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Immediate Dentoalveolar Restoration

– Immediate loading of implant in damaged fresh extraction socket with gingival architecture involvement, using bone sliver graft from maxillary tuberosity: a clinical case.

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Abstract

Background:
Immediate loading of implants in undamaged sockets following tooth extraction is very well established in the literature. In cases of tooth loss with socket structure loss, the esthetic risk increases, thus contraindicating immediate loading, such that the bone graft procedure needs to be prior to implant insertion. This paper describes an immediate loading procedure in a damaged fresh socket in the region of an upper central incisor that presented unevenness of gingival contour.

Methods:
The implant was inserted immediately after the removal of the tooth. The socket defect was repaired using a graft consisting of a bone sliver from the maxillary tuberosity, and an immediate single-unit prosthesis was installed above the implant. The criteria that enabled success in this clinical case were: (1) adequate positioning of the implant, taking the gingival level of the neighboring teeth as a reference; (2) adaptation of the bone sliver to the vestibular defect of the socket, as far as the level of the implant platform; and (3) adjustment of the emergence profile of the provisional crown, to provide space for the soft tissue to be accommodated.

Results:
This procedure promoted (1) osseointegration of the implant; (2) restoration of the bone architecture and improvement of the contour of the gingival margin, and (3) esthetic restoration in a single surgical stage, without the need for a flap.

Conclusions:
The authors believe that the characteristics of graft harvested from the maxillary tuberosity and the use of early low-intensity stimulation favor reconstruction of the
damaged fresh socket, thereby accelerating the healing process and osseointegration and enabling immediate loading. The positioning of the bone sliver as far as the level of the implant platform, thus promoting formation of a vestibular bone plate of adequate height and thickness, the platform switching and the emergence profile of the prosthesis were the essential factors enabling stabilization of the gingival margin.

Introduction

In the initial study on tooth implants by Brånemark et al, they observed that, for osseointegration to occur, a period of healing with the implant totally submerged would be needed. Thus, premature loading would be avoided and two surgical stages would be needed before inserting the prosthesis. This principle for promoting osseointegration subsequently underwent significant changes with the emergence of a scientific basis for inserting implants with immediate loading.

Several authors have now achieved success rates greater than 90% for implants with immediate loading following tooth extraction. Maintenance of bone and gingival architecture, immediate esthetic restoration, excellent postoperative recovery, lack of need for flaps or sutures and shorter duration of the treatment are the factors that have enshrined the immediate loading technique.

It has been shown that certain forces are important for triggering a series of biological reactions that accelerate the bone repair process, thus encouraging implantation in a single surgical stage.

Local infections associated with periodontal diseases, endodontic lesions, fractures or root reabsorption are capable of directly reducing the quantity and quality of the soft and hard tissues at potential or adjacent sites. When such infections are present, they require prior treatment. The socket walls may be involved, with or without associated gingival recession, and surgical techniques may be required to restore their anatomy, thereby contraindicating implants with immediate loading.

It has been suggested that bone-reconstructive methods (guide tissue regeneration and grafting materials) should be applied in conjunction with immediate implant placement in order to ensure bone formation in peri-implant bone defects. In case of damaged sockets, however, the possibility for its reconstruction by grafting and immediate restoration in a single operation would preserve patients from several surgical procedures, such as bone and/or gingival grafting, uncovering surgery and peri-implant soft tissue conditioning. Furthermore, the esthetic risk related to the mentioned procedures could be skipped.

The aim of this paper is to report on treatment for dentoalveolar damage in the region of an upper central incisor, with unevenness of the contour of the gingival margin, by means of an implant, bone graft and immediate loading following tooth extraction, thereby enabling immediate dentoalveolar restoration and gingival leveling in a single procedure.

Clinical case report

The patient was a 52-year-old man with high esthetic expectations whose main complaint was esthetic impairment in the region of the upper right central incisor and painful symptoms.

