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# The double split flap: a surgical approach for regenerative treatment of interproximal defects

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### Abstract

**Aims and Background:** Primary wound closure has been advocated to be indispensable for a successful outcome of guided tissue regeneration-procedures. Yet narrow inter-proximal spaces often lack sufficient tissue quantity in order to facilitate a tension free re-adaptation of periodontal flaps. In order to maintain an uneventful healing process, the concept of layer-wise wound closure is applied to periodontal surgery.

Material and Method: This article describes the introduction of a modified flap design, the double split flap.

**Results and Conclusion:** By preparation of a second, internal flap and a wound in a layer-wise fashion, it is assumed that primary healing will be more predictable to achieve.

# Case Report

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The ultimate goal of regenerative periodontal therapy is to completely restore lost periodontal attachment. Ideally this is characterized by formation of new root cementum with inserting collagen fibres, new periodontal ligament and new alveolar bone (Karring et al. 2003).

Several treatment modalities such as the use of different types of bone grafts, root surface demineralization, guided tissue regeneration (GTR), growth factors or the application of enamel matrix derivative (EMD) have been used with varying degrees of success in order to accomplish this goal (Bowers et al. 1989, Lynch et al. 1991, Brunsvold & Mellonig 1993, Lowenguth & Blieden 1993, Hammarström 1997, Karring et al. 2003).

Treatment with GTR involves the placement of a bioresorbable or non-resorbable barrier membrane over infrabony defects, thus allowing PDL and bone cells

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to selectively re-populate the isolated spaces (Karring et al. 2003). On the other hand the rationale for the use of EMD is the observation that enamel matrix proteins are deposited along the surface of developing tooth roots before cementum formation (Hammarström 1997). Findings from human histology have provided evidence that periodontal regeneration may be accomplished following treatment with GTR or EMD (Nyman et al. 1982, Gottlow et al. 1986, Heijl 1997, Mellonig 1999, Sculean et al. 1999a, b, 2000, Yukna & Mellonig 2000, Bosshardt et al. 2005, Majzoub et al. 2005). Data from controlled clinical studies have shown that both therapies may lead to an additional gain of clinical attachment level (Trombelli and colleagues) when compared with open flap debridement alone (Cortellini et al. 1996a, Tonetti et al. 2002, Esposito et al. 2005, Needleman et al. 2006). In order to limit the collapse of the flap into the bone defect a combined approach based on EMD plus a graft biomaterial has been suggested. This has particularly been advocated when the regenerative treatment is addressed in deep intra-osseous defects (Trombelli et al. 2006, Guida et al. 2007).

Membrane exposure, subsequent bacterial contamination and soft tissue recession have been reported to be the most frequent complications after regenerative procedures (Becker et al. 1988, Cortellini et al. 1993, 1999a, Selvig et al. 1993). Microbiological contamination of barrier membranes have been associated with compromised clinical outcomes, leading to a reduced gain in clinical attachment level (Selvig et al. 1992, Mombelli et al. 1993, Murphy 1995a, b, Nowzari et al. 1995, de Sanctis et al. 1996).

In this context it was advocated that an important element to improve regenerative outcomes is to achieve and maintain primary soft tissue closure in particular in the inter-dental area. Thus modified flap designs allowing access to the defect area while preserving the interdental papilla have been recently developed and used in clinical trials (Cortellini et al. 1995, 1999b, Trombelli et al. 2009). Primary closure could be accomplished in majority of the cases, particularly when a microsurgical approach was used (Cortellini & Tonetti 2001, Wachtel et al. 2003).

Yet narrow inter-dental spaces still seem to be challenging with respect to primary flap closure due to crowding or tooth migration. Skoog advocated a surgical technique for periosteoplasty in congenital cleft lip and palate surgery where a periosteal flap was used to achieve a layer-wise wound closure (Skoog 1965). Triaca et al. (2001) introduced this multilayer flap design in particular for edentulous ridges.

The purpose of this case report is to present a modified surgical approach for GTR to maintain the integrity of interproximal soft tissue above intra-bony defects.

