Ref: Ro J Stomatol. 2024;70(3)
DOI: 10.37897/RJS.2024.3.14

Determining biologic width and its relevance in periodontics – a review

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ABSTRACT

The length from the root surface of a tooth to the junctional epithelium and connective tissue attachment is termed as biological width (BW). It protects the tooth from diseases and infections by acting as a natural seal. On an average it is 2.04 mm. In clinical practice the BW is determined by periodontal probe. The calculation of BW can be done by several methods. An identification of BW breach is confirmed when the length is observed to be less than 2 mm at multiple locations or at a single location. When we are considering the prolonged health benefits of any restoration or a natural tooth, the health of the gingiva is of prime importance. An excess of BW breach leads to innumerable adverse effects, which are talked about in this review article. The article sheds light on BW in association to implants and conservative procedures and its evaluation clinically, and also a discussion about the procedures that can be used to rectify BW breaches in routine practice.

Keywords: dental epithelium, periodontal attachment, dentogingival junction, bone sounding, restorative margins, embrasures

INTRODUCTION

The biological width (BW) is described to be the length of soft tissue that is fixed to that part of the teeth which is coronally to the alveolar crest. Association between a restored teeth and periodontal health is inseparable and intimate. Maintaining the health of the gingiva constitutes to be one of the main factors for tooth and tooth restoration prolongation. A good knowledge of the association within restorative dentistry with periodontal tissue is utmost importance to secure decent function along with esthetics [1]. Many dentists have failed to utilize the biologic width concept practically, even when there has been emphasis on periodontic and restorative interface.

Anatomical features of biologic width

It is also called periodontal attachment lamina, is an ectodermal tissue that has a vital role in the preservation of periodontal health. This concept was established by Gargiulo et al (1961), he discussed about association along with the dimensions of the dentogingival juncture in people [2].

Measurements taken in dental and gingival components from 30 autopsy specimens and from these specimens 287 teeth individually were considered, which established that a definite proportional association among the crest of alveolar bone, the epithelial attachment, the connective tissue attachment and the sulcus depth. Following mean dimensions were reported: an epithelial attachment of 0.97 mm, a sulcus depth - 0.69 mm and attachment of connective tissue - 1.07 mm. The basis of this, the BW, often is stated to be 2.04 mm, amounting to the cumulating of the connective along with epithelial tissue readings. Understanding that marked differences in measurements were visible, specifically in the attachment of the epithelium, which had a range from 1.0 - 9.0 mm whereas the attachment of connective

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Article History:
Received: 27 May 2024
Accepted: 25 September 2024

tissue, was constant. Biologic width with similar dimensions were also observed in the study by Vacek et al. 1994 [3]. 171 tooth surfaces from cadavers were evaluated, the average dimension of 1.14 for attachment of the epithelium, 1.34 mm – sulcus depth and 0.77 mm – attachment of the connective tissue was observed. Measurement that was very consistent was that of the connective tissue attachment.

Koi categorized biological width as [4]:

1. Normal Crest
2. High Crest
3. Low Crest

Features	Normal Crest	High Crest	Low Crest
Occurrence	85% Gingiva stable for a long time	2% Unusual finding	13% Prone to recession after intracrevicular margin placement
Mid facial measurement	3mm	Less than 3mm	More than 3mm
Proximal measurement	3-4.5mm	Usually adjacent to edentulous area	Greater than 4.5mm

Evaluation of biologic width

1. Clinical Method

If a patient is hurting around tissues when restoration margin are being evaluated by periodontal probe, it is a sign of breach in the biological width. Loss of alveolar bone, CAL, pocket formation, gingival recession, chronic gingival inflammation circumventing restored tooth, hyperplasia, with bleeding on probing and which is localized with the amount of bone loss being minimum are the symptoms of breach in biological width. The locations for hyperplasia of gingiva are restorative margins situated beyond gingival level and passive eruption [5].

2. Bone Sounding

Biologic width can be assessed by "sounding to bone" (under local anesthesia, probing to the level of bone) from the measurement that is resulted, we derive the sulcus depth. Breach in biologic width can be assessed if this distance measured comes out to be <2 mm at multiple places or at a single place. To attain a perfect result and to lessen site and individual bias, measurement must be done on multiple teeth, those having physiologically healthy periodontium.