Clinical examination showed the following characteristics: triangular-shaped crown, tooth mobility, vestibular bone loss presenting a probing depth of 7 mm,
gingival recession of around 2 mm and thin gingival biotype, with the presence of a narrow band of keratinized mucosa and absence of fistula. (Fig. 1)

Radiographic examination showed the following characteristics: endodontic treatment problems, cast metal core, metal-free crown, bone height above the root apex of around 5 mm, thickening of the hard layer and reabsorption of the mesial bone crest suggestive of an endoperiodontal lesion. The donor area on the maxillary tuberosity presented good bone availability. (Fig. 2)

The treatment proposed consisted of extraction of the compromised tooth, curettage of the socket, immediate insertion of an implant, construction of a provisional crown and correction of the socket defect by bone graft harvested from the maxillary tuberosity, with the aim of achieving the immediate dentoalveolar restoration and leveling of the gingival contour in a single procedure.

Firstly, a modeling procedure was performed to construct an acrylic resin facet using the gingival margin of the homologous tooth as the reference.

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 pill 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.

Sequence of procedures:

- 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;
- Incision in the sulcus, using a microblade (69 WS, Swann-Morton®, England), around the tooth that was to be extracted;
- 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; (Fig. 3)
- Careful curettage of the socket, to remove the granulation tissue;
- Insertion of a NobelReplace™ Tapered TiUnite® (Nobel Biocare™, Göteborg, Sweden) implant, of dimensions 16.0 X 5.0 mm, with 50 N of initial 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
Fig. 3: Non-traumatic tooth extraction and clinical evaluation of the extent of bone loss in the apical and mesiodistal directions.

Fig. 4: Installation of the implant, 1 mm from the vestibular gingival margin, and evaluation of the quantity of bone material needed for grafting.
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 3.5, 4.3 and 5.0 conical-shaped drill bits. The implant was inserted such that the ideal apical-coronal positioning was sought, independent of the local gingival contour. The implant platform was at a distance of 1 mm from the local vestibular gingival margin, since the gingival contour of the homologous tooth was taken as the reference. After insertion of the implant, the vestibular spirals were exposed in the socket defect region; (Fig. 4)

- Apical-coronal (measured from the most apical bone level to the implant platform) and mesio-distal socket bone defect assessment to know the anatomical shape of the defect;

- Insertion of a temporary titanium abutment, with the cervical portion narrower than the diameter of the implant platform (platform switching), adjustment of the occlusion and opacification of the metallic component by using photopolymerizable opaque resin (Amelogen® Plus OW, Ultradent Products, Inc, USA);

- Construction of a provisional crown using facets that were prepared earlier using photopolymerizable resin. The ideal emergence profile was established on the provisional prosthesis, with free space to allow for accommodation of the soft tissues and promote a thicker and more stable margin of gingival tissue on the implant, and also to promote improvement of the gingival contour; (Fig. 5)

Fig. 5: Installation of temporary titanium abutment, with the cervical portion narrower than the diameter of the implant; facet test piece made of photopolymerizable resin; and construction of the provisional crown prior to the grafting procedure.
Fig. 6: Removal of a bone sliver from the maxillary tuberosity.

Fig. 7: Manipulation of the bone sliver, with the aim of achieving the anatomical shape of the vestibular defect.

- Temporary of the provisional crown insertion for adjustment of the occlusion avoiding centric and eccentric loading and clinical confirmation of its adaptation, considering that the implant platform was at a distance of 1 mm from the gingival margin;

- Removal of the provisional restoration for finishing and polishing, and to perform the stage of reconstruction of the socket bone defects;

- Infiltrative anesthesia in the donor area by means of 2% mepivacaine, with norepinephrine, into the base of the vestibule and into the palatine portion of the maxillary tuberosity;