### Case Report Baseline evaluation

A 36-year-old non-smoking male patient presented with a single deep infrabony defect in the anterior region of the mandible following completion of the initial periodontal therapy consisting of thorough oral hygiene instructions and fullmouth scaling and root planning. The infrabony component was estimated by a combination of radiographic and clinical criteria (Figs 1 and 2) (Tonetti et al. 1993).

### **Pre-surgical treatment**

The preparation of the patient consisted of oral hygiene instructions several weeks before the surgical procedure and the reduction of the API-value <25%.

### Surgical approach

Before the surgery, mouth rinsing with 0.2% chlorhexidine-digluconate solu-



*Fig. 1.* The pre-operative clinical aspect. A periodontal probe is used to measure the residual probing pocket depth. Note the delicate inter-dental area.



*Fig.* 2. The baseline radiograph shows a horizontal bone defect on the mesial aspect of a lower left cuspid.



Fig. 3. Intrasulcular incision on the buccal aspect.

tion was performed. After application of adequate anaesthesia buccal and interproximal intrasulcular incisions were performed onto the alveolar crest, involving the tooth with its periodontal defect and two adjacent teeth on each side (Fig. 3). Subsequently a horizontal incision with a slight internal bevel was traced in the buccal gingiva of the interdental space at the base of the papilla, it started from the gingival margin at the buccal line angle under the contact point to the adjacent tooth. This incision was connected with the intrasulcular incisions. A c-shaped vertical releasing incision extending into the alveolar mucosa was placed at the line angle of each tooth adjacent to the defect (Fig. 4). A full-thickness buccal flap was then elevated beyond the mucogingival junction (Fig. 5). According to the modified papilla preservation technique (Cortellini et al. 1995) palatal intrasulcular incisions were placed and



Fig. 4. A c-shaped vertical releasing incision is performed.



*Fig. 5.* Preparation and elevation of a full-thickness buccal flap.



*Fig.* 6. Preparation of the internal pedicle flap. At the base of the buccal flap a horizontal incision is performed.

the interproximal tissue was elevated to the palatal aspect. Subsequently a fullthickness flap was reflected on the palatal aspect.

Following the preparation of the external flap, an internal pedicle flap was prepared to facilitate a layer-wise wound closure.

An internal horizontal incision was performed at the base of the prepared flap (Fig. 6). Consecutively two internal vertical incisions were made from the base of the flap in a coronal direction and by sharp dissection starting from the base of the flap an internal partial thickness flap was elevated (Fig. 7). This procedure obtains a partial thickness flap towards the muco-gingival junction. The internal flap is still pedicled at the coronal part of the external flap (Fig. 8).



*Fig.* 7. The internal pedicle flap is elevated from the base of the flap in a coronal direction. The internal flap is pedicled at the coronal part of the external flap.



*Fig. 10.* The bone defect is filled with a combination of enamel matrix derivative and autogenous bone graft.



*Fig. 13.* Healing situation after 5 weeks. Uneventful healing process.



*Fig.* 8. The internal flap is placed over the defect. A tension-free adaptation is desirable.



*Fig. 11.* A layer-wise wound closure is performed. The inner flap is sutured with a vertical mattress suture to the palatal aspect.



Fig. 14. Clinical situation after 5 years follow-up.



*Fig. 9.* Intra-operative evaluation of the debrided bony defect.

All granulation tissue was then removed from the defect, and the root surface was scaled and planned with hand and ultrasonic instruments (Fig. 9).

In this case a combination of EMD and autologous bone was used for the regenerative approach. An adequate amount of autologous bone was harvested from the buccal cortical plate. The bone graft was collected from the surgical site adjacent to the intra-osseous defect. The exposed root surfaces were then conditioned with 24% EDTA gel for 2 min. Afterwards the defect was thoroughly rinsed with saline to remove the gel remnants. EMD was injected and the autologeous bone graft positioned (Fig. 10).



*Fig. 12.* The second layer is obtained by suturing the external flap to the palatal flap with interrupted sutures.

In order to facilitate a layer-wise wound closure, the inner flap was initially sutured underneath the palatal soft tissue with vertical mattress sutures (Fig 11). The second layer of wound closure was obtained by suturing the interproximal outer flap to the palatal flap with interrupted sutures. Finally, closure of the vertical releasing incision was completed with interrupted sutures. 6-0 monofilament polypropylene sutures were used to obtain primary closure of the inter-dental tissue (Fig. 12). Healing presented uneventful with maintenance of primary flap closure. Figures 13-15 depict the followup documentation 5 years after periodontal surgery.



