ORAL & IMPLANTOLOGY

case report

# COMBINING ORTHODONTIC EXTRUSION AND GUIDED BONE REGENERATION (GBR) FOR BONE AUGMENTATION AND IMPLANT PLACEMENT IN THE AESTHETIC ZONE: TECHNICAL ISSUES AND CASE REPORT

M. CABERLOTTO[1], M. GOBBO[2], E. BETTIO[3], C. SOLDINI[4], P. GHENSI[5]

[1] *IDIS (Institute for Dental & Implant Studies); Department of Neurosciences, University of Padua, Padua, Italy*
[2] *Department of Medicine, Surgery and Health Sciences, University of Trieste, Trieste, Italy*
[3] *Department of Neurosciences, University of Padua, Padua, Italy*
[4] *CLC Scientific, Vicenza, Italy; IDIS (Institute for Dental & Implant Studies); Department of Neurosciences, University of Padua, Padua, Italy*
[5] *Centre for Integrative Biology (CIBIO), University of Trento, Trento, Italy; IDIS (Institute for Dental & Implant Studies); Department of Neurosciences, University of Padua, Padua, Italy*

**SUMMARY**
Orthodontic extrusion is a non-surgical technique used to vertically augment bone ridges by extruding impaired teeth and then replacing them with dental implants. Both the volume of bone and the height of the gingiva are increased by means of this intervention, affording considerable benefits when aesthetic zones are being treated. Orthodontic extrusion can be combined with bone regeneration methods, and this is particularly useful in cases of vertical and horizontal bone loss. Guided bone regeneration (GBR) involves the use of a barrier membrane to keep a space free for a blood clot to form, while keeping epithelial cells and connective tissue fibroblasts at bay, thus promoting the generation of new bone tissue. The present case report describes a challenging aesthetic rehabilitation performed in a 50-year-old woman suffering from severe external resorption of the left superior second incisor. A multidisciplinary approach was adopted, achieving good functional and aesthetic results.

**Key words:** GBR, bone augmentation, orthodontic extrusion, implant, aesthetic.

## Introduction

Clinicians faced with the aesthetic rehabilitation of the anterior maxillary region have a very difficult task. The loss of vertical bone and attachment caused by periodontitis is bound to negatively affect the functional and aesthetic results achievable with dental treatments (1-4). When the resulting bony defects around the teeth become severe, extraction ultimately becomes unavoidable (5). The etiology of bone and attachment loss is sometimes mediated by periodontal disease induced by external root resorption, and the morphology of the residual bone may interfere with the most appropriate positioning of dental implants, impairing the success rates of such prosthetic solutions. Several tissue reconstruction approaches can be adopted to deal with this problem, however (6). Horizontal ridge augmentation generally produces reliable, predictable results, but vertical ridge augmentation

is not so easy to achieve (5, 7, 8). Guided forced orthodontic extrusion is a conservative technique that makes use of teeth that cannot be saved to raise the residual bone in the vertical sense before inserting a dental implant (9). One of the most important benefits achievable by this means is a better aesthetic result because both the bone and gingival level can be modified (10, 11). Adjunctive approaches may be needed, however, in patients with both vertical and horizontal bone loss. A tried and tested technique widely used in such cases is guided bone regeneration (GBR), the aim of which is to increase the volume of bone by using barrier membranes to keep the space free for a blood clot to form, with or without the aid of a scaffold of biomaterial (12). The membrane prevents the site of bone regeneration from being infiltrated by unwanted epithelial cells and connective tissue fibroblasts and facilitates an oriented bone formation (13, 14). The aim of this case report is to describe a challenging aesthetic rehabilitation performed in an adult woman suffering from severe external resorption of the left superior second incisor. A multidisciplinary approach based on orthodontic extrusion and successive guided bone regeneration (GBR) was adopted, permitting to achieve a good functional and aesthetic result.

