Biological width: The silent zone

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Abstract
Biologic width is a specific concept which reveals the dimensional relationship between epithelial attachment, sulcus depth, connective tissue attachment and alveolar crest. This natural seal is essential for maintenance for periodontal health and its violation leads to a damaged periodontium. An adequate understanding of biologic width is essential to ensure form, function and esthetics of the dentition. Violation of biologic width leads to complications like gingival inflammation and alveolar bone loss. This article discusses various methods for biologic width assessment, guidelines for margin placement and various procedures for reconstruction of biologic width around natural teeth as well as dental implants.

Key words: Biologic width, gingival inflammation, Bone loss, Teeth.

Introduction
Use of broad spectrum antibiotics in the dental setting has increased for therapeutic and prophylactic purposes in an alarming fashion. This is leading to the development of resistance to drugs and has become inefficient in curing infections. Studies throughout the world have shown that the prescription of antimicrobials by dentists is more prophylactic rather than treating a disease. Therefore, the inappropriate prescribing of antibiotics by dental practitioners is playing a significant role in the emergence of resistant microbial strains.

Introduction
The relationship between periodontal health and the restoration of teeth is interlinked.¹ Rather a great emphasis focused on the perio-restorative interface in restorative dentistry still many clinicians remain unable to utilize the concept of biologic width in a practical manner.²

Biologic width may be defined as “the total of supracrestal fibers, junctional epithelium and sulcus”.³ The term “biologic width” reveals dimensions of the connective tissue barrier between sulci and bone around teeth or implants are specific, scientifically robust, and unchangeable. The associated dimensions are hundredths of a millimeter (2.04 mm). Now dentists are taught that “the science” on the subject is settled and that biologic width is indeed a reality.⁴

The science behind biologic width
"Biologic width: the means of the means of the means of the various measurements"

Biologic width is the term applied to the dimensional width of the dentogingival junction. It was first described by Sicher in 1959 as “dentogingival junction” in which he conceived of a “physiologic division of labor of supporting tissues”.⁵ Data from the original paper by Gargiulo et al⁶ was used as the basis for the introduction of the notion of biologic width. The reported findings were gleaned from 30 human cadaver jaws, with an
Evaluation of biologic width violation

Clinical method: The signs of biologic width violation are chronic progressive gingival inflammation around the restoration, bleeding on probing, localized gingival hyperplasia with minimal bone loss, gingival recession, pocket formation, clinical attachment loss and alveolar bone loss.4

Bone sounding: The biologic width can be assessed by probing under local anesthesia to the bone level and if this distance is less than 2 mm at one or more locations, a diagnosis of biologic width violation can be confirmed.11 However, this method is not used routinely for biologic width assessment when other methods are available. Its use should be limited to surgical procedures under local anesthesia as a presumptive guide for bone level assessment.

Radiographic evaluation: Radiographic interpretation can identify interproximal violations of biologic width (Fig. 2). A new innovative parallel profile radiographic (PPR) technique has been devised which could be used to measure both length and thickness of the dentogingival unit with accuracy.12

Margin placement and Biologic width

A clinician is presented with three options for margin placement: supragingival, equigingival, and subgingival.13

Supragingival margin: It has the least impact on the periodontium. It has been applied in non-esthetic areas due to the marked contrast in color and opacity of traditional restorative materials against the tooth. Its advantages are ease of tooth preparation, finishing and duplication of the margins.

Equigingival margin: They were thought to favour more plaque accumulation than supragingival or subgingival margins, and therefore result in greater gingival inflammation. These concerns are not valid today, because the restoration margins can be esthetically blended and can be finished easily. From a periodontal viewpoint, both supragingival and equigingival margins are well tolerated.

Subgingival margin: Restorative considerations (caries and tooth deficiencies) will frequently dictate the placement of restoration margins beneath the gingival tissue crest. Investigators have correlated that subgingival restorations demonstrated more quantitative and qualitative changes in the micro flora, increased plaque index, gingival index, recession, pocket depth and gingival fluid.14

Margin placement guidelines

Based on the sulcus depth the following three rules can be used to place intracrevicular margins:15

1. If the sulcus probes 1.5 mm or less, the restorative margin could be placed 0.5 mm below the gingival tissue crest.
2. If the sulcus probes more than 1.5 mm, the restorative margin can be placed in half the depth of the sulcus.
3. If the sulcus is greater than 2 mm, gingivectomy could be performed to lengthen the tooth and create a 1.5 mm sulcus. Then the patient can be treated as per rule 1.

Categories of biologic width

Kois proposed three categories of biologic width based on the total dimension of attachment and the sulcus depth following bone sounding measurements: Normal Crest, High Crest and Low Crest.16,17

Normal crest patient (85%): In this, 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.

High crest patient (2%): In this, the mid-facial measurement is less than 3.0 mm and the proximal measurement is also less than 3.0 mm. In this, it is commonly not possible to place an intracrevicular margin because the margin will be too close to the alveolar bone.

Low crest patient (13%): In this, the mid-facial measurement is greater than 3.0 mm and the proximal measurement is greater than 4.5 mm. Traditionally, these patients have been described as more susceptible to recession secondary to the placement of an intracrevicular crown margin.
Reconstruction of biologic width
Violated biologic width can be reconstructed by means of a number of techniques.

Surgical crown lengthening:
Crown lengthening surgery is designed to increase the clinical crown length

**Indications:**
1. Inadequate clinical crown for retention due to subgingival caries or tooth fracture within the cervical 1/3rd of the root in teeth with adequate periodontal attachment,
2. Placement of subgingival restorative margins,
3. Unequal, excessive or unaesthetic gingival levels for esthetics,
4. Teeth with excessive occlusal wear or incisal wear,
5. Teeth with inadequate intercuspals for proper restorative procedures due to supracranption.

