International Journal of Pharmaceutical Research and Applications
Volume 6, Issue 2 Mar-Apr 2021, pp: 197-200 www.ijprajournal.com ISSN: 2249-7781

Biological Width – Violation and Its Consequence

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Date Of Submission: 20-03-2021 Date Of Acceptance: 05-04-2021

I. INTRODUCTION

In an effort to deliver high quality, predictable restorative dentistry to patients, all treating practitioners must consider the dynamic interplay of tooth restoration, the restorative procedure itself, and the health of the surrounding hard and soft tissues. Every restoration, whether it be a Class II amalgam or a full mouth fixed reconstruction, places added demands on the supporting periodontium. The most ideal marginal adaptation results in increased plaque accumulation at the restorative margin - tooth interface. Poorly contoured restorations will inhibit proper plaque control procedures, thus hastening periodontal breakdown and recurrent caries at the restorative margin - tooth interface. Should such margins be placed subgingivally, the destructive process is accelerated by the inability of the patient to adequately carry out plaque control measures. While many practitioners speak of the " self - cleansing zone "below the gingival margin, and the maintainability of a subgingival restoration if monitored carefully (1) , Waerhaug has shown that even a well - fitting restoration will harbor plaque and bacteria (2) . Several clinical investigators have demonstrated the detrimental effects of poorly finished and/or incorrectly positioned restorations with subgingival margins on the periodontal tissues. Local gingival inflammation and loss of periodontal attachment are the results of such therapy (3 – 7). It has additionally been demonstrated that it is plaque accumulation in relation to an overhanging restorative margin, and not merely the subgingival restoration, that causes promotion of the periodontal disease process (7 – 9). Nowhere is the delicate balance of the restored tooth and the health of the surrounding periodontium more evident than in the restoration of an interproximal area. A multitude of factors like periodontal, restorative, and geometric in nature work together to render this a primary area of concern in the successful management of any dentition compromised by oral bacteria. To properly manage the embrasure space, the area must be visualized as the fluid, three - dimensional entity it is.

Management Of The Apico - Occlusal Dimension

The concept of biologic width is paramount in understanding the apico - occlusal relationship of the restorative margin to the osseous crest. Proceeding coronally from the osseous crest, the attachment apparatus consists of Sharpey fiber insertion into the root surface, followed by a junctional epithelial adhesion to root surface, followed by the gingival sulcus. The combined dimensions of the connective tissue and junctional epithelium are, on average, 2.04 mm in humans (10). Impingement upon this dimension by the restorative margin results in soft tissue inflammation and eventual periodontal break down. In addition, postsurgical healing of tissues is impaired in the face of a compromised biologic width.

VIOLATING THE BIOLOGIC WIDTH

Violation of the biologic width can occur due to tooth preparation, which may damage the junctional epithelium and the supra alveolar

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connective tissues. A progressive inflammatory process may also occur following soft tissue retraction procedures, various impression techniques, electrosurgery, and the placement of a temporary restoration. Fortunately, Löe and Silness have shown that injuries created by insertion of a retraction cord are reversible, as long as the lesions are allowed to heal against a clean tooth surface (11). Duncan (12) found that damage attributed to poorly contoured provisional restorations was reversible, as long as the provisional restorations were modified and placed correctly. However, if inflammation occurs and is not resolved, the inflammatory process is perpetuated when the final restoration is cemented in the previously injured and inflamed area (13). Irreversible damage results, characterized by the development of a periodontal pocket, with apical migration of the junctional epithelium and loss of attachment. Placement of restorations prior to total healing and development of the supracrestal attachment apparatus postsurgically is also highly problematic, as it is impossible to know in advance where the most coronal position of the attachment apparatus will be. The net result is violation of the biologic width, impingement upon the attachment apparatus and development of an inflammatory lesion. Studies by Fugazzotto and Parma Benfenati (14) and Parma Benfenati et al. (15) examined the effects of restorative margin positions on the development and health of the supracrestal attachment apparatus postsurgically, as well as the role that quantity and quality of alveolar housing played in such attachment apparatus development. At the control sites, Class V amalgam restorations were placed 4 mm coronal to the osseous crest in beagle dogs, and the teeth were notched at the osseous crest. In the experimental sites, Class V amalgam restorations were placed at osseous crest. Histological examination 12 weeks post therapy underscored the effects of restorative margin position on postsurgical attachment apparatus development. At the control sites, all tissues healed uneventfully. Histologic specimens were characterized by connective tissue reattachment to the root surface supracrestally for approximately 1 mm, followed by 1 – 1.5 mm of junctional epithelial adhesion. Minimal alveolar bone crest resorption was evident. This crestal resorption was more pronounced in specimens where thinner preoperative bone had been present. In the experimental sites, the tissues coronal to the restoration were characterized by a thin atrophic epithelial lining, which was not attached to the root surface, and a localized inflammatory reaction in the gingival soft tissues. This epithelium extended slightly apical to the restoration. In all histological specimens of experimental sites, bone resorption was present to a varying degree, depending upon the quantity and quality of the preoperative bony septum. Thinner preoperative septa demonstrated greater loss of bone height than their thicker counterparts. Connective tissue attachment to the root surface always occurred apical to the restoration following the bone loss. Clinically, the healed tissues in the control sites appeared healthy and did not bleed upon probing. The postoperative tissues at the experimental sites demonstrated significant clinical inflammation and bleeding upon probing.