## Case report

A 50-year-old Caucasian woman presented to Periodontist's attention (M.C.) complaining of a dull pain in her left upper front jaw. Dental X-ray and CBCT revealed morphological changes involving the root of a non-vital left superior second incisor (Figure 1). Root canal treatment had been performed many years previously and was incongruous and the tooth had been reconstructed with a ceramic crown and a fiber post (Figure 2). Clinically, the gingiva was erythematous and slightly swollen and pain was moderate

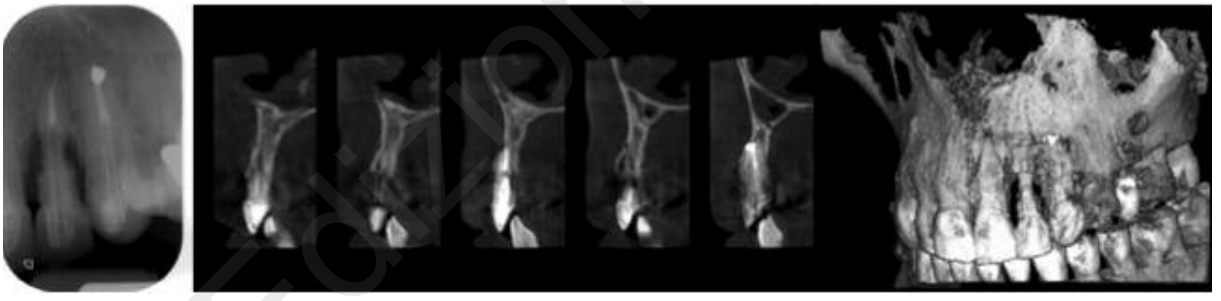

**Figure 1**
X-ray and CBCT showing root morphological changes.

**Figure 2**
Clinical frontal view.

and intensified on palpation and vertical percussion. Probing revealed circumferential pockets and some purulent exudate emerged on manual squeezing of the apical gingiva around the tooth. External cervical resorption and periodontal abscess were diagnosed. The prognosis was judged to be poor due to significant vertical bone loss around the tooth, making its extraction mandatory. As some form of bone augmentation was necessary, orthodontic extrusion was planned for the purpose of vertical bone gain, to be followed by the placement of a dental implant associated with a bone regeneration procedure to increase its volume horizontally. Dental impressions were obtained to ensure a correct orthodontic procedure, and orthodontic treatment was begun in April 2014. The teeth from the right superior canine to the left superior canine were ligated with a stainless steel arch wire to anchor a segmented NiTi arch wire attached to the left superior second incisor (Figure 3). Ten days later, at a scheduled follow-up, there was evidence of an excessive extrusion of the incisor. Clinical examination and X-ray revealed a root fracture in the terminal portion of the fiber post (Figure 4). With the patient's written informed consent, the coronal fragment of the tooth was removed under local anesthesia and, at the same time, an intracanal pin was inserted and ligated to a spring to provide sufficient anchorage for the orthodontic extrusion and consequent vertical bone gain around the incisor (Figure 5). For aesthetic reasons, a Maryland bridge was attached to the adjacent teeth and adapted so as to enclose the activated spring (Figure 6).
For the next two months, the patient returned fortnightly for adjustments to the extrusion force of the spring, and to reduce the extruding root as necessary to enable the correct positioning of the Maryland bridge (Figure 7).
By the end of July 2014, the extrusion was complete and placement of the dental implant was scheduled for October 2014. Under local anesthesia, the residual root of the incisor was extracted and a 3.5x12 mm implant (CLC Conic, CLC Sci-

**Figure 4**
X-ray showing a root fracture.

**Figure 3**
A stainless steel arch wire anchored to a segmented NiTi arch wire.

**Figure 5**
Insertion of an intracanal pin and ligation to spring.

**Figure 6**
Clinical view of Maryland bridge.

**Figure 7**
Clinical view of ongoing extrusion.

entific, Vicenza, Italy) was inserted (Figure 8). A GBR procedure was implemented, placing Bio-Oss (Bio-Oss, Geistlich Pharma, Wolhausen, Switzerland) around the implant site, and the surgical site was covered with a resorbable collagen membrane (*Biomet 3i, Palm Beach* Gardens, Florida, USA), fixed in place with pins (Figure 9). Antibiotics (Augmentin, GlaxoSmithKline, Verona, Italy) and anti-inflammatory agents (Brufen 600, Abbott Labora-