3. Radio-graphical method

Interproximal breaches in biological width can be interpreted by using radiographs. But because of super-imposition, radio-graphical techniques cover the distofacial, mesiofacial line angles [6]. Estimate the size of the dentogingival unit, a unique technique known as the parallel – profile – radiography (P.P.R) is been used. Since PPR method is straightforward as well as non-invasive, succinct and can be repeatable, authors arrived to the conclusion that it could be used to quantify the thickness and length of the dentogingival unit precisely [7].

Biologic width and its clinical implications

For the removal of the irritant that may cause damage the periodontium and for the preservation of periodontal health, biological width is important. In order to ensure the success of any treatment, a clinician must ensure the biological width is preserved at all time.

There are three options, one clinician can put forward with relation to margin placement:

1. Supragingival
2. Equigingival and
3. Subgingival locations

	Supragingival	Equigingival	Subgingival
Impact on periodontium	Minimal Impact	More impact than supragingival, causes increased plaque retention	Greatest risk, may cause biological width violation
Placement	In non-esthetics area	At the crest of the marginal gingiva	Below the gingiva

The biologic width is not consistent, it varies from tooth to tooth, dependable on the site of the tooth in alveolus, and dependable on the side of the tooth. It has been proved – 3 mm between the alveolar bone and prepared margin helps in maintaining periodontal health (4-6 months) [8]. 3 mm constitutes for 1 mm junctional epithelium,1 mm supracrestal connective tissue attachment, and 1 mm for gingival sulcus on an average. Thus even the margins of the restoration are 0.5 mm within the gingival sulcus, there is sufficient biological width [9].

Rules for margin placement

If the sulcus probes 1.5 mm or less, the margins of the restoration could be positioned 0.5 mm below the gingival tissue crest. Can be placed in the sulcus, half of the depth of sulcus depth is deeper than 1.5 mm. Gingivectomy done if the sulcus is greater than 2 mm to create a 1.5 mm sulcus and to extend the tooth. Then, rule number 1 can be applied.

Interdisciplinary effects of biologic width

Biologic width encroachment is a chief concerning factor is a tooth with a restoration which has caries near alveolar crest area or is fractured [10]. Ectodermal tissue situated within body acts as bar-

rier that fights the bacterial and unknown particle invasion. Yet, barrier must be traversed by both dental implants, tooth. So, term for seal which forms organically circumventing both and that defends alveolar bone from infection is biological width.

Importance of biologic width in prosthodontics

In addition, the unpolished margin of the prosthesis becomes an ideal ground of bacterial colonization causing an inflammatory response and leading to violation of the biological width [11]. Overtime, this improper rehabilitation may lead to inflammatory responses and gingival recession. Hence, supragingival and Equigingival margins are more encouraged. Sublingual margins are contraindicated as they pose the highest risk of violating the biological width by impinging the gingival attachment apparatus which may be a cause for:

A) Gingival recession
B) Gingival hyperplasia
C) Bone resorption

Importance of biologic width in implantology

For an implant placement to be successful, a large of focus should be on accurate analysis of the biologic width of the region of interest. Berglundh T et al. stated that the soft tissue development occurring around the implant during abutment connection has dimensions similar to the natural biological width [12]. In addition studies conducted by Hermann JS et al determined how an implant abutment interface must be supracrestal to the bone, with a 3mm depth from the labio-gingival to preserve the biologic width and ensure the longevity of the implant placed [13].

The buccal bone also must be at least 2mm to prevent circumferential bone loss, hence following the 2B-3D rule of implant placement. A modern take on prevention of bone loss in implant cases is the use of platform switches. The lingual placed switch reduces the diameter of the implant thereby preventing implant contamination and subsequent biologic width violation and recession.

Importance of biologic width in restorative dentistry

Overhanging restorations are a deterrent to the health of the periodontium. It is one of the most significant etiological factors contributing to the progression of periodontal disease.

