Article review

Periodontal health and restorative Dentistry

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ABSTRACT

The interaction between periodontology and restorative dentistry play an important role in many aspects including location of restorative margins, crown contours and response of all gingival tissues to restorative preparations. Most of the clinicians are aware of this interrelationship but the dilemma remains concerning specific concepts such as biologic width, its maintenance and applications of crown lengthening in cases of biologic width violation.

Keywords: Crown lengthening, Biologic width violation, periodontal health, restorative dentistry.

INTRODUCTION

Preservation of periodontal health is one of the most important factors for successful restorative dentistry. Periodontal tissues form the foundation for proper aesthetics, function and comfort of the dentition. The relationship between periodontal health and the restoration of teeth is intimate and indiseable. Maintenance of gingival health constitutes one of the keys for tooth and dental restoration longevity. An appropriate understanding of relationship between periodontal tissues and restorative dentistry is of prime importance to ensure adequate form, function, esthetics, and comfort of the dentition.

The periodontal soft tissue

The tooth is secured in the alveolar bone by a combination of connective tissue and epithelial attachment. Connective tissue attaches to a tooth in two distinct areas: below the alveolar crest and above the alveolar crest. With this, maxillary gingival fiber bundles provide additional attachment to secure the tooth in the alveolus, but they also serve to immobilize the gingival tissues in relation to the supra-alveolar portion of the root cementum. This tissue immobility, along with resistance to bacterial and mechanical challenges, contributes to the maintenance of a permucosal seal.¹

The biologic width
The term “biologic width” derives from histometric measurements of some of the above-mentioned structures. The biologic width is defined as the combined dimensions of the supra-alveolar connective tissue attachment and junctional epithelial attachment with a mean value of 2.04 mm. It represents a dimension of 1.07 mm for connective tissue attachment and 0.97 mm for epithelial attachment, the mean of raw data with a very large range.\(^2\)

**Location of the margin**
Following Maynard and Wilson,\(^3\) a distance of 0.5 to 1.0 mm between the restorative margin and the base of the sulcus is generally considered to be safe. To ensure an esthetic and physiologic intra-crevicular restoration, they suggested a minimum depth of 1.5 to 2.0 mm from the free gingival margin to the base of the sulcus prior to intra-sulcular margin preparation. Furthermore, the assertion has been made that approximately 5 mm of keratinized gingiva, composed of 2 mm of free gingiva and 3 mm of attached gingiva, is necessary to maintain health when the margins of the restorations are extended into the sulcus.\(^4\) The placement of restoration margins subgingivally is generally discriminated as an invasion of the biologic width, and may not only create a direct operative trauma to the tissues but may also facilitate subgingival plaque accumulation with resultant inflammatory alterations in the adjacent gingiva.

**Influence of material**
Subgingival restoration margins neither prevent recurrence of decay, nor do they stop the onset of gingivitis, periodontal attachment loss, or gingival recession. Nevertheless, there is a tendency to hide them, in the sulcus or even subgingivally, out of esthetic and functional reasons. In those situations, dental restoration materials are coming into intimate contact with the adjacent tissues.\(^5\)

**Clinical interpretation**
Prefer crevicular or supragingival margins by minimally to non-invasive techniques and adhesive ceramics. If subgingival margins are inevitable, then choose the best biocompatible materials with optimal biologic response with regard to plaque accumulation, to ensure esthetic outcome and stability in the long run. Make sure that the overflow of fixation materials can be reached and properly detached. Go for gingival augmentation to stabilize the marginal interface for changing the periodontal biotype and the dimension of the keratinized gingiva.\(^6\) Downshift the biologic width by resective techniques (surgical crown lengthening) to avoid violation of the biologic width

**Biological Width**
The biological width is defined as the dimension of the soft tissue, which is attached to the portion of the tooth coronal to the crest of the alveolar bone. This term was based on the work of Gargiulo et al. described the dimensions and relationship of the dentogingival junction in humans. In 1977, Ingber et al. described “Biologic Width” and credited D.Walter Cohen for first coining the term.\(^7\)

