Implant therapy of edentulous sites

Authors: Balint Török, Istvan Gera, Agnes Meszaros & Peter Windisch, Hungary

Deep periodontal defects with advanced bone loss of the buccal cortical plate represent a challenge for periodontal treatment in the upper front region. Literature data suggest that one and two-wall periodontal defects do not have tendency for complete periodontal regeneration and bone fill (Eickholz et al. 1996, 1998, 2000). Remaining residual pockets can also jeopardize the long term result of periodontal treatment (Matuliene et al. 2008). Tooth extraction in the upper front region even without any periodontal defect will result in certain amount of oro-vestibular and eventually vertical shrinkage of the original soft tissue contour (Schropp et al. 2003). Due to bone remodelling appropriate implant placement cannot be achieved in most of the cases. Socket preservation and different alveolar site developments are used to offset this unfavourable feature (Camargo & Lekovic, 2004; Lekovic & Kenney, 1997). It is obvious that the application of one of these techniques can be of great importance when tooth extraction is being considered at periodontally compromised teeth with advanced buccal plate involvement. It is not clear that ridge preservation procedures are effective in limiting horizontal and vertical ridge alterations in postextraction sites. Comparing the clinical and histological results obtained by different preservation techniques there is no literature data to support the superiority of one technique over another (Darby et al., 2009). Nevertheless each preservation technique provided better results than natural socket wound healing (Barone et al. 2008). The effect of extraction site development on the changes of attachment level of neighbouring teeth has not been clarified yet.

While supraalveolar periodontal regeneration is still unpredictable (Sculean et al., 2004) vertical ridge augmentation has been successfully demonstrated in several publications (Barboza EP., 1999; Urban et Jovanovic, 2009; Merli & Lombardini, 2010; Beitlitum et al., 2010). Treatment of vertical ridge deficiencies has been performed in edentulous areas without neighbouring teeth demonstrating advanced periodontitis. It was suggested that natural teeth with advanced periodontitis, may impose a risk for an infection of the augmented site and of membrane exposure originating from the neighbouring periodontally compromised teeth (Karoussis et al., 2003; Hoffmann et al., 2007). Nevertheless in certain clinical situations, teeth presenting deep intrabony defects are located in close vicinity of the compromised alveolar ridge.

In these particular cases, it is of clinical interest to simultaneously reconstruct both the intrabony periodontal defect and the resorbed alveolar ridge, thus allowing proper insertion of dental implants. For those implant patients having a history of chronic periodontitis it is inevitably important to reduce periodontal pockets at natural teeth to 3 mm and even below to facilitate proper individual plaque control and to reduce the chance of periodontal reinfection (Carnevale et al., 2007). The importance of proper implant positioning
and adequate amount and quality of periimplant hard and soft tissues have to be considered to maintain long term stability around implants. Therefore, the aim of the present cases was to evaluate the effect of a new step-by-step surgical technique designed to simultaneously reconstruct resorbed alveolar ridge and the adja-
cently located intrabony defect to achieve a pre-
dictable clinical outcome and adequate peri-implant
tissue stability.

_Materials and methods_

Three patients exhibiting chronic periodontitis with localized advanced periodontal bone loss were referred to the Department of Periodontology, Sem-
melweis University, Budapest, for comprehensive pe-
riodontal therapy. All three patients were middle aged Caucasian males (51, 50 and 49 years-old), systemi-
cally healthy and had never been smokers. Each pa-
tient presented at least one deep advanced periodon-
tal bony defect in the upper front region. After initial
therapy teeth were considered to be hopeless because of their disadvantageous pathomorphology. Before tooth extraction each patient had completed basic
cause related periodontal therapy including full
mouth scaling and root planning and oral hygiene
training. Before surgery all exhibited high standards of
oral hygiene. Treatment plan consisted of tooth
removal followed by extraction site development
(Surgery 1), and soft tissue augmentation (Surgery 2),
and implant placement with simultaneous ridge aug-
mentation (Surgery 3) and abutment connection with
non resorbable membrane removal (Surgery 4). The
following parameters were measured at baseline, im-
mmediately before augmentation procedure and 11–20
months after implant placement: plaque index (PI),
gingival index (GI), bleeding on probing (BOP), probing
depths (PD) around the neighbouring teeth at 6 sites,
gingival recession (GR), clinical attachment level (CAL)
with a millimetre calibrated periodontal probe (PCP-
UNC 15, Hu-Friedy, Chicago, IL, USA) and also intra-
surgical direct measurements: the level of periodontal
bone of neighbouring teeth, the width and height of the
alveolar ridge. Standardized radiographs were
taken with the long cone parallel technique preopera-
tively, between surgeries and postoperatively; for
qualitative assessment of bone height.