An overhanging restoration can lead to problems such as:

- Increased plaque accumulation
- Impingement on interproximal embrasures
- Decreased crestal bone height

A retrospective comparative study conducted by Desai et al in 2021 evaluated the severity of bone loss in Class II, Class III restorations as well as crowns and bridges by calibrating the calculation from CEJ till the crest of alveolar bone. In addition, they also compared the pattern of bone loss in the restorations. Through these studies, the authors were able to conclude that angular bone loss is more prevalent than horizontal bone loss and Class II restorations facing the highest likelihood of bone loss [14].

While overhanging restorations serve as a potential threat of their own to the gingival health, special emphasis must also be laid on Class V restorations and their impact on the biological width. Faulty Class V restorations alter the periodontal microflora, leading to an increase in pathogens such as Fusobacterium nucleatum polymorphum and Geinella morbillorum to name a few. Michele Paolantonio et al. stated in his study that composite restorations usually have a negative impact on the gingiva [15]. Hence, in such cases, glass ionomer cement is preferred.

Importance of biologic width in endodontics

Biologic width has a crucial role to play in case of fractured teeth. Trauma to the teeth ruptures periodontal ligaments and Sharpey's fibers may lead to biological width violation. Hence, biological width is a prime factor that determines the prognosis of the overall treatment outcome for endodontically treated teeth. In a case report by Peixoto et al in a 24 year old male who came with an Ellis Class III fracture with irreversible pulpitis and a biological width violation of 2 mm.

Periodontal surgery was performed along with an ostectomy and osteoplasty to establish the biologic width and increase the crown length. The tooth was stored in saline and later endodontically treated. A 3 year follow up to check the status of the lamina dura was done to ensure the tooth was both endodontically as well as periodontally sound. The lack of periodontal pockets, mobility and bleeding on probing were indicators of restoration of biologic width in this case [16].

Importance of biologic width in pediatric dentistry

Due to the extruded positioning of the anterior teeth, the upper incisors are at the highest risk of dento alveolar traumas, especially in children. An involvement of the biologic width often poses a chance of a poor prognosis and hence, immediate care must be delivered. A case report presented by Nandlal B et al. and Daneswari V et al. involved an irreversible pulpitis with vertical crown-root fracture in a 10 year-old patient. Unlike conventional techniques, they used a conservative technique of reattaching the fragments using dentin bonding agents to preserve the functionality as well as biologic width of the tooth. Vertical grooves reinforced

with flowable composite were used to strengthen the tooth internally. Splints were placed, flap surgery performed along with odontoplasty to preserve the biologic width of the tooth conservatively [17]. This technique ensured adequate bone and gingival levels and successful maintenance of biologic width surrounding the tooth.

Management of biologic width violation

A case where a tooth restoration becomes carious nearing to crest of the alveolar bone or it has cracked then the encroaching of BW becomes the chief concern. Aesthetics, dictate us to bury margins of restoration beneath margins of the gingiva, which pressurizes them into sulcus of gingiva, thus violating the BW. Both interpersonal as well as intrapersonal heterogeneity existing within the BW. Each patient and each site must be analyzed before making a decision, so as to respect the anatomy [18].

Crown lengthening – surgically

Strategy of crown lengthening which has been considered the best is made as choice after analysis of each case, regard to the association of the root, crown of the alveolar bone.

Crown lengthening – surgical	Procedures – orthodontic
Gingivectomy – internal bevel, external bevel	Rapid, slow, forced eruption with/ without supracrestal fibrotomy, fibrotomy and root planning
Apical repositioned flap (ARF) surgery – with/without reduction	

Indications [19]

1. Clinical crown length deficiency for retention due to extensively large and deep caries, subgingival/cemental/root caries, root perforation, or any type of tooth fracture, or resorption within the cervical 1/3rd of the root with suitable periodontal attachments
2. Insufficient or short crowns clinically
3. Unequal, excessive, or unaesthetic levels of gingiva esthetically
4. Tooth with tremendous occlusal and incisal wear
5. Supraeruption of teeth causing less interocclusal space for restorative procedures
6. Teeth requiring root resection and hemisection.