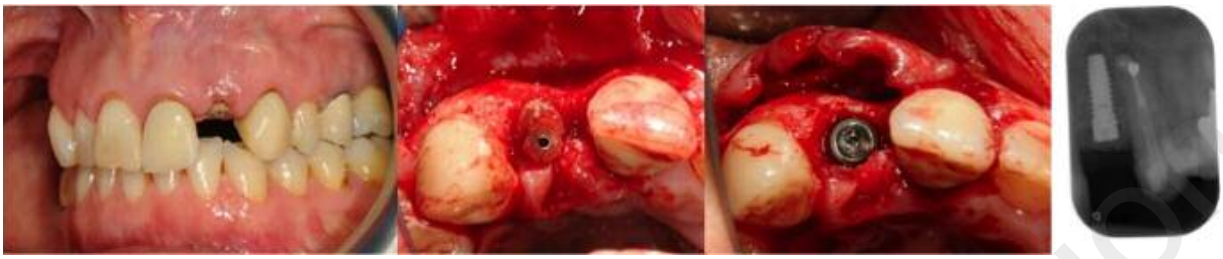

**Figure 8**
Extraction and implant placement.

**Figure 9**
GBR with Bio-oss and a resorbable collagen membrane.

tories) were prescribed. The patient reported unusual bleeding a few days after the implant's placement, and tranexamic acid once a day was recommended.

At second-stage surgery in March 2015 a connective tissue graft was obtained from the hard palate to improve the periodontal tissue biotype. A provisional abutment was inserted during the same session, and a temporary crown was fashioned, then a resorbable suture was performed (Figure 10). The patient was instructed to apply 1% chlorhexidine gel (Dentosan, Pfizer Consumer Healthcare, Rome, Italy) to the gingiva around the incisor. The palatal stitches were removed a week later, and buccal stitches after a further week. The patient was followed up once a month to gradually augment the temporary crown in order to achieve an optimal gingival profile (Figure 11). After six months of healing and soft tissue stabilization, final impressions were taken, and a zirconia-ceramic crown was directly screwn onto the implant. Two years later soft tissue contours showed no significant changes and radiographic examination highlighted mantained bone levels around implant platform (Figure 12).

**Figure 10**
Soft tissue augmentation and insertion of a provisional crown.

**Figure 11**
Clinical view of provisional crown.

**Figure 12**
X-ray and clinical frontal view at 2-year follow-up.

## Discussion

Replacing a lost tooth with a dental implant in the aesthetic zone is by no means easy. Clinicians generally need to combine several methods that often demand both surgical and prosthetic expertise with a view to repairing and preserving the bone and soft tissue (1-4). In the case described here, the patient did not expect to be told that her tooth could not be saved. It is common, in fact, for external resorptions to go unnoticed until the patient has a routine check-up, or until the situation deteriorates (15). The structure of the tooth is gradually destroyed by the resorption process, and replaced by highly vascular tissue (16). In our patient, the soft tissue probably developed along a subclinical root fracture near the tip of the fiber post, and the fibrovascular tissue was probably the only area where the coronal and apical portions of the root were still attached. This would explain the onset of the periodontal abscess for a start, and also why the two portions of the root became separated a week after starting the extrusion procedure. Numerous methods have been suggested for the conservative treatment of external resorption, but it was so extensive and apical in our patient that it was impossible to save the tooth. The vertical and horizontal bone loss was also too severe for it to be amenable to periodontal therapy, so extraction of the incisor was unavoidable.
Extracting the tooth posed two main problems: a tooth was lost in the aesthetic area; and an implant placement with a chance of success was unfeasible – vertical and horizontal bone augmentation was needed to obtain a predictable result. Vertical defects can be treated with simultaneous and staged GBR, bone block grafts, and distraction osteogenesis (7, 17). The forced orthodontic extrusion of teeth that cannot be saved is a more conservative method for increasing the residual bone volume at the site of a future implant (18). The process of guided extrusion by exerting a controlled tensile stress has the effect of stretching the fibers of the periodontal ligament, thereby prompting new bone formation (19, 20). In addition to increasing the volume of bone available, this method also induces a simultaneous movement of free gingiva (about 90% of the dental displacement) and attached

gingiva (about 80% of the dental displacement), shifting the free gingiva and interdental papillae coronally, while leaving the level of the mucogingival junction unchanged (21). Orthodontic extrusion has several advantages: it is a conservative, non-surgical procedure, painless for the patient, less invasive than the above-described alternatives, and relatively quick (though patients must be seen frequently for adjustments to reactivate the system and facilitate the tooth's displacement).

## Conflicts of interest

Dr Claudio Soldini declares a conflict or interest with the implant brand used in this case report as co-owner for the company CLC Scientific.
All the other Authors declare no conflict of interest.

