Biologic Width – A Comprehensive Review

Surbhi Patil[1], Gauri Ugale [2], Vishnudas Bhandari [3], Priya Lahane [4]
[1]PG Student, [2]Professor, [3] Professor & HOD, [4] Lecturer,
Dept of Periodontology and Implantology, MIDSR Dental College, Latur.

Abstract:
The relationship between periodontal health and the restoration of teeth is special and indivisible. Maintenance of gingival health is essential for tooth and dental restoration's longevity. Violation of any kind to the biological width hampers the normal periodontium. A plethora of Biologic width violations can lead to numerous complications, which are discussed briefly in this article. Despite an increase emphasis on the perio-restorative interference in restorative dentistry, many clinicians have been unable to utilize the concept of biologic width in a practical manner. Biologic width is essential for the preservation of periodontium, which ultimately decides the success of restorative procedures. This article reviews the anatomy, alterations, evaluation, violation, methods to correct the violation of biologic width and its relationship to periodontal health and restorative dentistry.

Keywords: Crown lengthening, dentogingival complex, restoration margin, biologic width violation.

Corresponding Author: Dr. Surbhi Patil, PG Student, Dept of Periodontology and Implantology, MIDSR Dental College, Latur. Email id.: surbhipatil01@gmail.com

INTRODUCTION:

To guarantee adequate dental structure for a repair or cosmetic enhancement, teeth may need to be surgically exposed or have their crowns lengthened. This is consistent with basic biology and avoids interfering with biologic width or the periodontal attachment system1.

Understanding how the restorative margin sits in respect to the surrounding gingival tissue is crucial to understanding the connection among periodontal and restorative characteristics. The role that biologic width plays in preserving the health of gingival tissues and forming the gingival form surrounding restorations is something that clinicians must understand. This information is especially important for placing restorative margins, since hiding the point where the margin joins the tooth is the main goal in the aesthetic zone[2].

Historical aspects:

The soft tissue attached to the part of the tooth above the crest of the alveolar bone is measured as the biological width. It refers to the dimensional width of the dentogingival junction that includes the connective tissue beneath it as well as the epithelial connection.

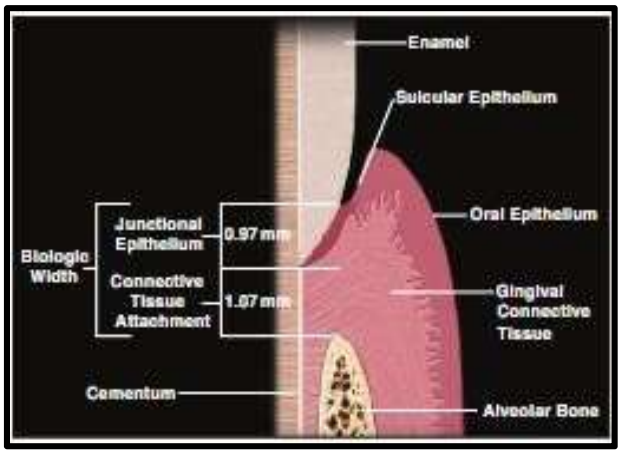

Figure 1: Anatomy of biologic width

Timeline:-

Sr. no.	Year	Author	Work
1.	1959	Seicher	First description
2.	1961	Garguilo, Wentz, Orban	Stated the average measurement precisely as a constant 2.04 mm, with the epithelial attachment measuring 0.97 mm and the connective tissue measuring 1.07 mm. Additionally, a sulcus depth of 0.69 mm was accounted for in this context.
3.	1977	Ingber et al.	Described "Biologic Width"
4.	1977	D. Walter Cohen	First coined the term "Biologic Width"
5.	1984	Nevins and Skurow	Defined biologic width as the sum of the combined supracrestal fibers, the junctional epithelium, and the sulcus which is over 3 mm
6.	1994	Vacek and colleagues	Stated that biologic width increased anteroposteriorly (1.75 to 2.08 mm)[1]
7.	2009 & 2012	Khuller N et al. & Nugala Bet al	Defined biologic width as "the dimension of the soft tissue, which is attached to the portion of the tooth coronal to the crest of the alveolar bone"[3]
8.	2018	World Workshop on the Classification of Periodontal and Peri-Implant Disease and Conditions	Stated biologic width as "Commonly used clinical term to describe the apical - coronal variable dimensions of the supracrestal attached tissues."[4]

