

Relationship Between Periodontics and Restorative Procedures: Surgical Treatment of the Restorative Alveolar Interface (Rai)—Case Series

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Received: 7 November 2011 / Accepted: 31 October 2012 / Published online: 15 November 2012
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Abstract Maintenance of a healthy periodontium is fundamental for the long term success of prosthetic restorations. Thus, prosthetic procedures with subgingival margins may affect the periodontal health if the distances between the junctional epithelium and supracrestal connective tissue attachment aren't respected, or if there is insufficient space to maintain the health of the interproximal tissues, leading to gingival inflammation, connective tissue attachment loss and bone resorption. The restorative alveolar interface (RAI) technique was described as the portion of the root surface extending from the alveolar crest apically to the restorative margin coronally. RAI consists of modifying the restorative margin position into a healthier environment, respecting the biological width and therefore allowing effective plaque control. This paper describes four clinical cases with indication for the RAI technique for maintenance of periodontal health. The cases were associated with prostheses. All cases were evaluated at 90 days and exhibited a healthy periodontal tissue. Successful outcomes were observed in the different indications for the RAI technique.

Keywords Prosthetic · Periodontal · Restorative dentistry · Gingival health

Introduction

A study on human necropsy material established the dimensions and mean value of 0.69, 0.97 and 1.07 mm for the gingival sulcus, junctional epithelium and connective tissue attachment, respectively [1]. These dimensions add up to approximately 3 mm from the gingival margin to the alveolar crest.

The term frequently used to describe the dimensions of mucous tissues contacting the teeth is biological width of attachment mucous tissues. Mucous tissues adhered to the teeth are divided in two parts: fibrous tissue and epithelial attachment, which make part of the biological width concept based on the studies of Gottlieb [2], Orban and Köhler [3] and Sicher [4].

The importance of maintaining the biological width integrity is due to the interplay between bacterial activity and host defenses, i.e. the effect of bacterial toxins on the bone crest [1, 6]. Subgingival restorations can have damaging effects on the neighboring hard and soft tissues, especially when they encroach on the junctional epithelium and supracrestal connective tissue [7]. Parma-Benfenati et al. [5] studied restorative margins coinciding with the bone crest level in dogs and reported approximately 5 mm of bone loss after 3 months of intervention.

Crown lengthening involves the surgical removal of hard and soft periodontal tissues to gain supracrestal tooth length, allowing longer clinical crowns [8–11] and reestablishment of the biological width.

The restorative alveolar interface (RAI) was described as the portion of the root surface extending from the

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alveolar crest apically to the restorative margin coronally. Histologically, the RAI contains cementum, Sharpey's fibers and collagen fibers, which are part of the gingival fiber apparatus, gingival sulcus, sulcular epithelium and the restorative margin itself. The surgical management of the RAI aims at modifying the restorative margin position into a healthier environment, respecting the biological width and therefore allowing effective plaque control [6]. According to Ross and Gargiulo [13] the root surface morphology dictates the morphology of the restorative dental junction and the marginal contours, affecting plaque retention and potentially the integrity of the attachment apparatus.

This article describes three cases of surgical management of the RAI in order to create a healthy environment for the papillae and restoration.

Case Reports

Case 1

A patient was referred to the Periodontology sector of the Hospital for rehabilitation of craniofacial anomalies (HRAC) after tooth preparation and cementation of provisional restorations with a persistent gingival inflammation which did not respond to root scaling and planning. During clinical examination, the evidence of root proximity of the maxillary right central incisor, lateral incisor and canine was diagnosed (Fig. 1a).

Following local anesthesia, an intrasulcular incision was traced. A full-thickness flap was raised for degranulation of the defect (Fig. 1b, c) and proximal reduction of the roots with a #3203 diamond bur (Fig. 1d). Following degranulation of the defect and careful scaling and root planing with Gracey curettes, the papillae were secured with non-resorbable 4.0 silk sutures (Ethicon, Johnson & Johnson®) (Fig. 1e). Sutures were removed 1 week after surgery. No intraoperative or postoperative complications such as hemorrhage and infection occurred and healing was considered clinically normal. The teeth were re-prepared at the one-month follow-up (Fig. 1f) and the soft tissue presented a normal healthy aspect. The final restoration was performed at the 3 month follow-up (Fig. 1g, h).

