J Clin Periodontol 2007; 34: 182–187 doi: 10.1111/j.1600-051X.2006.01027.x

Journal of Clinical Periodontology

Fibre retention osseous resective surgery: a novel conservative approach for pocket elimination

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Carnevale G. Fibre retention osseous resective surgery: a novel conservative approach for pocket elimination. J Clin Periodontol 2007; 34: 182–187. doi: 10.1111/j.1600-051X.2006.01027.x.

Abstract
Aim and Background: The position of the most apical inter-dental portion of the alveolar crest is classically used in osseous resective surgery (ORS) to establish the amount of the inter-proximal and buccal/lingual bone resection. Supracrestal fibres connected to the root cementum are always present coronal to the alveolar crest both in healthy and diseased sites. The aim of this paper is to report a novel surgical approach that combines the classical method of osseous resection with the gingival fibre retention technique.
Material and Methods: A description of the surgical procedure in four steps is provided (flap design, marginal soft tissue removal and fibre retention, ORS, suture of the flap).
Results and Conclusion: The proposed technique shifts the bottom of the defect in a more coronal position at the level of the connective tissue fibre attachment, establishing a more conservative supporting bone resection.

Key words: gingival fibre retention; infrabony defect; osseous resective therapy; pocket elimination

Accepted for publication 11 October 2006

The objective of periodontal therapy is the maintenance of a functional dentition for a lifetime. A series of surrogate endpoints in periodontal therapy have been identified to evaluate treatment outcomes (Hujoel 2004). These include the achievement of shallow pockets, absence of bleeding on probing and absence of furcation involvement. These endpoints are supported by the finding that increased probing pocket depths are associated with an increased risk of disease progression (Armitage 1996, Kaldahl et al. 1996a), the observation that the lack of bleeding on probing is associated with periodontal stability (Lang et al. 1990) and that the presence of furcation involvements increases the risk of tooth loss in treated and well-maintained populations (Cattabriga et al. 2000).

Conflict of interest and source of funding statement
The author declares that he has no conflict of interest.
The study was self-funded by the authors and their Institutions.

Flap surgery with osseous resection is a well-known method to obtain shallow pockets (Ochsenbein 1958). In spite of the concept, supported by controlled clinical trials, that the long-term outcomes of different periodontal surgical procedures are similar (Knowles et al. 1979), osseous resective surgery (ORS) is still an important clinical tool. It is the only technique that allows surgical lengthening of the clinical crown and modification of the anatomy in conjunction with root separation/resection (RSR). Furthermore, ORS resulted in a lower incidence of disease recurrence ($\geqslant 3$ mm of CAL loss) during maintenance as compared with root planing and/or access flap surgery (Kaldahl et al. 1996b).

Considerable misconceptions, however, have existed with regard to its surgical performance. ORS, in fact, comprises a coordinated sequence of surgical manoeuvres that includes access to the root surface and to the margin of the alveolar bone, elimination of the gingival pocket, root debridement, elimination of the infrabony defect (if present), modification of the alveolar anatomy to obtain a positive architecture and suture of the flaps in an apical position. Besides ORS, in other words, a specific soft tissue management is required. This includes elevation of thin flaps, preservation of a periosteal anchorage for suturing of the flap in a more apical position and requires mobility of the flap obtained with a combination of vertical-releasing incisions and a split-thickness extension into the alveolar mucosa. Furthermore, the palatal flap needs to be thinned and scalloped to adapt precisely to the anticipated osseous profile.

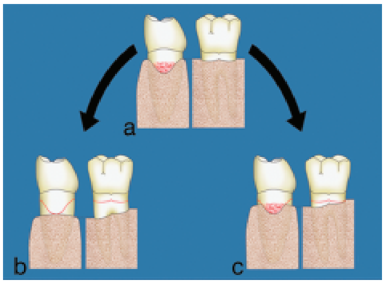

Fig. 1. (a) Inter-proximal and buccal view of a lower molar with an inter-dental osseous crater. Transeptal gingival fibres inserted into the root cementum are designed as red dots inside the crater. (b) Inter-proximal and buccal ostectomy performed according to the classical technique of osseous resective surgery (ORS) where the bottom of the defect is changed into the most coronal part of the new inter-proximal bone surface. The buccal ostectomy is executed to create a positive bony architecture. The amount of supporting bone removed is delineated in red. (c) Inter-proximal and buccal ostectomy performed according to the technique of ORS with gingival fibre retention. The coronal part of the fibres is considered as the bottom of the defect and the inter-dental and buccal ostectomy is performed accordingly. The amount of supporting bone removed is delineated in red.