**Concept of Biologic Width**
There is general agreement that placing restorative margins within the biologic width frequently leads to gingival inflammation, clinical attachment loss, and bone loss. This is thought to be due to the destructive inflammatory response to microbial plaque located at deep periodontal pockets or gingival recession. Various authors have recommended minimal distances restorative margins must be from the bone crest to avoid deleterious effects. Ingber et al. (1977) suggested that a minimum of 3 mm was required from the restorative margin to the alveolar crest to permit adequate healing and restoration of the tooth. Maynard & Wilson (1979) divided the periodontium into three dimensions; superficial physiologic, crevicular physiologic and subcrevicular physiologic. The superficial physiologic dimension represents the free and attached gingival surrounding the tooth, while the crevicular physiologic dimension represents the gingival dimension from the gingival margin to the junctional epithelium. The subcrevicular physiologic space is analogous to the biologic width described (Gargiulo et al. 1961), consisting of the junctional epithelium and connective tissue attachment. The biologic, or attachment, width can be identified for each individual patient by probing under anaesthesia to the bone level (referred to as “sounding to bone”) and subtracting the sulcus depth from the resulting measurement.

**Figure 1: The Biologic width**

**Violation of Biologic Width**

Violation of the biologic width is a common occurrence in the practice of restorative dentistry and it is impossible to maintain periodontal health. The biologic width can be violated is by the placement of a deep subgingival restoration. The need to establish a subgingival restorative margin can be dictated by caries, tooth fracture, external root resorption, or the need to increase axial height of a tooth preparation for retention purposes. If the apical margin of the restorative preparation is placed within the biologic width (i.e., too close to the bone), a zone of chronic inflammation is likely to develop. Bone loss under the preparation margin that violated the biologic width. Pocket and progressive periodontal tissue loss (periodontal ligament and bone) develop. Gingival recession and localized bone loss develop. This happens in cases where the labiobuccal bone is thin. Localized gingival hyperplasia with minimal bone loss.
Evaluation of Biologic Width Violation

Clinical method If a patient experiences tissue discomfort when the restoration margin levels are being assessed with a periodontal probe, it is a good indication that the margin extends into the attachment and that a biologic width violation has occurred.

Bone sounding
The biologic width can be identified by probing under local anesthesia to the bone level (referred to as “sounding to bone”) and subtracting the sulcus depth from the resulting measurement. If this distance is less than 2 mm at one or more locations, a diagnosis of biologic width violation can be confirmed. This measurement must be performed on teeth with healthy gingival tissues and should be repeated on more than one tooth to ensure accurate assessment, and reduce individual and site variations.

Radiographic evaluation
Radiographic interpretation can identify interproximal violations of biologic width. However, on the mesiofacial and distofacial line angles of teeth, radiographs are not diagnostic because of tooth perimposition.

Guidelines for Biologic width Placement
Categories of biologic width and margin placement guidelines to prevent biologic width violation Kois proposed three categories of biologic width based on the total dimension of attachment and the sulcus depth following bone sounding measurements, namely:

Normal Crest
In the Normal Crest patient, the mid-facial measurement is 3.0 mm and the proximal measurement is a range from 3.0 mm to 4.5 mm. In these cases, the gingival tissue tends to be stable for a long term. The margin of a crown should generally be placed no closer than 2.5 mm from alveolar bone. Therefore, a crown margin which is placed 0.5 mm subgingivally tends to be well-tolerated by the gingiva, and is stable long term in the Normal Crest patient.

High Crest
High Crest is an unusual finding in nature and occurs approximately 2% of the time. There is one area where High Crest is seen more often: In a proximal surface adjacent to an edentulous site. In the High Crest patient, the mid-facial measurement is less than 3.0 mm and the proximal measurement is also less than 3.0 mm. In this situation, it is commonly not possible to place an intracrevicular margin because the margin will be too close to the alveolar bone, resulting in a biologic width impingement and chronic inflammation.