Consequently, it is recommended to keep the gingival edge and the bone crest at least 3 mm apart. When the restoration is placed 0.5 mm inside the gingival sulcus, this gap guarantees that there will be enough biologic width present. Protecting periodontal health and avoiding interfering with the biologic dimensions that are indispensable for the health of the surrounding soft tissues are the goals of this guideline[2].

Studies reveal that the biologic width is roughly 2 mm in about 85% of the population. About 13% of the subjects have a distance greater than 2 mm, and 2% of the subjects under investigation had a distance below 2 millimeters. Age and tooth migration from lost occlusal or arch integrity can all affect the biologic width's physiologic placement. Orthodontic treatment can also affect its location. These variances highlight how biologic width is dynamic and sensitive to individual differences as well as dental procedures[6].

Interproximal dentogingival complex:-

As mentioned by Gargiulo and colleagues (1961) and Vacek and colleagues (1994), interproximally, the biologic width is similar to that of the facial surface, but the total dentogingival complexes shows variances. The dentogingival complex is 3.0 mm facially and 4.5 to 5.5 mm interproximally, as highlighted by Kois (1994) and Spear (1999). They emphasized that greater bone scalloping only partially explains the height of the interdental papilla. In 1997, Becker and associates classified differences in gingival scallop (flat, scalloped, and prominent scallop) according to the height variation (2.1, 2.8, and 4.1 mm) of gingival tissue between the face and interproximal regions. 3.0 to 3.5 mm is said to be an average height difference (Wheeler, 1961). According to Spear, the presence of neighboring teeth is necessary to sustain the extra 1.5 to 2.5 mm of interproximal gingival tissue height and interproximal gingival volume.

If there are no neighboring teeth, the interproximal tissue may flatten and assume a biologic width of 3.0 mm with the underlying bone scallop, which could compromise aesthetics. These results are consistent with those of Tarnow and colleagues (1992), who found that greater distances result in a significant loss of gingival height. Specifically, for full coverage of the interdental space by gingival tissue, the distance from the contact point to the osseous crest ought to be between 5 to 5.5 mm. The total number of papilla filling interproximal voids decreased as the distance between teeth grew, according to Cho et al. (2006). Using interproximal denudation, Van der Velon (1982) showed that three years later, interproximal tissue rebounded or recovered by 4.33 mm. This is consistent with the findings of Rusling (1976) and Nyman (1977) about tissue recovery after two years, which were 5.1 and 3.5 mm, respectively. Clinical experience has led some doctors to recommend a minimum of six months (Maynard and Daniel, 1977; Rosenberg and colleagues, 1999; Lanning and colleagues, 2003; Deas and colleagues, 2004) or up to three years (Kois, 1994) for tissue rebound and full maturation[1].

Biologic width in dental implants:

Dental implants also fall under the biologic width concept. A certain peri-implant mucosal breadth, according to certain research, is necessary to maintain the integrity of the soft tissue framework. If this breadth is not enough, there may be a physiological resorption of bone until the required dimension is determined[7].

A study conducted on animals revealed that the peri-implant "biologic width" is roughly 3 to 4 mm in height overall. The epithelial attachment is approximately 2 mm in length, and the supracrestal connective tissue zone is approximately 1 to 2 mm in length. In line with this, a study on human histology discovered that the peri-implant "biologic width," which includes the supracrestal connective tissue and epithelial attachment, has a height of approximately 4 to 4.5 mm[2].

This data is used clinically to detect violations of biologic width. For example, a possible breach of biologic width is indicated when the gingival tissues show inflammation in the absence of any other evident etiologic reasons and the restoration margin is positioned 2 mm or less from the alveolar bone. This knowledge is essential for identifying and resolving problems with dental implant restorations[2].