Fig. 2. Buccal split-thickness flap. With a 15 blade, the marginal area is thinned evenly and the flap is incised beyond the mucogingival junction to increase its mobility to allow a precise apical positioning during sutures' application.

Fig. 3. Lingual split–full-thickness flap extending beyond the mucogingival junction.

Clinical studies demonstrate that when ORS is correctly performed where indicated, the amount of required ostectomy is minimal. At the inter-radicular crestal area, in fact, an average of 0.09–0.12 mm of supporting bone was removed (Moghaddas & Stahl 1980). On the facial and lingual aspects, on the other hand, this average amount of bone removal was 0.3 mm (Moghaddas & Stahl 1980). Other authors have reported a total average of supporting bone removed by ostectomy ranging from 0.6 to 1.2 mm (Selipsky 1976, Smith et al. 1980). In this respect, it should be noted that the ORS approaches, described until now, have used the position of the most apical inter-dental portion of the alveolar crest to determine the amount of the buccal/lingual bone that needs to be removed in order to establish a physiologic architecture (Fig. 1a and b).

It has been established that supracrestal fibres invested in the root cementum are always present coronal to the alveolar crest both in healthy and diseased sites (Gargiulo et al. 1961, Carnevale et al. 1985). This observation questions the need to remove completely the soft tissue at the time of flap surgery and suggests the possibility to preserve the supracrestal fibres during ORS. This approach would result in a reduced need to remove supporting bone in the areas where ORS is indicated and thus place the deepest part of the infrabony defect in a more coronal position.

The aim of this report was to describe a surgical scheme that combines the classical method of osseous resection with the gingival fibre retention technique in the surgical treatment of periodontal pockets.

Description of Surgical Method

The description of the surgical procedure identifies four steps: flap design, marginal soft tissue removal and fibre retention, ORS and suture of the flaps.

First step: flap design

The flap design should be carefully planned before the surgical procedure in order to predict and achieve the apical of the gingival margin at the level of the reshaped osseous crest.

The surgical technique first requires the delineation of the primary incision. At the buccal sites, this is an internally bevelled incision and can be intra-sulcular or extra-sulcular. The probing depth and the apico-coronal dimension of the keratinized tissue indicate the position of the incision (Carnevale & Kaldahl 2000). A split-thickness flap is then incised beyond the mucogingival junction; mesial and/or distal vertical-realising incisions extending into the alveolar mucosa may be useful to augment flap mobility (Fig. 2). In case of thin soft tissue, a combined flap (split–full–split thickness) is suggested to prevent flap perforation.

At the mandibular lingual sites, a split-thickness flap is generally contraindicated. A full-thickness flap is then recommended but the position of an extra-sulcular internal bevelled primary incision should reduce the marginal soft tissue thickness. Also, the lingual flap should extend past the mucogingival junction (Fig. 3).

At the palatal area, the thinned palatal flap is recommended. The primary incision is a split-thickness incision and is achieved by positioning the blade perpendicular to the teeth. The location of the primary incision is determined by assessment of probing depths of the involved teeth and the anatomy of the palatal vault. As indicated for buccal sites, this incision should predict the position of the remodelled osseous crest. In case of a deep vault, the distance of the primary incision from the gingival margin is approximately coincidental with the probing depth measures. When the palatal vault is shallow, the primary incision is close to the gingival margin. This primary incision is extended in an apical direction, using a partial-thickness dissection, until contacting the palatal bone in a position 3–5 mm apical to the alveolar crest. This flap is the ''primary flap''. A secondary intra-sulcular incision, positioning the blade parallel to the long axis of the teeth, is performed to reach the palatal alveolar crest. Using a periosteal elevator or a kidney-shaped scalpel (Goldman-Fox 7, Hu-Freidy, Chicago, IL, USA), a full-thickness flap is elevated to reach the primary flap. A horizontal incision to bone at the base of the flap will define the ''secondary flap'' that will be eliminated (Fig. 4).