Case 2

The second patient was referred to the Periodontology sector of the HRAC with a missing maxillary left first premolar. The adjacent second premolar and the first molar were restored with provisional acrylic resin single-unit fixed partial dentures. After removal of the provisional dentures, clinical examination revealed insufficient space

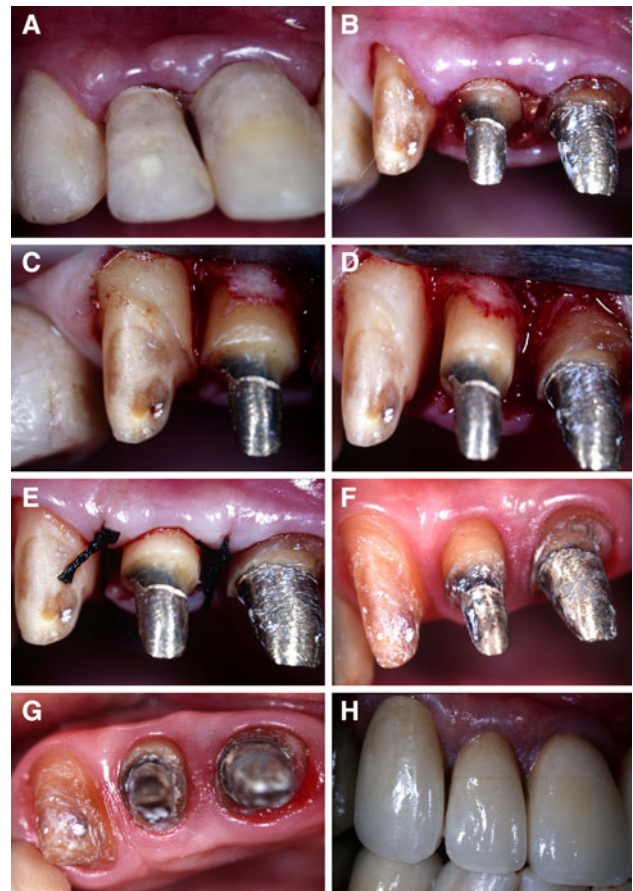


Fig. 1 a Buccal view after tooth preparation and cementation of provisional restorations. b Presence of gingival inflammation. c Root proximity of the lateral incisor and canine. d Buccal view of intrasulcular incision to raise a full-thickness flap and inflammatory tissue debridement, and buccal view after root reduction and planing with a #3203 diamond bur and curettes. e Buccal view of the suture. f Buccal view after a 30 day control period. g Occlusal view of 90 day postoperative control. h Clinical aspect of the ceramometal crown

between both roots, evidenced by an inflammatory response (Fig. 2a). The patient was submitted to the same surgical protocol (Fig. 2b, c) and after 90 day healing the periodontal tissues presented a healthy aspect (Fig. 2d).

Case 3

The main complaint of the third patient was pain on the maxillary left quadrant during mastication. The maxillary left second premolar had an extensive amalgam restoration (Fig. 3a) and a fractured cusp (Fig. 3b). The management of the RAI was indicated as well, due to the cusp fracture. After removal of the fractured cusp, the restorative margin and the bone crest were exposed by a full-thickness flap (Fig. 3c). Reestablishment of the biological distances was performed associated with root reduction and planing (RAI) in order to minimize bone reduction (Fig. 3d, e). The flap was sutured with nonresorbable 4.0 silk sutures

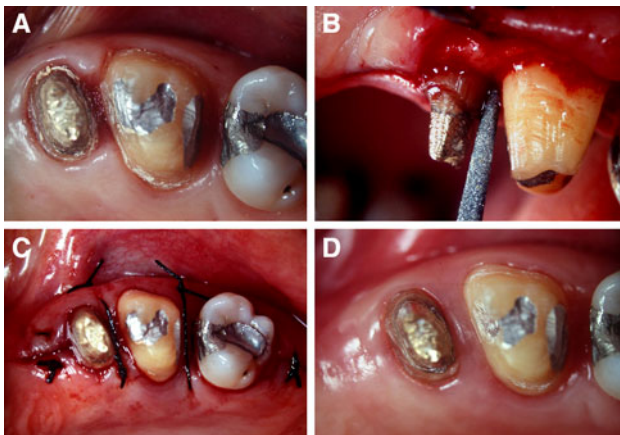


Fig. 2 a Gingival inflammation and root proximity of the second premolar and first molar. b RAI management reducing root proximity. c Occlusal view of suture. d 90 day control