- Crestal incision at the center of the edge of the maxillary tuberosity, as far as the distal face of the last molar. Deepening of the incision until scratching the bone tissue, along the whole length of the incision. There was no need for a relaxing incision, because of the size of the access area available;

- Selection of an appropriate chisel, to harvest the graft material according to the shape of the region to be reconstructed and the ease of access to the donor region. The width of the chisel used should be 2 mm greater than the width of the bone defect;

- Careful harvesting of the bone sliver; (Fig. 6)

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

- Manipulation of the bone graft to reproduce the shape of the socket defect; (Fig. 7)

- Careful adaptation of the bone sliver, as far as the level
Fig. 8: Insertion of the bone sliver, with the cortex on the vestibular side, as far as the level of the implant platform.

Compaction of the bone marrow that was taken from the maxillary tuberosity, between the internal portion of the bone sliver and the vestibular surface of the implant, to ensure the final stabilization of the graft; (Fig. 9)

- Insertion of the provisional crown on top of the implant; (Fig. 10)
- 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);
- Suturing in the donor region, using simple stitches.

Fig. 9: Final stabilization of the bone sliver by means of filling with medullary bone tissue between the vestibular surface of the implant and the internal portion of the bone sliver.
It is always appropriate to perform the insertion of the implant followed by construction of the provisional crown and only to perform the bone grafting after concluding this stage. This avoids the risk of graft contamination through handling of the materials for constructing the provisional crown.

It is advisable to perform the suturing of the donor region after performing the grafting and installing the provisional crown. This has the aim of achieving faster handling and lower exposure of the graft, in order to keep the cells alive.

The patient was required to avoid any loading on the treated region and to make topical application of 0.12% chlorhexidine, three times a day for seven days. Clinical monitoring was undertaken every two days for the first two weeks and every fifteen days for the next four months.

After seven days, the soft tissue had migrated in the incisal direction by approximately 1.5 mm, thus leveling the gingival contour with that of the homologous tooth. (Fig. 11)

After sixty-five days a clinical evaluation was realized (Fig. 12) and after three months of osseointegration and maturation of the tissues, molding to transfer the personalized emergence profile was performed.

The abutment made of Procera® zirconia, with its cervical portion narrower than the diameter of the implant (platform switching), was inserted with torque of 20N. A new provisional crown was constructed, in order to reproduce the emergence profile, and radiographic confirmation of the adaptation was obtained. (Fig. 13)

A coping made of Procera® alumina was constructed for personalized porcelain application. After testing the porcelain and performing esthetic and functional
adjustments, the crown was fixed with adhesive cement (Multilink®, Ivoclar Vivadent, Liechtenstein). The esthetic success was judged in terms of the re-establishment of bone and gingival architecture, the Procera® abutment, the metal-free porcelain and the anatomical shape of the tooth.

**Discussion**

Immediate loading following tooth extraction, in cases in which the support tissue is undamaged, is very well established in the literature. Primary stability is the most important factor in indicating that the implant can go into immediate use. This is associated with the quantity and quality of the bone, the geometry of the implant and the surgical technique.5-12

Studies have suggested that immediate loading with platform switching promotes greater stability of the soft and hard tissues surrounding the implant.12

In situations of immediate loading following tooth extraction in an undamaged socket, the implant should be inserted beside the palatine wall of the socket because of the greater bone anchorage, better three-dimensional positioning for spreading the occlusal forces and greater bone availability and quality. This positioning is directly related to the diameter of the implant and the size of the socket opening. The amount of space will define whether filling with particulate bone is needed. Such filling would preferably be autogenous, since this presents the best results with regard to bone healing.9,20-21

The biological changes that occur when an implant is put into use at an early stage are of great importance in bone repair.12 Early low-intensity stimulation increases the local blood flow and the contact osteogenesis, thereby accelerating the process of bone graft repair.23

Implants of conical shape are the ones most indicated for receiving immediate loading. They adapt better to the socket, have a greater contact surface with the bone, increase the initial stability and make it possible to spread the occlusal load better. Conical implants compact the trabecular bone laterally, thereby increasing bone density.6,24-28