Second step: marginal soft tissue removal and fibre retention

Soft tissue removal begins at the buccal and lingual sites. The apical end of this sharp dissection is positioned at the apical level of the pocket. This gentle removal is performed by using a blade number 15. At inter-dental sites, an

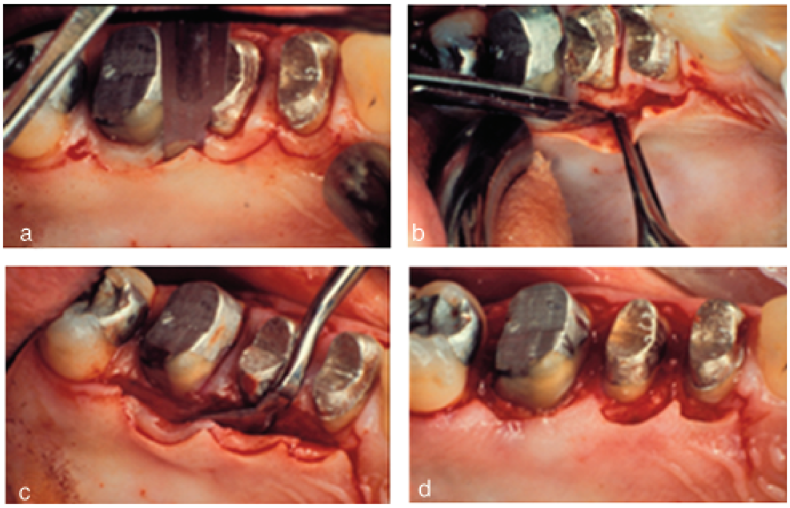

Fig. 4. Palatal thinned flap. (a) Marginal incision and thinning of the papillary area. (b) Deepening the incision of the primary flap. (c) The secondary flap is fully detached by the palatal alveolar bone with a gingivectomy instrument. (d) Adaptation of the palatal thinned flap to the underlying bone after the removal of the secondary flap.

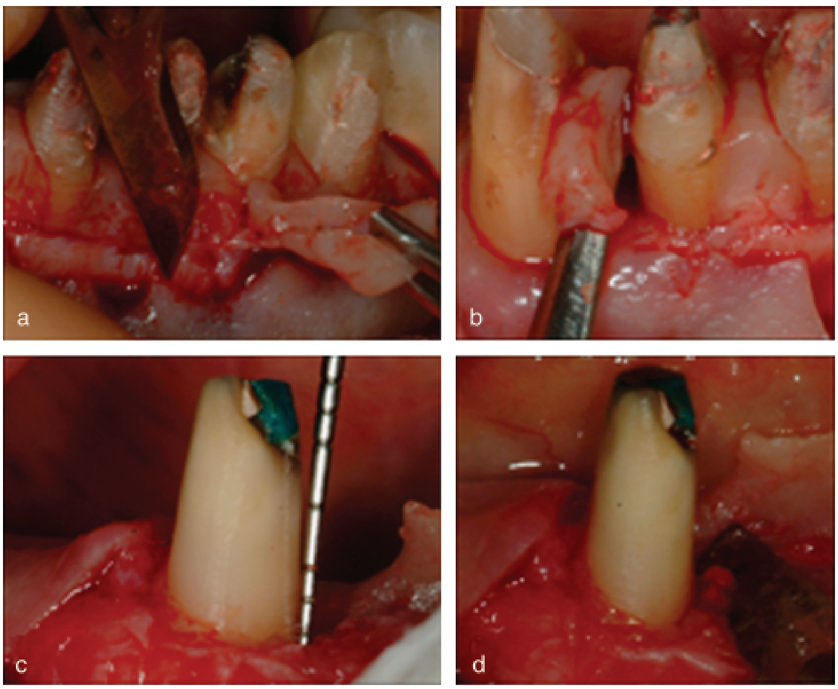

Fig. 5. (a) and (b) Gentle removal of the buccal and inter-proximal soft tissue after flap elevation. (c) The attachment fibre system within the bony defect is identified by using a periodontal probe. (d) All the soft tissue not attached to the root surface is carefully removed using a 15 blade.