Low Crest
In the Low Crest patient group, the mid-facial measurement is greater than 3.0 mm and the proximal measurement is greater than 4.5 mm. Low Crest occurs approximately 13% of the time. Traditionally, the Low Crest patient has been described as more susceptible to recession secondary to the placement of an intracervical crown margin.
Crown Lengthening
The concept of crown lengthening was first introduced by D.W. Cohen (1962) and is presently a procedure that often employs some combination of tissue reduction or removal, osseous surgery, and or orthodontics for tooth exposure. One of the first authors to describe a technique for the preservation of the gingiva following surgery was Nabers (1954). The surgical technique developed by Nabers was originally denoted "repositioning of attached gingiva" and was later modified by Ariaua & Tyrrell (1957). In 1962 Friedman proposed the term apically repositioned flap to more appropriately describe the surgical technique introduced by Nabers. Clinical crown lengthening refers to the procedure designed to increase the extent of supragingival tooth structure for restorative and esthetic purpose. Clinicians often encounter the need for crown lengthening in the practice of dentistry and have to make treatment decisions taking into considerations how to best affects the biological, functional and esthetic requirements of each particular case. The procedure is based on two principles: biologic width (BW) establishment and maintenance of adequate keratinized gingiva (KG) around the tooth. Studies indicate that a minimum of 3 mm of space between restorative margins and alveolar bone would be adequate for periodontal health, allowing for 2mm of BW space and 1 mm for sulcus depth. An adequate width of KG should be maintained around a tooth (±2 mm) for gingival health whenever possible.

Classification
1. Based on Gingival Reduction with or without Osetectomy
   I. Gingival reduction only bone removal not required
      • Gingivectomy
      • Gingival flap surgery
   II. Mucoperiosteal flap with ostectomy: Bone removal required
      A. One-stage procedures, which require one of the following:
         • Flaps, ostectomy, apical positioning
         • Flaps, ostectomy, gingivectomy, positioning
         • Gingivectomy, flaps, ostectomy, positioning
      B. Two-stage procedure, which requires:
         • Flaps, ostectomy, and repositioning 4 to 6 weeks later — Gingivectomy.
2. Based on Purpose
   I. Esthetic Crown Lengthening: Crown lengthening for esthetic reasons aims to correct either a gummy smile or gingival overgrowth.
   II. Restorative (or Functional) Crown Lengthening: Crown lengthening for restorative reasons include increasing retention and to expose subgingival caries, fracture, or restorative margins by increasing the amount of sound tooth structure above the alveolar crest.

Indications
- Restorative needs.
- To increase clinical crown height lost due to caries, fracture and wear.
- To access subgingival caries.
- To produce a ferrule for restoration.
- To access the perforation in the coronal third of the root.
- To relocate margins of the restorations that are impinging on biological width.
- Esthetic.
- Short teeth.
- Uneven gingival contour.
- Gummy smile.

**Contra Indications and Limiting Factors**
- Inadequate crown to root ratio.
- Non restorability of caries or root fracture.
- Esthetic compromise.
- Inadequate predictability.
- Tooth arch relationship inadequacy.
- Compromise adjacent periodontium or esthetics.
- Insufficient restorative space.
- High furcation.
- No maintainability.

**Presurgical Analysis**
Smukler and Chaibi (1997) recommended the following presurgical clinical analysis prior to crown lengthening procedures:

1. Determine the finish line prior to surgery.
2. If non determinable, it should be anticipated.
3. Transcrevicular circumferential probing prior to surgery is performed for establishing the biologic width (Bone Sounding).
   a. Surgical site
   b. Contralateral site
4. The biologic width requirements will determine the amount of alveolar bone removal.
5. The combination of biologic width and prosthetic requirements determines the total amount of tooth structure necessary for exposure.
6. Tooth structure topography, anatomy, and curvature are analyzed for determining
   a. Osseous scallop.
   b. Gingival form.

**General Tissue Assessment before Undertaking Crown Lengthening**

**Soft Tissue Assessment**

**Situation 1** If width of attached gingiva adequate (>3mm)- external bevel gingivectomy or internal bevel gingivectomy

**Situation 2** If width of attached gingiva inadequate (<3mm)- apically positioned flap

**Hard Tissue Assessment**

**Situation 1** If bone crest is low i.e. more apically – no ostectomy

**Situation 2** If bone crest is high i.e. more coronal- ostectomy performed.

**Treatment Options**
The techniques of surgical crown lengthening are:

a. external Bevel Gingivectomy
b. Internal Bevel Gingivectomy with or without bone reduction
c. Apically positioned flap with or without bone Reduction
d. Combined technique (Surgical and orthodontic)

**Crown Lengthening Surgery Using External Bevel Gingivectomy**
This technique is generally performed when there is sufficient sulcular depth and keratinized tissue so that the incision does not violate the biologic width or cause exposure of the bone. It can be performed with the help of scalpel or a Kirkland knife (conventional), lasers or electrocautery. The incisions are given apical to the point of tissue that is desired to be removed. The incisions are directed coronally. Discontinuous or continuous incisions may be used. The incision should be bevelled approximately 45 degrees to the tooth surface and should recreate, as far as possible, the normal festooned pattern of the gingiva. Then the excised tissue should be removed. Carefully granulation tissue should be curedt out and any remaining calculus or necrotic cementum should be removed so as to leave a smooth clean surface. Finally, the area should be covered with a periodontal pack. 