_The combined surgical technique_

_Surgery 1
Tooth extraction with extraction site development_

Following tooth removal a full thickness flap was
raised up to the mucogingival line and beyond a par-
tial thickness flap was mobilised with a horizontal ex-
tension thus allowing a tension free soft tissue man-
gagement and wound closure. This flap design let the
operator to evaluate and treat the periodontal defects
around the neighbouring teeth. A combined alveolar
site preservation technique was used with a slow re-
sorbable membrane (Resolut Adapt LT 2530, Gore-
Tex®, Newark, DE, USA) fixed with titanium pins (Ti-
pins; DENTSPLY Friadent, Mannheim, Germany) to
cover the missing part of the buccal plate and to main-
tain the original form of the earlier arch. Following an
appropriate-sized connective tissue graft was re-
moved from the palatal mucosa by using the Hürzeler
technique (Hürzeler & Weng, 1999). The harvested tis-
sue was trimmed and sutured (5.0 non-absorbable
polyamide monofilament, Braun AG, Tuttingen, Ger-
many) to the inner surface of the partial thickness mu-
case report _edentulous sites

Fig. 10. The horizontal dimension of the implant site is already satisfactory but its vertical dimension needs further augmentation.

Fig. 11 & 12. Surgery 2: implantation with simultaneous hard tissue augmentation using a BioOss and titanium membrane.

Fig. 13a–c. Radiological follow up of the augmented site development.

Surgery 1
Cosal flap. Additionally the oral flap at the earlier tooth removal site was covered by a connective tissue graft with an epithelial collar. The periodontal defect and the edentulous ridge were either filled and overfilled vertically and horizontally with BDX (Bio-Oss®, particle size 0.25 to 1.0 mm, Geistlich AG, Wolhusen, Switzerland) (Case 1 and 3) or no bone grafting material was used (Case 2). After grafting, a biodegradable collagen membrane of porcine origin (Bio-Gide®, Geistlich AG, Wolhusen, Switzerland) was trimmed and adapted over the graft (Case 1 and 3). Finally the buccal mucoperiosteal and the oral “CTG reinforced” flaps were re-positioned by avoiding any extra flap mobilizing procedure and closed with vertical mattress sutures (5.0 non-resorbable polyamide monofilament, Braun AG, Tuttingen, Germany).

Surgery 2
Soft tissue augmentation
Following the above mentioned procedures if the width of the keratinized soft tissue allowed proper coverage after augmentation procedure simultaneous augmentation and implant placement was performed. If the thickness and the width of the alveolar mucosa were not sufficient to provide predictable primary wound healing during hard tissue augmentation procedure, soft tissue augmentation was performed prior to implant placement. A free autogenous soft tissue graft or a xenograft (Alloderm®, BioHorizons, Birmingham, AL, USA) was used in order to gain enough keratinized gingiva and deepen the vestibule at the implant area using a modified tunnel technique (Azzi et al. 2009). The tissue harvesting technique has already been described before.

Surgery 3
Implant placement with simultaneous hard tissue augmentation
One implant (Straumann Bone Level, Straumann AG, Waldenburg, Switzerland, and Nobel Replace Tapered Effect, Nobel Biocare, Gothenburg, Sweden) was inserted with simultaneous 3-D hard tissue augmentation using BDX and a non-resorbable membrane (Titanium membrane—FRIOS® Boneshield; DENTSPLY Friadent®, Mannheim, Germany) or a slow resorbable membrane (Resolut Adapt LT 2530, Gore-Tex®, Newark, DE, USA) was fixed over it. A tension free wound closure was achieved in all cases resulting in primary wound healing.