*Fig. 15.* Radiograph after 5 years follow-up. Note the amount of radiographic bone fill.

### Discussion

This modified surgical approach, the double split flap, which is based on the principle of wound closure in two layers, is indicated to achieve a complete soft tissue closure in delicate interdental, areas i.e. narrow interproximal spaces with lack of an isthmus connecting the buccal with the lingual/palatal papilla, presence of interdental soft tissue craters, and/or small inter-dental anatomic papillae with wide buccolingual dimensions.

Primary wound healing and therefore stability of the blood clot and membrane have been discussed as components of a successful healing response. Wikesjö et al. (1992) reviewed the significant events in the early healing of a periodontal wound and stressed the importance of a stable clot and wound, if regeneration is to be succeeded. Flap coverage of the membrane barrier has been quoted as essential for optimized healing. Murphy (1995b) stated that 85% of all membranes used in his study became exposed and that exposure was evident approximately 2 weeks after placement. Membrane exposure has been associated with a reduction in attachment gain (Nowzari & Slots 1994, Nowzari et al. 1995). The greater the exposure of the membrane was, the less the gain of clinical attachment.

When conventional incision techniques are used, 20-40% of primary closure were reported (Cortellini & Tonetti 2000). Modifications of the incision technique (papilla preservation techniques) improved the amount of primary wound closure up to 80% primary closure (Cortellini et al. 1996b, Murphy 1996). Yet it was also reported that when the interdental space was very narrow or located in the posterior segments, the manipulation of a large buccal or palatal saddle shape flap incorporating the interdental tissue was technically very demanding and the risk of papilla necrosis was very high.

For these delicate indications the concept of multi-layer wound closure as shown in the presented case might be beneficial. It may be speculated that the double-spilt-flap has the potential to improve healing, reduce the incidence of dehiscence, and generally improve the success rate in delicate indications.

Several technique-related factors may influence treatment outcome of the double split flap. The technique comprises deep vertical releasing incisions. It can be speculated, that these incisions heal uneventful in particular when a microsurgical approach is used. The mesial– distal dimensions of the ap is critical for the vascular support of the preparated soft tissue. The wider the pedicle, the greater is the blood supply to the marginal portion of the ap. A flap's length to width ratio should not exceed 2:1 (Mörmann & Cianco 1977). Therefore care should be taken, to leave the flap wide enough to perform a proper nutrition of the inner flap.

To minimize the risk for flap fenestration or rupture a sufficient amount of tissue thickness in the buccal soft tissue complex is of importance. Proper flap thickness is necessary to maintain sufficient flap nourishment and tissue strength to withstand the forces of the suture material. Although the difficulties in sculpturing and therefore in rising the flap increase according to the thickness of the tissue. Baldi et al. (1999) showed in the field of recession coverage that periodontal flaps should not be thinner than 0.8 mm, in order to avoid necrosis.

### Conclusion

The proposed technique shows the potential to achieve and maintain complete soft tissue closure of the interdental tissues, even in the presence of the abovementioned unfavourable characteristics of the defect-associated interdental area. The efficacy and predictability of the application of the double split flap should be further evaluated in clinical studies. Such studies are currently being performed.

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### **Clinical Relevance**

*Scientific rational for this study:* The goal of the present study was to demonstrate a modified surgical flap technique to obtain primary wound closure following periodontal surgery.

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*Principal findings:* The double-split flap seems to achieve a bi-layer wound closure, sealing the wound and submerging the regenerative material. & Wallkamm, B. (2002) Enamel matrix proteins in the regenerative therapy of deep intrabony defects. A multicentre randomized controlled clinical trial. *Journal of Clinical Periodontology* **29**, 317–325.

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*Practical implications:* In particular in delicate interproximal locations with limited amount of papillary soft tissue, the double-split flap may be beneficial to improve the rate of primary wound closure. This document is a scanned copy of a printed document. No warranty is given about the accuracy of the copy. Users should refer to the original published version of the material.