Biologic Width and Its Importance in Dentistry

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Abstract
Biological width and the health of the periodontium are inseparable. Any violation of the biological width impairs the normal periodontium. This article gives a brief overview about the concept of biological width and its importance in implants and restorative dentistry.

Key words: Biological width, periodontium, margin placement, violation of biological width, periodontitis

INTRODUCTION
Biological width is defined as the dimension of soft tissue which is attached to the portion of the tooth coronal to the crest of alveolar bone. (Gargiulo et al 1961) Gargiulo et al described the dimensions and relationships of the dentogingival junction in humans. Following his work, the biological width was found to be 2.044 which represents: a sulcus depth of 0.6mm, an epithelial attachment of 0.97mm and connective tissue attachment of 1.07mm. [1]

A similar study performed by Vacek et al 1994 [2] by evaluating cadaver tooth surfaces concluded that the connective tissue attachment was the most consistent measurement based on the mean measurements of 1.34 mm for sulcus depth, 1.14 mm for epithelial attachment and 0.77 mm for connective tissue attachment.

CONCEPT OF BIOLOGICAL WIDTH

Encroachment of the biological width becomes of particular concern when considering the restoration of a tooth that has fractured or been caries near the alveolar crest. [8]

Maynard and Wilson (1979) divided the periodontium into 3 dimensions: superficial physiologic, crevicular physiologic and subcrevicular physiologic. [5]

The superficial physiologic dimension represent 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. [9]

Maynard and Wilson claimed that all three of these dimensions affect restorative treatment decisions and the clinician should conceptualize all three areas and the interplay between them and restorative margins. [5]

In particular, authors claimed that to prevent the placement of 'permanent calculus', margin placement into the subcrevicular physiological space should be avoided.

CLINICAL EVALUATION OF BIOLOGICAL WIDTH-

Biological width is determined in clinics using periodontal probe. The biological width can be identified by probing under local anesthesia (referred to as 'sounding to bone') subtracting the sulcus depth from the surrounding measurements.

If this distance is less than 2mm at one or more locations, a diagnosis of biological width violation can be confirmed. This measurement must be performed on teeth with healthy gingiva and should be repeated on more than one tooth to ensure accurate assessment and reduce individual and site variations. [10]

In 2000, Kois proposed three categories of biological width based on total dimension of attachment and the sulcus depth following bone sounding measurements. They are normal crest, high crest, low crest. [11]

Normal crest patients: The midfacial measurement is 3mm and the proximal measurement range from 3mm to 4.5mm. It occurs approximately 85% of the time. The gingival tissues tend to be stable in patients.

High crest patients: It occurs in approximately 2% of the time. There is one area where the crest is seen more often, in a proximal surface adjacent to an edentulous site. In these patients, the mid-facial measurement is less than 3mm.

Low crest patients: It occurs approximately 13% of the time. The mid-facial measurement is greater than 3mm and the proximal measurement is greater than 4.5mm. [10]

Radiographic interpretation can also be used for identification of inter proximal violations of biological width but they are not diagnostic because of tooth superimposition. [12]

MARGIN PLACEMENT

There are three options available for the placement of margins: supra gingival, equigingival and sub gingival.
1. Supragingival
It has the least impact on the periodontium. This margin has been applied in non-esthetic areas due to the marked contrast in color and opacity of traditional restorative materials against the tooth.

[8]

Advantages
1. Preparation of the tooth and finishing of the margin is easiest.
2. Duplication of the margins with impressions that can be removed past the finish line without tearing
3. Fit and finish of the restoration and removal of excess material is easiest.
4. Verification of the marginal integrity of restoration is easiest.
5. The Supragingival margins are least irritating to the gingival tissues. [13]

2. Equigingival Margin
It was thought that placement of equigingival margins caused more plaque accumulation than supragingival or sub gingival margin resulting in gingival inflammation. But, today the restorative margins can be esthetically blended with the tooth and finished to provide a smooth, polished interface at the gingival margin.