Surgery 4
Abutment connection with non resorbable membrane removal
The same split thickness flap design was applied for non-resorbable membrane removal and abutment connection.

After surgery patients were instructed to take antibiotics (Augmentin, 3 x 625 mg/day for 1 week). Post surgically mechanical plaque control was not performed in the surgical and adjacent area and chemical plaque control was maintained with a 0.2 % chlorhexidine solution twice daily (Corsodyl, GlaxoSmithKline). Sutures were removed at 14 days after surgery. Additional recall appointments including supragingival professional tooth cleaning were scheduled biweekly for the first 6 postoperative weeks. Prior tooth extraction each patient received a resin bond prefabricated bridge to provide immediate provisional prostodontic reconstruction after tooth extraction. Finally all patients received fixed prostodontic restoration i.e. PFM crowns on each implant.

Case 1 (Figs. 1–14)
A 51 years-old male patient was referred with generalized periodontitis for a comprehensive periodontal treatment. At the upper right lateral incisor an ad-
Now possible:

machine preparation of the fully equipped surgical tray
I case report _edentulous sites

36 I implants

Fig. 14a & b. Post treatment view of the final PFM crown in place surrounded by optimal and harmonious soft tissues.

Fig. 15. The tooth 11 has got a deep one-wall bony defect that after extraction would cause tissue collapse influencing also the periodontal status of the neighbouring teeth.

_vanced periodontal defect was registered with tooth mobility III (see the standardised X-ray, Fig. 1a–b). Deep periodontal pocket depths were assessed on the adjacent teeth. After flap elevation a two-wall crater-like defect was found on the mesial aspect of the tooth with a missing buccal bony plate (Fig. 2 & 3). After tooth extraction the previously described step-by-step technique was carried out (Fig. 4–7). As a result of surgery 1, completed with a soft tissue augmentation, the alveolar ridge configuration allowed the implant placement with simultaneous further augmentation (Fig. 8–12). During abutment connection the 3-D reconstruction of alveolar ridge was observed around the previously supracrestally placed implant. This surgical approach allowed a re-entry procedure of adjacent periodontal defects, they presented bone fill and complete regeneration of earlier one-wall defects. After soft tissue healing a screw retained temporary crown was placed in situ to form an ideal emergence profile for further three months. This situation was then transferred to the cast to make the permanent PFM crown. See the final restoration on Fig. 14.

_Case 2 (Figs. 15–17)

A 54 years-old male patient presented an advanced vertical bony defect on the mesial aspect of the right upper central incisor with excessive tooth mobility (Fig. 15). After tooth extraction an alveolar site development was performed in the same way like described before without any bone substitute material. The second surgical phase was the previously described soft tissue augmentation. During surgery 3 implant placement with simultaneous hard tissue augmentation was proceeded by. As an augmentation material BDX was used covered by a slow resorbable membrane. The width and height of the alveolar ridge became sufficient to promote long term stability for the implant borne restoration (Fig. 16a & b, 17).

_Case 3 (Figs. 18–20)

The third case is a 49 years-old male patient who presented the left upper lateral incisor with an advanced horizonto-vertical bony defect on its mesial aspect (Fig. 18). Following tooth extraction an alveolar ridge preservation was performed and implant placement with simultaneous augmentation as described before. The augmentation material was BDX covered by a titanium membrane (Fig. 19). The final soft tissue augmentation was followed by the prosthodontic rehabilitation, a PFM crown was established (Fig. 20).