KEY FINDINGS AFTER VIOLATION

The study demonstrated that:

1. Following surgical intervention, osseous resorption occurs. This pattern of resorption is influenced by the preoperative bone morphology.
2. When the biologic width is violated, inflammation not only will result in osseous resorption in an attempt to afford space for connective tissue insertion into the root supracrestally, but also will perpetuate the ongoing pathological process.
3. The presence of subgingival restorations will result in greater plaque accumulation.
4. Histologically, the findings adjacent to a subgingival restoration will correspond to those encountered when examining an inflammatory periodontal lesion.
5. When a restoration impinges upon the needed dimensions for development of the attachment apparatus during healing after periodontal surgical therapy, the extent of osseous loss encountered will be greater than when such a compromise is not present.
6. When a subgingival restoration is present, the inflammatory lesion encountered in the healed periodontal tissues postsurgically will be walled off by the establishment of a new " dentoperiosteal " fiber system. This "dentoperiosteal "fiber system will be more apical than it would be if the restoration were not present, and will occur in the presence of greater loss of osseous structures crestally.

II. DISCUSSION

In light of the fact that a continuing inflammatory lesion is present when a subgingival restoration exists that impinges upon the necessary

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dimensions for reestablishment of a healthy attachment apparatus postsurgically, and because this attachment apparatus will establish itself regardless of osseous loss, crown - lengthening procedures to establish adequate biologic width to ensure that restorations are not placed too close to the osseous crest are usually justifiable. In situations where the septa consisted of both thin and thick components, the thinner portions of the septa were resorbed to a greater extent. These findings are in agreement with widely accepted understanding regarding postsurgical periodontal healing. Ruben et al. (16) postulated that thinner septa would demonstrate greater liability than their thicker counterparts due to their biological and histological characteristics. Thin bony septa predominantly consist of cortical plates with a small marrow component. As a result, such septa are deficient in their primary source of pluripotential cells, which have the ability to differentiate into blastic cells of both hard and soft - tissue natures. Thus, the osteogenic reaction expected following initial postsurgical resorption is attenuated or absent altogether in the presence of thin osseous septa. The initial resorptive phase itself may often be enough to eliminate a thin osseous septum because of its buccolingual dimension. Parma - Benfenati et al. (14,16) found this to be the case in most of the thin septal specimens examined. The osseous septum began to resorb progressively from the external aspect of the septum inward (i.e., from the periosteal aspect toward the periodontal ligament). Simultaneously, resorption occurred from its thin coronal aspects. As the septum resorbed in the presence of the postsurgical chronic inflammatory process which is associated with any surgical procedure, the bone was replaced by connective tissues. These connective tissues served to join the periosteum with the remaining components of the periodontal ligament, which remained inserted into the cementum of the tooth (17). When thicker bony septa had been present preoperatively, the biological and histological characteristics of the postoperative bone, and hence the postoperative results, were markedly different. Thicker septa contain greater amounts of marrow components than their thinner counterparts, and are thus capable of a more exuberant osteogenic response to surgical insult. When the cortical plate is resorbed, a pluripotential cell population is unmasked, yielding the expected result of new bone and other tissues. A highly exaggerated initial resorptive phase would be necessary to result in the obliteration of a thick bony septum. As a result, significantly less occluso - apical osseous loss was found when thick bony septa were present preoperatively, as compared to thin bony septa specimens. Prior to the work of Parma - Benfenati et al. (14,15) , no well - controlled clinical or histological studies had been performed that compared the extent and pattern of osseous resorption following a given surgical procedure in a thin septal scenario to that of a thicker septal scenario. Authors had discussed these considerations following gingival autograft placement (18,19) . Friedman has shown that 0.5 mm of osseous resorption occurred during healing following osseous resective surgery when a thick bone septum was present, but did not compare his findings to those when a thin bony septum was present presurgically (20)

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