Clinical significance of biologic width:

Practitioners should know a lot about basic normal anatomy and adhere to the right rules when deciding where to set margins. According to Nevins and Skurow (1984), restoration margin placement should follow these guidelines:

1. It is appropriate to place the restorative margin 0.5 mm below the gingival tissue crest when the sulcus probing depth is 1.5 mm or less.
2. The restorative margin can be positioned half the depth of the sulcus if the sulcus probe depth is greater than 1.5 mm.
3. Gingivectomy may be considered to extend the tooth and create a 1.5 mm space between the gingival tissue and the restorative margin in scenarios where the sulcus probing depth is greater than 2 mm.

The patient can thereafter be managed in accordance with rule 1, with the restorative margin positioned 0.5 mm below the gingival tissue crest[4].

1. **Supragingival Margins:-**

- Impact on Periodontium: Minimal in comparison to other types of margins.
- Because of their color and opacity inconsistency with traditional restorative materials, they are frequently used in non-esthetic areas.
- Benefits: Provides comfort, simplicity, and less gingival irritation.

2. **The Equigingival Margin:-**

- Historical Beliefs: It was once believed that this margin caused more gingival irritation and plaque accumulation than any other.
- Advanced procedures: By using these procedures, it is now feasible to create a smooth, polished interface at the gingival border by artistically blending restorative borders with the tooth.

3. **Subgingival Margin**

- Reasons for Placement: Because of the desire to conceal the tooth/restoration interface, dental cavities, or insufficient tooth structure
- Potential Problems: Placing it too far below the gingival tissue crest can damage the gingival attachment system and result in chronic inflammation. It could be challenging for patients to clean the area thoroughly.
- Repercussions: As the body tries to create space for tissue reattachment within the bone of the alveolar region and the margin, gingival recession and loss of bone may happen.
- Risk factors: More likely to appear in areas where the gingiva is thin and severely scalloped, and when the alveolar bone around the tooth is small.
- Take into account: Stress the need to maintain the adequate gingival third crown contour, appropriate polishing, rounded edges, a sufficient linked gingival zone, and adherence to accepted guidelines (e.g., no deviation from B).

Alterations in biological width:

Restoration of tooth crown defects, whether direct or indirect, that have borders located inside a gingival biologic width area may result in unpredictably low bone loss, gingival inflammation, and loss of the connective tissue attachment. Clinically, periodontal pockets, gingival retraction, and bleeding are possible manifestations of these consequences. These observations have been confirmed by both histology and clinical research.

When Newcomb G. M. (1974) investigated 66 front tooth crowns with edges positioned at different intervals from the epithelial attachment, she discovered that more severe inflammation was caused by deeper subgingival restoration margins. When restoration margins were close to the alveolar bone, Parma-Benfenati S. and co-authors (1986) saw bone resorption in dog teeth up to 5 mm, but when restoration margin were 4 mm from the alveolar bone, no bone resorption happened. Where there was inadequate cortical and interdental bone, there was severe bone resorption.

It was shown by Tal H. and colleagues (1989) that changes in gingival biological width result in the periodontal ligament's destruction. In a one-year study, gingival retraction and loss of bone were more prominent in the experimental group of 43 Class V carious lesions in dog teeth with margins close to the alveolar bone than in the control group, which had amalgam-filled margin at the cementoenamel junction.

Restoration margin within the gingival biologic width area have been shown by Gunay H. and coauthors (2000) to produce periodontal pathology. In regions where the distance between restoration margins and alveolar bone was less than 1 mm, periodontal pockets formed and the index of gingival bleeding increased, according to a 2-year evaluation of 41 patients' 116 restored and 82 healthy teeth. A minimum of 3 mm should be kept between the restoration and the alveolar bone, according to several studies, to maintain periodontal health.