_Results

After the cause related periodontal therapy the patients developed proper individual oral hygiene measures. Each patients' gingival and plaque index was under 20%, the mean of PI was 7.7%, and 12.7% of GI, respectively. At baseline the mean periodontal PD of the neighbouring teeth was 3.97 mm, GR 0.88 mm and CAL 4.78 mm. After the healing of the 3rd stage the neighbouring teeth’s PD was 2.55, GR 2.13 and CAL 4.58. The clinical parameters showed slight improvement although the number of cases does not offer any statistical analysis. The intrabony component of the adjacent teeth is being eliminated clinically and radiologically and during re-entry. Optimal hard and soft tissue conditions were found around implants.

_Discussion

The long term success of implant therapy depends on the adequate volume of bone around the implant site. The lack of mineralized tissue is an unfavourable condition for a predictable implant therapy (Lekholm et al., 1986). Another key factor for maintaining the alveolar crest level around implant is the quantity and morphology of the covering soft tissues. Implant therapy in the aesthetic zone needs a comprehensive consideration of several contributing factors. In periodontal patients implant placement is even more challenging. Periodontally compromised teeth often show disadvantageous bone loss, especially if the buccal bony plate is missing. For achieving predictable healthy periodontal conditions tooth extraction cannot be avoided. Several techniques and materials have recently been developed for the purpose of extraction socket preservation. There are controversial data in the literature concerning the possible role of bone fillers in alveolar socket preservation. Several different techniques have been described to achieve this goal. There is a substantial ambiguity in the literature regarding the predictability of these kind of techniques. Several
Learn more about a new revolutionary concept in high-performance implantology.
The authors report positive findings on the effect of bone substitutes (Froum et al., 2002). Different animal studies (Araújo & Lindhe, 2009; Fickl et al., 2009) suggest that bone filler materials can to a certain extent retard or modify the resorption of the buccal bone. It is also the matter of discussion whether these grafting materials in the alveolus have an active role in the modulation of alveolar bone formation or they only slow down the vestibular bone resorption (Araújo & Lindhe, 2009). Other studies suggest the utilization of membranes. The biodegradable membranes have recently been increasingly applied because of its incorporation in the host tissues and providing better soft tissue healing. If it is exposed to the oral cavity the healing is less compromised and the risk of infection is low (Lekovic et al., 1997, 1998). Tooth extraction always presents conditions where a complete wound closure is questionable. If the membrane is not able to maintain enough space for regeneration it should be supported with some grafting material (Case 3). Similar ridge configuration was achieved when using bone fillers (see our Case 1) or without any bone substitute (see our Case 2) (Chia- pasco et al., 2006).

The use of non-resorbable membrane became the gold standard for GBR with a need of 3-D reconstruction of the edentulous ridge (Simion et al., 2007). One of the disadvantages of this technique that the gingival flaps should be sutured over the membrane in a way that a primary wound healing without any flap dehiscence could be achieved. Membrane exposure may severely compromise wound healing and also the consecutive regeneration and final treatment outcomes (Hämmerle et al., 1998). The soft tissue coverage is a prerequisite for the management of hard tissue augmentation and for the final aesthetics of the implant borne restoration. The three demonstrated clinical cases showed favourable hard and soft tissue alteration during the third surgery. During this step-wise surgical approach we managed to develop an ideal implant position in all the three dimensions covered by the required amount of hard and soft tissues (Buser et al., 2004). Literature data suggest that survival and success rate of implants partially or fully placed into augmented bone is comparable to implants placed into non-regenerated alveolar ridges (Mayfield et al., 1998; Zitzmann et al., 2001b). The biological mechanism of the alveolar regeneration is not fully investigated and understood and the role of this issue in the healing of neighbouring teeth’s periodontal intrabony defects even needs further examination.

**Conclusion**

This stepwise series of surgical techniques could be successfully applied for correcting severe ridge deficiencies and also can facilitate the comprehensive regenerative therapy of periodontal defects at adjacent teeth.

*Editorial note: A list of references is available from the publisher.*

**Contact**

Dr Peter Windisch  
DMD, PhD Associate professor  
Departement of Periodontology  
Semmelweis University, Budapest  
1088 Budapest, Szentkirályi u 47, Hungary  
Phone/Fax: +36 1 267 4907  
peter.windisch@gmail.com