## References


1. Solakoglu O, Cooper LF. Immediate implant placement and restoration in the anterior maxilla: a tissuerelated approach. Observations at 12 months after loading. Int J Periodontics Restorative Dent. 2006 Dec;26(6):571-9.
2. Scala R, Ghensi P, Cucchi A, Pistoia E. Postextraction implant placement with immediate provisionalisation and finalisation, using a simplified technique: technical notes and a case report. Open Dent J. 2012;6:164-9.
3. Malchiodi L, Cucchi A, Ghensi P, Nocini PF. Evaluation of the esthetic results of 64 nonfunctional immediately loaded postextraction implants in the maxilla: correlation between interproximal alveolar crest and soft tissues at 3 years of follow-up. Clin Implant Dent Relat Res. 2013 Feb;15(1):130-42.
4. Malchiodi L, Ghensi P, Cucchi A, Bondì V. One-stage surgical approach to rehabilitate severely injured anterior teeth in a young woman. J Craniofac Surg. 2010 Jul;21(4):1184-8.
5. McAllister BS, Haghighat K. Bone augmentation techniques. J Periodontol. 2007 Mar;78(3):377-96. Review.
6. de Molon RS, de Avila ED, de Souza JA, Nogueira AV, Cirelli CC, Margonar R, Cirelli JA. Forced orthodontic eruption for augmentation of soft and hard tissue prior to implant placement. Contemp Clin Dent. 2013 Apr;4(2):243-7.
7. Cucchi A, Ghensi P. Vertical Guided Bone Regeneration using Titanium-reinforced d-PTFE Membrane and Prehydrated Corticocancellous Bone Graft. Open Dent J. 2014 Nov 14;8:194-200.
8. Ghensi P, Stablum W, Bettio E, Soldini MC, Tripi TR, Soldini C. Management of the exposure of a dense PTFE (d-PTFE) membrane in guided bone regeneration (GBR): a case report. Oral Implantol (Rome). 2017 Nov 30;10(3):335-342.
9. Korayem M, Flores-Mir C, Nassar U, Olfert K. Implant site development by orthodontic extrusion. A systematic review. Angle Orthod. 2008 Jul;78(4):752-60.
10. Lin CD, Chang SS, Liou CS, Dong DR, Fu E. Management of interdental papillae loss with forced eruption, immediate implantation, and root-form pontic. J Periodontol. 2006 Jan;77(1):135-41.
11. Brindis MA, Block MS. Orthodontic tooth extrusion to enhance soft tissue implant esthetics. J Oral Maxillofac Surg. 2009 Nov;67(11 Suppl):49-59.
12. Hämmerle CH, Karring T. Guided bone regeneration at oral implant sites. Periodontol 2000. 1998 Jun;17:151-75. Review.
13. Mangano FG, Zecca P, Luongo F, Iezzi G, Mangano C. Single-tooth morse taper connection implant placed in grafted site of the anterior maxilla: clinical and radiographic evaluation. Case Rep Dent. 2014;2014:183872.
14. Dahlin C, Linde A, Gottlow J, Nyman S. Healing of bone defects by guided tissue regeneration. Plast Reconstr Surg. 1988 May;81(5):672-6.
15. Heithersay GS. Management of tooth resorption. Aust Dent J. 2007 Mar;52(1 Suppl):S105-21.
16. Kandalgaonkar SD, Gharat LA, Tupsakhare SD, Gabhane MH. Invasive cervical resorption: a review. J Int Oral Health. 2013;5(6):124-30.
17. Milinkovic I, Cordaro L. Are there specific indications for the different alveolar bone augmentation procedures for implant placement? A systematic review. Int J Oral Maxillofac Surg. 2014 May;43(5):606-25.
18. Salama H, Salama M. The role of orthodontic extrusive remodeling in the enhancement of soft and hard tissue profiles prior to implant placement: a systematic approach to the management of extraction site defects. Int J Periodontics Restorative Dent. 1993 Aug;13(4):312-33.
19. Reitan K. Clinical and histologic observations on tooth movement during and after orthodontic treatment. Am J Orthod. 1967 Oct;53(10):721-45.
20. Reitan K. Tissue behavior during orthodontic tooth movement. Am J Orthod. 1960;46:881-900.
21. Kajiyama K, Murakami T, Yokota S. Gingival reactions after experimentally induced extrusion of the upper incisors in monkeys. Am J Orthod Dentofacial Orthop. 1993 Jul;104(1):36-47.