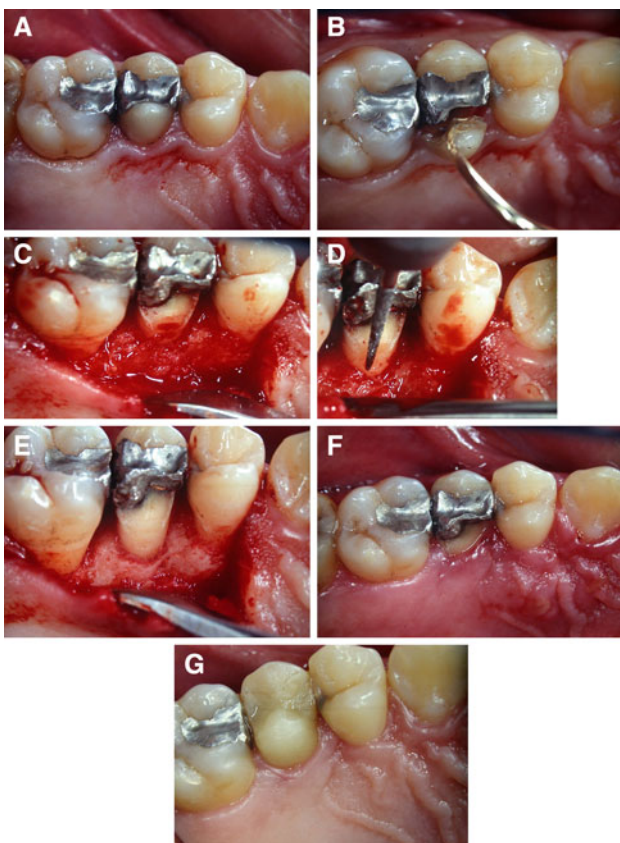


Fig. 3 a Extensive amalgam restoration. b Removal of the fractured palatal cusp. c Flap elevation exposing the preparation margins and bone crest. Note invasion of the biological width at the distal aspect of the second premolar and mesial aspect of the first molar. d Reestablishment of biological distances with root planing (RAI). e After RAI. f 15 day control showing minimal swelling. g 3 month postoperative control

(Ethicon, Johnson & Johnson®). At the 15 day follow-up visit, the area was still edematous (Fig. 3f). At the 3 month follow-up visit, after final restoration, the periodontium presented no inflammation (Fig. 3g).

Case 4

A patient presented for evaluation and treatment of hypodontia of the maxillary right lateral incisor (Fig. 4a). The orthodontic planning comprised movement of the canine toward the central incisor. Due to the canine anatomy and crown convexity, this movement could not be fully performed. Re-anatomization of the canine through the RAI management enabled the right positioning of teeth in order to replace the lateral incisor. The RAI protocol applied was similar to that previously described (Fig. 4b, c, d). The orthodontic movement was interrupted for 30 days. After a 3 month period the canine was reduced to a lateral incisor-like shape, enhancing the esthetics and function (Fig. 4e).

Discussion

The RAI management is a procedure that aims to modify the restorative margin position into a healthier environment. This procedure reestablishes the natural relationship of the tooth and its periodontium, respecting the biological width and therefore allowing effective plaque control.

According to Ross and Gargiulo [13, 14], the RAI is an area of the root surface totally accessible to the periodontist at the time of periodontal surgery and is rarely seen by the dentist fabricating the prosthesis. Because of the periodontist’s access and understanding of the importance of tooth preparation and the emergence profile of the prosthesis, the root surface should frequently be modified to create a parallel emergence profile of the tooth preparation as it emerges from the periodontium.

The margins of prosthetic restorations are located subgingivally in the presence of carious lesions, preexisting restorations, short clinical crowns, esthetic demands [15], or in case of tooth structure loss at the cervical region of the tooth [16]. The depth of preparation and quality of the restoration directly influence the periodontal health [16].

The margins of a tooth prepared for restorative purposes should respect the supra-alveolar space, so that the junctional epithelium and the connective tissue attachment are not violated. Invasion of the junctional epithelium or connective tissue attachment promotes an inflammatory process, which is harmful to homeostasis. The cases reported had an urge for root proximity and fracture line elimination (RAI management). The procedure was performed with rotary instruments, enabling the formation of a posterior soft tissue protection, so the margins are located at a healthy environment.