inter-proximal knife (Orban 5/6, Buck 1/2, Goldman-Fox 11, Hu-Freidy) is used to remove the soft tissue carefully. The blade is positioned in the inter-dental soft tissue over the most coronal part of the buccal and lingual walls of the bony defect. Gentle removal of soft tissue in a bucco-lingual and linguo-buccal direction is accomplished by sharp dissection (Fig. 5a and b).

The identification of the attachment fibre system within the bony defect is then performed by using a periodontal probe with a magnifying system (loops or microscope) (Fig. 5c). All the soft tissue not attached to the root surface is carefully removed by the use of a 15 blade, a diamond-round bur or a curette, leaving only fibres connected to the root cementum in the infrabony defect (Fig. 5d).

Third step: ORS

Traditional approaches to inter-proximal ORS firstly suggest to identify the base of the defect and secondly to reshape the bony anatomy by eliminating the buccal and lingual walls. The base of the defect is then levelled to the adjacent bone (Ochsenbein 1958). This implies that the previous bottom of the defect is changed into the most coronal part of the new inter-proximal bone surface (Fig. 1a and b). With the fibre retention technique, the vision of the inter-proximal defect changes: the coronal level of the fibre system is considered as the bottom of the defect. This reference point, being more coronal than the real base of the bony defect, minimizes bone removal in order to level the adjacent buccal/lingual bone to the inter-proximal retained fibres. An inverse bony anatomy generally results following this inter-proximal reshape. In order to recreate a positive bony architecture and a physiologically scalloped appearance of the buccal and lingual bony anatomy, an ostectomy/osteoplasty is performed in these areas using diamond-round burs and chisels. Taking into account that with the use of this technique the resulting inter-proximal bone is more coronal than that consequential to a traditional approach, the amount of buccal and lingual bony removal is also reduced (Figs 1a, c and 6a). Final root instrumentation by means of curettes must be carefully performed, depending on the area, to the fibre system or to the bone crest. Alveolar bone and fibres are considered as one tissue during the procedure and at the end of the osseous resection at the circumferential base of the tooth only bone and preserved fibres attached to the root should be identified (Fig. 6b).

Fourth step: suture of the flaps

Suturing of the apically positioned flap requires periosteal anchorage. This allows flap stability during healing and minimizes the amount of coagulum between the flap and the periosteal/bone surface. Moreover this suture technique provides the clinician with the possibility of choosing the desired apico-coronal position of the flap. When an ''adequate'' dimension of gingiva is present, the flap margin is positioned at the level of the alveolar crest. If an increase of the apico-coronal dimension

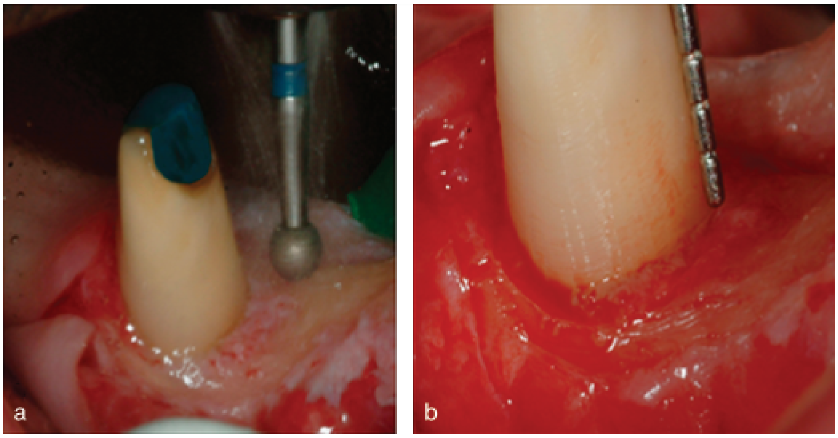

Fig. 6. (a) In order to recreate a positive bony architecture and a physiologically scalloped appearance of the buccal and lingual bony anatomy, an ostectomy/osteoplasty is performed using diamond-round burs. (b) Alveolar bone and fibres are considered as one tissue during the procedure and at the end of the osseous resection at the circumferential base of the tooth, only bone and fibres attached to the root should be identified.