Contraindications [20]

1. Fractured tooth or carious tooth which in which bone removal is been advised.
2. A compromise on alveolar bone support or esthetics
3. Teeth that cannot be restored.
4. Tooth with risk furcation involvement

Complications [20]

1. Presence of black triangles leading to poor esthetics
2. Hypersensitivity of the root
3. Resorption of the root
4. Tooth mobility

Surgical methods for crown lengthening

1. Gingivectomy

Effective; can be done when pseudo pocketing (>3 mm BW) or hyperplasia and considerable amount of tissue i.e. keratinized is there.

1.1. External bevel. External-bevel is a method in which we reduce the excessive depth of a pocket and expose larger tooth structure coronally where attached gingiva present is sufficient or larger and no involvement of bone. [21]

1.2. Internal bevel. Not requiring to rectify osseous defects, minimizing huge depth of pocket and exposing the supplemental coronal tooth part in absenteeism of a required zone of attached gingiva requiring surgery. The flap, always beveled within to uncover the supporting alveolus. [22]

2. Apical repositioned flap (ARF) surgery [23]

It's advised when crown lengthening is to be done in multiple teeth in a single quadrant. This technique is not advised for crown lengthening of singular tooth, specifically for aesthetically significant areas.

2.1. Apical repositioned flap without osseous reduction. When the BW is more than 3 mm and there is inadequate width of the attached gingiva. This method is indicated.

2.2. Apical repositioned flap with osseous reduction. In cases where in the BW - <3 mm, inadequate breadth or inadequate area of attached gingiva. Osteotomy is done first, then secondly osteoplasty to expose sufficient tooth part in scalloped pattern, then getting a perfect contour of overlying gingiva. An unsaid rule that says 4 mm of structure of tooth needs to be uncovered, as soft tissues will bulge coronally to cover 2-3mm of root, which leaves 1-2mm of supragingival structure of the tooth.

Orthodontic techniques

1. Slow orthodontic movement

Slow forces are applied to cause a slow tooth eruption. This causes the periodontium to move along with the tooth. Tooth is extruded until level of the bone has achieved position coronally which can be compared to ideal position having sufficient area addressing biological breach.

2. Rapid orthodontic movement

Tooth is made to erupt to required level for number of weeks (once a week supracrestal fibrotomy

done, to halt the tissue, bone from covering the tooth).

3. Forced eruption method

Method which is used in treating "non-restorable"/"hopeless" teeth. This was first told by Heithersay et.al. [24] Advised: conventional crown lengthening via ostectomy is unattainable such as in anterior area. When not much sufficient crown : root ratio, not the desired amount of occlusal clearance which is paramount for eruption, periodontal problems, are situations in which forced tooth eruption is not feasible[25].

4. Forced eruption with fiberotomy

The combination of using extrusion by orthodontic techniques and detachment of supracrestal fibres. The gingival margin and the crestal bone fall back in their original targets if fibrotomy, performed while performing the forced eruption method, leaving tooth-gingiva interaction with the adjacent tooth intact. Fiberotomies are done once every 7 to 10 days in the forced tooth eruption phase [26].

5. Orthodontic extrusion (OEFRP) and supracrestal fiberotomy

Flapless method to extend crown preceded by extrusion with the help of orthodontic methods. Throughout, whole extrusive phase, OEFRP method should be performed in 14 days [27].

Future perspectives

Significant reporting is done with a number of cases are studied but there is a need for laboratory-based research and also the need for clinical assessment in respect with Biological Width. Studies could be done analyzing the Biological Width in varied populations and figuring which technique of evaluation is supremely advisable. Studies which focusing on aspects like this could enhance the ongoing scientific literatures.

CONCLUSION

Biologic width is key in maintaining the periodontal health, affecting the wellbeing of a tooth. Breaches due to marginal restoration being improper cause's complexities. Techniques similar to orthodontic methods or crown lengthening could be practiced to preserve the biologic width. Not required to mention that the, biologic width is the organic seal that protects the tooth and periodontium, which has to be kept intact for having a good oral health.

Conflict of interest: none declared
Financial support: none declared

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