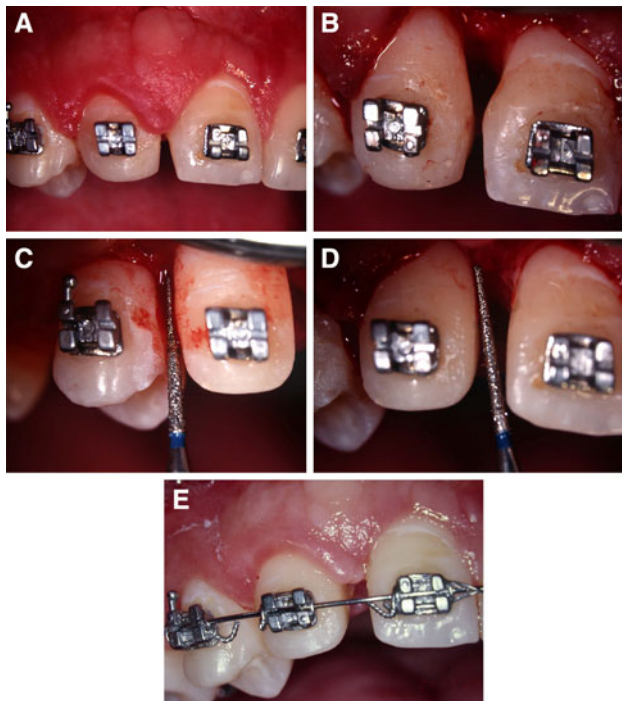


Fig. 4 **a** Buccal view of hypodontia of the lateral incisor. **b** Full-thickness flap. **c** RAI management. Root reduction and distal planing of canine with a #3203 diamond bur. **d** Root reduction and mesial planing of canine with a #3203 diamond bur. **e** 90 day control—the canine was transformed into lateral incisor in order to reestablish the esthetics and function

A crater deformity is normally present at interproximal areas with root proximity (cases 1 and 2), also known as *col* area. The *col* area is represented by buccal and lingual papillae peaks and a crater-like deformity covered by non-keratinized epithelium. This crater becomes the *locus minorae resistentiae* for further breakdown. In order to reestablish homeostasis, gingivectomy of the crater's soft tissue along with root planning is performed, hence creating an adequate space of approximately 1.0 mm for the papillae [17]. Clinically, the free passage of a curette's cutting end denotes enough space for papilla creation. The buccal and lingual papillae are sutured and the papilla peak assumes a convex shape with keratinized epithelium [18]. According to Novaes et al. (2001) [6] the RAI procedure modifies the interproximal *col*, going from a concave non-keratinized to a convex keratinized epithelium. The condition of the interproximal area can be improved by plasty of the dental tissue during periodontal surgery with a flap, obtaining a larger embrasure and modifying the *col* so that a convex connective tissue covered by keratinized epithelium is formed. This simplifies the oral hygiene and increases the resistance to interproximal periodontal disease [19].

Whenever the soft tissue around a prosthetic crown presents an inflammatory response, a conservative RAI approach may be performed through simple elimination of

the previous preparation margins or fracture lines, without any osteotomy (case 3). After a 60–90 day period, if necessary, the teeth may be re-prepared.

As shown in case 4, the RAI management may conciliate esthetics and periodontal health when performed simultaneously with orthodontic movement.

Since the RAI technique consists of root planning during surgical procedures, the root surface becomes more adequate to re-attachment of the gingival fibers and adaptation of the epithelial attachment [4]. Thus, restorative subgingival interventions should be avoided in order to maintain the biological widths during the healing period. Some authors report that at 3 months postoperatively the final restorative procedure can be initiated, without the need of early subgingival re-preparation or casting [19, 20].

Conclusion

The RAI technique is to be performed in all cases with root proximity whenever the interproximal gingival tissue presents a persistent inflammatory response, even with well adapted and polished provisional crowns.

Three cases were reported in which the RAI procedure was proposed to reestablish the periodontal tissues homeostasis. A notable improvement at the marginal periodontal area with wider and adequate space for the papillae was evident. The longevity of the restorations and oral health maintenance were improved.

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