Fig. 12: Sixty-five days after the operation, showing maintenance of the leveling of the gingival margin through reestablishment of the biological periodontal distances.
The presence of local infection is an important factor in assessing the esthetic risk of the treatment, and it is directly related to the quantity of bone and the gingival phenotype. The highest esthetic risk is associated with acute infection with suppuration and local edema. This requires effective therapy to control it, and it may result in an additional loss of esthetically important periodontal tissue due to possible contraction of this tissue. To minimize the risk of esthetic complications, local infection should be treated before insertion of the implant, regardless of whether the infection is chronic or acute. 15-18

In the case of tooth loss together with damage to the integrity of the socket, the esthetic risk increases. This contraindicates implants with immediate loading and, in such cases, the bone grafting procedure is needed in order to restore the anatomy of the socket edge, before inserting the implant. 29

The morphology of damaged sockets immediately after tooth extraction generally presents greater involvement of the vestibular cortical bone, because of its smaller thickness and lower vascularization and because it is subject to occlusal forces. Since the vestibular wall of the socket is fragile, total loss of this cortical bone can often be seen, without involvement of the other walls.

The maxillary tuberosity is an excellent choice of donor area for small reconstructions. It has a limited quantity of bone material available for grafting and presents low bone density and difficulty of surgical access. On the other hand, it has the advantages of excellent postoperative recovery and ease of harvesting the graft material and adapting it in the receptor region because of its bone malleability.

One study has indicated that the maxillary and mandibular periosteum and the maxillary bone marrow may effectively serve as reliable and easy-to-harvest intraoral sources of osteoprogenitor cells.30

It is known that the vascularization pattern is vital for bone grafting success. Because of the trabecular nature of grafts coming from the maxillary tuberosity, they have a high capacity for revascularization and release of growth factors to the receptor site. Thus, they need to be manipulated quickly, such that the graft is exposed for as little time as possible, in order to keep the cells alive. 31-32

Fig. 13: After five months, clinical and radiographic evaluations on the zircon abutment, with the cervical portion narrower than the diameters of the implant and temporary prosthesis.
Cell survival in the graft is related to the efficiency of the surgical technique and the time taken to transfer the graft to the receptor area.\(^{33}\)

Stabilization and close contact between the bone graft and the receptor site facilitates the revascularization process and favors early incorporation of the graft into the host’s vascular bed.\(^{33-37}\)

Immediately after implant insertion and dentoalveolar restoration, coagulum and a fibrin network form and fill the remaining spaces between the implant and the grafted bone. With the passage of time and with appropriate mechanical stimulation, the resistance of the grafted area will tend to increase.\(^{23,36-37}\)

After a four-month period of osseointegration, it was observed that the vestibular bone wall had thickened due to palatine anchoring of the implant and the grafting of the bone sliver. Consequent to the greater thickness of the vestibular bone crest, associated with an adequate emergence profile for the prosthetic crown, a greater volume of soft tissue was obtained, thus providing better and more stable gingival margin contour.

**Conclusions**

- Graft harvested from the maxillary tuberosity promoted reconstruction of fresh damaged sockets and prevented cell competition between the hard and soft tissue, thus making immediate restoration implant possible.

- The positioning of the bone sliver as far as the level of the implant platform, thus promoting formation of a vestibular bone plate of adequate height and thickness, the platform switching and the emergence profile of the prosthesis were the essential factors enabling stabilization of the gingival margin.

- Primary stability of the implant and graft was fundamental to the success of this procedure.

- We believe that the characteristics of graft harvested from the maxillary tuberosity and the use of early low-intensity stimulation favor reconstruction of damaged fresh socket enabling immediate dentoalveolar

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restoration. Although the technique requires long-term follow-up, the result obtained so far have been satisfactory and promising.

References