3. Subgingival Margin
Authors have correlated that subgingival restoration demonstrated more quantitative and qualitative changes in the micro flora, increased plaque index, gingival index, recession, pocket depth and gingival fluid. ([14], [15])

VIOLATION OF BIOLOGICAL WIDTH
Authors have compared Bermuda triangle to biological width. Like the Bermuda triangle where a number of aircraft and sea vessels are said to have disappeared, the margins of the prosthetic crowns are extended so much that the dentist loses the access and vision where the margin is actually located, in the sulcus region. This leads to periodontal complications and eventually leading to prosthetic failure. [16]

Signs of biological width biological width violation:
1. Chronic progressive gingival inflammation around the restoration.
2. Bleeding on probing.
3. Localized gingival hyperplasia with minimal bone loss.
4. Gingival recession
5. Pocket formation
7. Alveolar bone loss. [1]

BIOLOGICAL WIDTH IN IMPLANTS
In an investigation [17] to determine the position of the implant-abutment interface relative to the crest of the bone and peri-implant tissues, it was revealed that when the implant-abutment connection was placed at the gingival level supracrestal to the alveolar bone, the biological width measurement was similar to natural dentition.

When the interface was placed at deeper level, the biological with increased accordingly. When the restoration margin is placed far below the gingival tissue crest, it will impinge on the gingiva and
constant inflammation is created. Highly scalloped, thin gingiva is more prone to recession than a flat periodontium with thick fibrous tissue. However, the implant level should always be placed subgingivally to allow development of desired profile and aesthetics. ([18]-[23])

**BIOLOGICAL WIDTH IN RESTORATIVE DENTISTRY**

The relationship between restorative dentistry and periodontics is interdependent. Restorative procedures must be based not only on mechanical specification but also fulfill biologic requirement. [24]

If there are no signs of inflammation before the restoration, then the following rules can be followed:

1. If gingival sulcus is 1.5mm or less, then place the margin one half the depth of the sulcus below the tissue crest. Thus, the margin is far enough below the tissue so that it is still covered if the patient is at higher risk of recession.

2. If gingival sulcus is greater than 2mm, then the margins of restoration is prepared 0.7mm subgingivally. This places the margin far enough below the tissue so that it is still covered if the patient is at higher risk of recession.

3. If gingival sulcus is more than 2mm, especially in an esthetically zone from vestibular side then gingivectomy is recommended and margins of restoration is prepared 0.5mm subgingivally. ([25]-[27])

**Restoration overhangs**

Restorative overhangs pose a significant concern as their prevalence has been estimated at 25-76% for all restored surfaces. (Brunsvold & Lane 1990)


Instead of curettes and sonic scalers, motor driven diamond tips can be used to remove overhanging restorations. [28]

**Surgical crown lengthening**

Teeth with subgingival caries or shortened by extensive caries, short clinical crowns with or without esthetically deficiencies and teeth shortened by incomplete exposure of the anatomic crowns are indicated for surgical crown lengthening.

Surgical crown lengthening procedures:

1. **External Bevel Gingivectomy**

It eliminates excessive pocket depth and exposure of additional coronal tooth structure. It is indicated in crown lengthening of multiple teeth in a quadrant and contraindicated in crown lengthening of single teeth in esthetically zone.

2. **Apically Displaced Tooth**

When the tooth is apically displaced, osteotomy is done. The osseous contour and height of supra gingival crest is estimated by "sounding" to bone.
3. Forced Tooth Eruption
Orthodontic tooth movement will cause the entire attachment apparatus and dentogingival junction to move with the root of the tooth coronally. It is indicates in sites where removal of attachment of bone from adjacent teeth must be avoided. It is contraindicated in individuals who have only a few teeth remaining.

3. Forced Tooth Eruption With Fibrotomy
When fibrotomy is performed the crestal bone and gingival margin are retained at the pretreatment location. It is indicated where the location of gingival margin should be unchanged. It is contraindicated in teeth associated with angular bone defects and ectopically erupting tooth.

If the margins of the final restoration will be <3mm from the alveolar bone crest, crown lengthening is recommended. [29]

Artificial crown contour Yuodelis et al (1973) demonstrated that the greater the amount of facial and lingual bulge of an artificial crown, the more the plaque retained at cervical margin.

CONCLUSION
The health of the periodontium is necessary for maintenance of the stability of the teeth. Any jeopardy to the periodontium can cause instability of the teeth and cause exfoliation. Biological width is a key aspect in maintaining the periodontium. Any encroachment of biological width would affect the healthy status of the periodontium. Meticulous care must be taken in designing the margin of the restorations to maintain the periodontium.

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