**Contraindications:**
1. Deep caries or fracture requiring excessive bone removal,
2. Post surgery creating unaesthetic outcomes,
3. Tooth with inadequate crown root ratio,
4. Non restorable teeth,
5. Tooth with increased risk of furcation involvement.

External bevel gingivectomy: It can be used only in situations with hyperplasia or pseudopocketing (> 3 mm of biologic width) and presence of adequate amount of keratinized tissue.

Internal bevel gingivectomy: Reduction of excessive pocket depth and exposure of additional coronal tooth structure in the absence of a sufficient zone of attached gingiva with or without the need for correction of osseous abnormalities requires internal bevel gingivectomy.

Apical repositioned flap surgery:
This procedure is done when there is no adequate width of attached gingiva and is indicated for crown lengthening of multiple teeth in a quadrant or sextant of the dentition, root caries, fractures and contraindication during surgical crown lengthening of a single tooth in the esthetic zone.

Apically repositioned flap without osseous resection is done when there is a biologic width of more than 3 mm on multiple teeth. Apical repositioned flap with osseous resection is done when biologic width is less than 3 mm.

Orthodontic extrusion: If the biologic width violation is on the interproximal or across the facial surface and the gingival tissue level is correct, then orthodontic extrusion is indicated. The extrusion can be performed in two ways. By applying low orthodontic extrusion force, the tooth is erupted slowly, bringing the alveolar bone and gingival tissue with it. The tooth is stabilized in this new position and then treated with surgery to correct the bone and gingival tissue levels. Another option is to carry out rapid orthodontic extrusion along with it supracrestal fibromy is performed weekly to prevent the tissue and bone from following the tooth. The tooth is then stabilized for at least 12 weeks.

Orthodontic Extrusion associated with Supracrestal Fiberotomy and Root Planing (OEFRP): It is a new flapless technique for crown lengthening after orthodontic extrusion. The OEFRP procedure must be carried out every 2 weeks for the entire extrusive orthodontic phase.

Biologic width and Dental implants
The implant epithelium junction (Fig. 3) is similar to that in the natural dentition, except that it is shorter and thinner than the tooth epithelium junction. Because of the absence of a cementum layer around an implant, most connective-tissue fibers in supracrestal region are oriented in a direction parallel to the implant surface. The average biologic width around implants is 3.08 mm which can have significant influence on the character of soft tissues and depends on a variety of characteristics that include implant design, presence of adjacent teeth and quality of soft tissue.

Berglundh and Lindhe (1996) suggested that the soft tissue attachments (biologic width), once established, were nature’s mechanism for protecting the zone of osseointegration from the bacterial and mechanical challenges of the oral cavity. This study validates the clinical rationale for augmenting soft tissue prior to abutment connection or nonsubmerged implant placement when thin mucosal tissues are present.

Violation of the biologic width
It is the inadequacies of the tooth transition zone (Fig. 4) rather than depth of margin placement that cause tissue inflammation, and it is indeed possible to place restoration margins subgingivally (> 1 mm) without usurping the traditional notion of a biologic width. In other words, the biologic width can be physiologically disregarded or “disturbed”. With appropriate oral hygiene, the intracrevicular position of the restoration did not appear to adversely affect peri-implant mucosal health or stability. The lack of observed peri-implant mucosal pathology in these situations was attributed to the smooth implant component surfaces and the “rotation symmetric” design. This was contrasted with the scalloped cemento enamel junction of teeth.

**A suggested name change to ‘Biologic Barrier’**
The term “biologic width” is regrettably perceived to bestow specific numeric dimensions to a unique and dynamic biologic entity. In any individual epithelial attachment and connective tissue attachment “measurements” will change with time and in response to variations in the local and systemic environment. Given this vast variability, it is inappropriate and misleading to constrain discussion of margin placement to mathematically derived “averages”. These observations underscore...
the need for a name, or at least an emphasis, change - one that reflects the dynamic and mutable nature of the supra-alveolar connective tissue. We are, after all, dealing with a biologic barrier, no more and no less and calling it so should help clarify one more of the inconvenient truths that we have inadvertently burdened ourselves with.4

Conclusion
The biologic width dimensions represent anatomical and physiologic tissues where the host responds to physical (e.g., restorative margins, abutments, and microgaps) and environmental (e.g., bacteria and chemicals) challenges through the initiation of inflammation and, under pathologic conditions, tissue change. Restorative dentists need to take into account that these are responsive biologic tissues and that impinging on them has consequences. Memorizing the mean dimensions may be a good strategy for learning, but few would not recognize that great variability exists in these dimensions just the same as the mean weight of a man or woman or, for that matter, the dimensions of the dental golden proportion. While the fact that the “biologic width” exists and has important consequences for dentistry might be “inconvenient” for some, its significance and existence should not be.26

Biologic width: A physiologically and politically resilient structure

References


Table 1

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<thead>
<tr>
<th>Phase and environment</th>
<th>Total attachment (mm)</th>
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<tbody>
<tr>
<td></td>
<td>Length of epithelial attachment (B)</td>
</tr>
<tr>
<td>Composite average of all phases</td>
<td>0.97</td>
</tr>
<tr>
<td>III Attachment on cementum (at CEJ)</td>
<td>0.74</td>
</tr>
<tr>
<td>IV Attachment on cementum (below CEJ)</td>
<td>0.71</td>
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CEJ = cementoenamel junction