Crown Lengthening Surgery Using Internal Bevel Gingivectomy With or Without Ostectomy (Undisplaced Flap)

It can also be referred as flap surgery with or without osseous surgery.

**Flap Surgery without Osseous Surgery:** In this technique the initial or inverse bevel incision is made depending upon that how much crown exposure is required. Then the second or the crevicular incision is made from the bottom of the sulcus to the bone to detach the connective tissue from the bone. The clinician should determine that enough attached gingival will remain after the incisions are made so that any maccogingival defect does not occur. The flap is then raised and third incision is given to remove the tissue tags. After complete scaling and root planning, flap is then sutured back in position.

**Flap surgery with osseous surgery:** It is the most common procedure used for clinical crown lengthening. A mucoperiosteal flap is designed and raised as described above. The alveolar bone is reduced by osteectomy and osteoplasty, using a combination or rotary instruments and chisels to expose the required tooth length in a scalloped fashion to follow the desired contour of the overlying gingival. The bone is reduced close to the tooth followed by measuring the bone level carefully in all locations around the tooth to be certain that the
minimal dimension of 3 to 5 mm of tooth height has been achieved throughout the entire circumference of the tooth. Following flap surgery, a periodontal dressing may be placed to aid in maintaining flap adaptation. Gentle brushing and flossing may begin at 4 to 7 days post-surgery or following dressing removal at 7 days post-surgery. Chlorhexidine mouth rinse should be used for 4 to 6 weeks to aid in plaque control. Restorative procedures should be delayed until 3 to 6 months post-surgery. The longer period reduces the risk for gingival margin shrinkage in areas requiring maintenance of subgingival restoration margin. Provisional restorations may be reshaped at 3 to 4 weeks post-surgery but the margins should be placed supragingivally.

Using Apically Positioned Flap with or Without Ostectomy
The apically positioned flap technique with bone recontouring (resection) may be used to expose sound tooth structure. As a general rule, at least 4 mm of sound tooth structure must be exposed at time of surgery. During healing the supracrestal soft tissues will proliferate coronally to cover 2-3 mm of the root, thereby leaving only 1-2 mm of supragingivally located sound tooth structure.19

Combined (Surgical And Non-Surgical[Orthodontic])
In this technique, orthodontic therapy is done along with surgical technique. Increasing the clinical crown length by orthodontic extrusion is useful when the amount of surgical bone reduction around the affected tooth and adjacent teeth would be excessive. The major advantage of this procedure is the reduced hazard to the adjacent teeth with very little change in crown/root ratio occurs. Orthodontic extrusion for crown lengthening is of prime importance in esthetic zone, because it results in better crown root ratio and improved esthetics than surgical procedure alone as shown in the picture below. The procedure may be
contraindicated, however, because of short root length ratio and poor root form, which result in inadequate crown/ root ratio following extrusion. The extrusion can be performed in two ways:  

1. Using LOW ORTHODONTIC FORCE, the tooth can be extruded slowly, bringing the alveolar bone and gingival tissue with it. The tooth is extruded until the bone level has been carried coronal to the ideal level by the amount that will need to be removed surgically to correct the attachment violation. The tooth is stabilized in this new position and then is treated with surgery to correct the bone and gingival tissue levels.

2. Second method is by applying rapid orthodontic extrusion, where the tooth is extruded rapidly. During this period, a supercrestal fibrotomy is performed weekly in an effort to prevent the tissue and bone from following the tooth. Occasionally, especially with rapid orthodontic extrusion, there is no need for osseous reduction and the soft tissue may be removed by simple excision. The tooth is then stabilized for at least 12 weeks to confirm the position of the tissue and bone, and any coronal creep can be corrected surgically.

CONCLUSION

Harmony between periodontal tissue and restoration is very important factor for success of treatment both functionally and esthetically. Erroneously placed restorative margin and unadapted restoration violates the biologic width which leads to the instability of both the factors and can lead to deleterious effects on the periodontium and restoration failure.

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