Fig. 7. The flap placement of the apically positioned flaps requires periosteal anchorage. This suture technique provides the clinician with the possibility of choosing the desired position of the flap.

of attached gingiva is considered, the flap margin may be positioned apical to the bony crest (Fig. 7). This procedure may not be recommended in aesthetical areas when thin bony tissue is present (Parma-Benfenati et al. 1985).

Discussion

The presence of the connective fibre apparatus (CFA) is considered as one of the components of the biological dimension (Maynard & Wilson 1979). An experimental study on autopsy material performed on individuals with a healthy periodontium demonstrated that the mean supra-alveolar connective tissue measurement is 1.07 mm (Gargiulo et al. 1961). This dimension was confirmed on autoptical specimens of a diseased peridontium. Carnevale et al. (1985) investigated 11 cadavers from periodontitis-affected subjects, demonstrating that the mean dimension of the attachment fibre apparatus (1.06 mm) was similar to that of persons with a healthy periodontium. The authors also verified that in 10% of the samples, the mean dimension of CFA was $\geqslant$1.8 mm and that there was a positive correlation between pocket depth and CFA dimension. These data were more recently confirmed by Vacek et al. (1994), who reported a more variable width for CFA when compared with the dimension of the epithelial attachment and of the sulcus depth.

Bone reactions following periodontal surgical procedures have been a topic of debate from the beginnings of the 1960s. In a classical study, Staffileno et al. (1962) analysed the healing process following split-thickness flap in dogs. The authors demonstrated that minimal bone resorption occurs after this procedure when compared with full-thickness flap (Wilderman et al. 1961). Carnevale et al. (1983) tested in an animal model the effect of inter-proximal bone denudation and tooth preparation at the level of the alveolar crest compared with inter-proximal bone denudation and fibre retention without any root instrumentation. The authors verified that in test sites, there was an apical migration of the epithelial attachment to the apical portion of the tooth preparation with an average of 1 mm of bony resorption to form a new CFA while in control sites the healing gave a *restitutio ad integrum* with no bone and attachment loss. This experimental observation demonstrated the importance of fibre retention with connective tissue attachment preservation on the root surface in preventing periodontal injuries.

Different clinical and experimental studies have demonstrated that the re-establishment of a connective tissue attachment shows low predictability on previously diseased roots surfaces. Caton et al. (1980) evaluated the effect of four treatment modalities (modified Widman flap procedure alone or combined with freeze-dried bone, or beta tricalcium phosphate, and root planing) on the connective tissue attachment level in Rhesus monkeys. The healing resulted in the formation of an epithelial lining (long junctional epithelium) along the treated root surfaces with no new connective tissue attachment.

Nyman et al. (1982) first demonstrated on humans that a new attachment apparatus may be obtained by means of a membrane barrier that may create and maintain a space in the defect to guide selective colonization and prevent apical down-growth of the epithelium. This observation demonstrated the possibility to regenerate the lost periodontium with the use of specific regenerative techniques, leading to appreciable clinical

