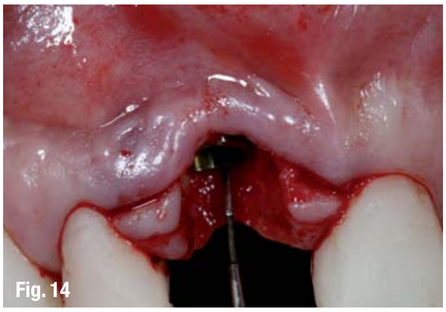
Fig. 14

® Suturing and stabilization of the connective-bone sliver

17. Harvesting of gingival tissue between the double incisions, in the region of the papillae.

18. Detachment of the gingival flap to make it possible to reposition it coronally, free from tension.

19. Manipulation of the connective-bone graft to reproduce the shape of the socket defect.

20. Careful insertion of the connective-bone sliver, as far as the level of the implant platform, while leaving the bone portion in contact with the exposed spirals of the implant and the connective tissue portion in contact with the internal portion of the gingival flap.

21. Stabilization of the graft by means of suturing the connective tissue portion of the graft on the internal face of the gingival flap, and passive accommodation of the flap in order to suture the papillae using simple stitches.

22. Compaction of the bone marrow, that was taken from the maxillary tuberosity, between the vestibular surface of the implant and the graft, to ensure the final stabilization of the connective-bone sliver.

23. Insertion of the provisional crown on top of the implant.

24. Torque of 20 N on the attachment screw of the provisional crown and sealing of the palatine orifice with temporary filling material (Fermit, Ivoclar North America, Amherst, NY, USA).

25. Suturing of the gingival flap in the donor region, using simple stitches.

The patient was instructed not to place any loading on the region and to make topical applications of 0.12% chlorhexidine, three times a day for seven days.

After a three-month period to allow osseointegration and restoration of the bone and gingival architecture, an abutment made of Procera zirconia was inserted using torque of 20 N. At that time, the anatomical shape of the emergence profile obtained for the provisional crown on the implant was checked.

Transfer molding was performed on the implant emergence profile and on the neighboring teeth. The dies were scanned using Procera Forte to construct copings made of Procera alumina. After testing the copings, transfer molding was performed to enable personalized application of porcelain. The esthetic finish was determined according to the adequacy of the gingival architecture and the crowns made of metal-free porcelain on the anterior teeth of the maxilla.

This technique was shown to be esthetically and functionally predictable: it minimized the surgical trauma and provided favorable results immediately and after 24 months of follow-up.

_Discussion

Immediate loading of implants following tooth extraction, in cases in which the support tissue is undamaged, is very well established in the literature (Tarnow DP 1997, Worhle PS 1998, Brånemark P-I 1999, Buser D 1999, Polizzi G 2000, Gomez-Roman G 2001, Hui E 2001, Kan JY 2003, Glauser R 2003, Malo P 2003, Tupac RG 2003, Covani U 2003, Hamerle CH 2004, Schropp L 2005, De Kok IJ 2006, Barone A 2006, Degidi M 2007, Covani U 2007, Crespi R 2007, Canullo L 2007, Schropp L 2008, Villa R 2008). Maintenance of the bone and gingival architecture, esthetic restoration and reduction of the treatment duration are the factors that have given recognition to the technique (Tarnow DP 1997, Brånemark P-I 1999, Buser D 1999). In addition to the initial stability, the biological changes that occur when an implant is put into use at an early stage are of great importance in the bone repair process (Romanos G 2001, Isidor F 2006, Vandamme K 2007).

In cases of tooth loss together with loss of support structures, the esthetic risks are greater. In such cases, implant insertion associated with grafting or with the use of membranes is indicated, so that function is reestablished only after a healing period.

Many papers have reported the use of grafts from the maxillary tuberosity for correcting socket defects (ten Bruggenkate CM 1992, Misch CE 1999, Rosa JCM 2008). The maxillary tuberosity presents the disadvantages of the limited quantity of bone material available, the low bone quality and the difficulty of surgical access. Its advantages are the greater speed of graft repair, the ease of harvesting the graft material and adapting it to the receptor region because of the bone malleability, and the excellent postoperative recovery (Rosa JCM 2008).

The bone and periosteal cells of the maxillary tuberosity behave as osteoprogenitor cells (Cicconetti A 2007). Knowing that the vascularization


Fig. 15


Fig. 16


Fig. 17

pattern is vital for bone grafting success, the trabecular nature of grafts harvested from the maxillary tuberosity means that such grafts have high revascularization capacity and release growth factors to the receptor site Hence, these grafts need to be transported rapidly, so that their fundamental properties are not lost (Prolo & Rodrigo 1985, Goldberg &.Stevenson 1987).

With the aim of shorter time required for bone-implant integration, it needs to be emphasized that spongy bone presents greater vascularization and cellularization and is metabolically more active, thus favoring the initial osseointegration processes.

Stabilization of the bone graft in the receptor site is fundamental for avoiding micromovement and facilitates the graft neovascularization process. Graft revitalization and incorporation success depend on close contact between the graft and the host's vascular bed (Burchardt H 1983/1987, Abrektsson T 1980/1980, Gordh & Alberius 1999).

With the passage of time and with appropriate mechanical stimulation, the mechanical resistance of the grafted area will tend to increase. Early low-intensity stimulation increases the local blood flow and contact osteogenesis (Burchardt & Enneking 1978, Abrektsson T 1980/1980).

The use of a connective-bone sliver harvested from the maxillary tuberosity was indicated for restoration of the socket anatomy and compaction of the bone marrow established an improvement in bone density.

The technique of immediate loading of implants following tooth extraction, associated with grafting of a connective-bone sliver harvested from the maxillary tuberosity promoted acceleration of bone repair for the implant and graft and minimized the number of surgical procedures. The connective-bone sliver not only restored the lost vestibular bone plate but also impeded cell competition between the hard and soft tissues, thereby promoting effective bone and gingival healing.


Fig. 18

Immediate loading of implants following tooth extraction, associated with grafting of a connective-bone sliver avoids the need to subject the patient to several surgical procedures, such as bone grafting, gingival tissue grafting, implant insertion, surgery to reopen the implant and conditioning stages for the soft tissue surrounding the implant. This also avoids esthetic impairment through performing these procedures.

This technique promoted acceleration of the bone repair around the implant and in the graft, thereby providing effective connective-bone healing in a single procedure.

_Conclusion

The connective-bone sliver graft from the maxillary tuberosity was indicated for recovery of the vestibular bone cortex of the damaged fresh socket and covering of the exposed spirals of the implant, and it increased the thickness and quality of the gingiva. In combination with coronal repositioning of a gingival flap, correction of the gingival recession was enabled.

The connective-bone sliver graft from the maxillary tuberosity impeded cell competition between the hard and soft tissues, thereby promoting effective bone and gingival healing.

Immediate loading of the implant in the damaged fresh socket associated with a connective-bone sliver graft from the maxillary tuberosity enabled dentoalveolar restoration in a single procedure. Although the technique requires long-term follow-up, the result obtained was satisfactory and promising._

The Literature list can be requested from the editorial office.

_contact implants

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