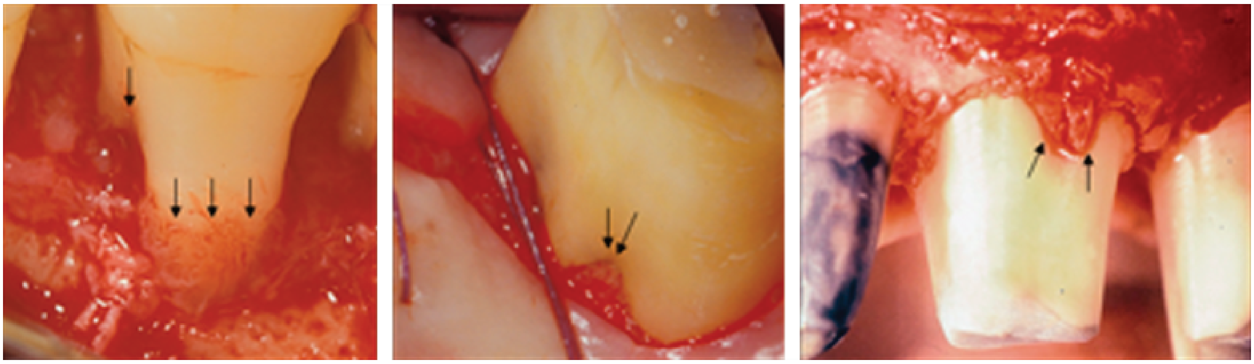

Fig. 8. In the treatment of a furcation entrance or a class I furcation involvement, careful maintenance of the attachment fibre apparatus in the area will prevent epithelial migration into the furcation area, allowing healing without any further loss of horizontal attachment.

results in the treatment of deep intrabony defects (Tonetti et al. 1998).

Therefore, preservation of the CFA during ORS seems to be a rational approach for the treatment of shallow infrabony defects when minimal pocket depth is desired and gain of attachment is not an end-point of therapy. On the other hand, a regenerative approach in shallow infrabony defects may display a larger variability in terms of clinical attachment gain if compared with deeper defects (Cortellini et al. 1998).

In the early 1970s, Levine (1972) applied in case reports and in a wound-healing histological study on humans the fibre retention technique during flap surgery. In the test sites, the author sutured the flap in the pre-operative position without removing the supracrestal gingival fibres while in the control site such fibres were removed with a curette. The histological evaluation demonstrated a marked apical migration of the epithelium in the control teeth, while no attachment was lost in the test site (Levine & Stahl 1972).

ORS is a well-documented treatment approach for pocket elimination (AAP 1996). Its healing implies secondary intention healing in the inter-proximal space and coronal re-growth of the gingival complex with minimal pocket depth at 6 months (Becker et al. 1988, Kaldahl et al. 1988, Pontoriero & Carnevale 2001). This treatment modality is based on the possibility to eliminate inter-proximal bony defects by ostectomy/osteoplasty, creating a physiological, scalloped appearance of the buccal and lingual bony anatomy. In the classical technique, the bottom of the defect is changed into the most coronal part of the resulting inter-proximal bone (Schluger 1949). ORS with gingival fibre retention (FibReORS) is a proposal for a variation of the classical osseous resective protocol. This technique changes the vision of the inter-proximal defect, shifting the bottom of the defect in a more coronal position at the level of the connective tissue fibre attachment considering mineralised and, unmineralised connective tissue as a unit. This vision may result in a more conservative resection of the supporting bone. Similarly, in the treatment of a furcation entrance or a class I furcation involvement, careful maintenance of the attachment fibre apparatus in the area may prevent epithelial migration into the furcation area, allowing healing without any further loss of horizontal attachment (Fig. 8) as described by Ochsenbein (1985).

The clinical effectiveness and long-term results of this technique are provided in two companion papers (Carnevale et al., unpublished results) demonstrating that shallow probing depths achieved by FibReORS can be maintained over time and clinical complications in terms of tooth loss are negligible when a careful SPC programme is established. Further investigations are needed in order to evaluate the healing process in terms of coronal re-growth of soft tissues following FibReORS and clinical performance in terms of pocket elimination compared with the traditional resective approach.

A classical indication of resective bony defect elimination is the presence of defects with an infrabony component $\leqslant 3$ mm (Carnevale & Kaldahl 2000). The application of FibReORS changes the evaluation of the defect depth, shifting it in a more coronal position and thus rendering it shallower. This new paradigm might be useful in redefining the clinical indications to ORS.

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Clinical Relevance

Scientific rationale for the study: The classical approach to ORS considers the most apical inter-dental portion of the alveolar crest for determining the level of bone resection.

Principal findings: This novel approach shifts the bottom of the infrabony defect to the level of the supracrestal connective tissue fibre attachment, resulting in a more conservative bone resection.

Practical implications: ORS with gingival fibre retention may lead to pocket elimination and limitation of attachment loss and may thus strengthen the classical indications for infrabony defect elimination.