A model describing the periodontium's response to changes in gingival biological width has been published in the literature. It establishes a minimum width of 2 mm necessary for gingiva to adhere to the bone. In cases where this width has been

compromised (less than two mm from the alveolar bone to the restoration margin), gingivitis, or inflammation of the gingiva, develops. This causes the human body to resorb bone in order to make space for the gingival attachment to make contact with the alveolar bone.

The patient's periodontal biotype, which can be divided into two categories with intermediate variants, determines the implications of these alterations.

1. Thin periodontium: 3.5–5 mm in width, less than 1 mm in thickness of connected gingiva, and thin marginal bone.
2. Thick periodontium: thick marginal bone, breadth of 5–6 mm and more, and thickness of attached gingiva to 1.3 mm.

In both situations, the loss of the periodontal ligament and bone may be followed by the development of a periodontal pocket and gingival retraction. When there is little periodontium,

More quickly, marginal bone begins to resorb horizontally. Gingival retraction frequently takes place if the area is well cleaned.

On the other hand, gingival retraction is less frequent and bone loss happens more gradually in those with thick periodontium. However, there is a higher chance of bone abnormalities and undesirable bone shapes developing. Periodontal pockets, difficulties with self-cleaning, and the potential occurrence of: [continuation is required for a comprehensive response] can all result from this condition.

- Root caries,
- Furcation involvement,
- Tooth mobility as a result of the tooth attachment apparatus loss
- Loss of teeth, etc.

It is imperative to preserve the gingival biological width during tooth restoration in order to avert pathological alterations and improve the accuracy of treatment results. When there is less than 2 mm between the margin of the restoration and the marginal bone, clinical crown lengthening should be included in the treatment plan. The relationship between the crown, root, and alveolar bone as well as aesthetic expectations influence the choice to proceed with therapeutic crown lengthening. By carefully balancing functional and aesthetic factors, this method promotes the best possible periodontal health and the success of treatment as a whole.

Evaluation of biologic width:-

1. **Radiographic method** - Finding interproximal biologic width violations can be successfully accomplished by radiographic interpretation. However, because of dental superimposition, radiographs may not be diagnostic in more typical sites such as the mesiofacial and distofacial line angles of teeth. In these circumstances, a patient's sensation of tissue discomfort with the use of a periodontal probe to test restoration margin levels may serve as a trustworthy indicator of the presence of a biologic width violation, as the margin may extend into the attachment.

   The parallel profile radiography (PPR) technique was developed by H. Sushama and Gouri as a novel method of measuring the dento-gingival unit's (DGU) dimensions. According to the authors, the PPR method can precisely determine the length and DGU's thickness. This approach is simple, brief, reproducible, and non-invasive; it provides a useful substitute for determining biologic width and bringing up possible violations[8].

	Normal crest	High crest	Low crest
Mid-facial measurement	3 mm	<3 mm	>3 mm
Proximal measurement	3-4.5 mm	<3 mm	>4.5 mm

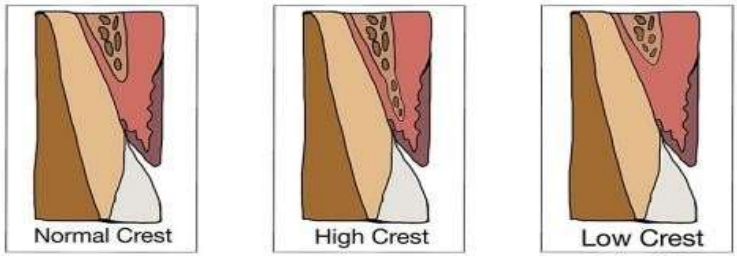

Figure 2: Categories of biologic width

2. **Clinical method -** A more favourable clinical evaluation for biologic width violations can be carried out by measuring the distance between the bone and the restoration margin using a sterile periodontal probe. The probe is carefully introduced from the sulcus to the underlying bone through the anesthetized attachment tissues. Biologic width violation is diagnosed if the distance measured is less than 2 mm at one or more places. To determine the severity of the problem, a circumferential evaluation of the tooth is conducted. It's important to remember, nevertheless, that biologic width violations may still happen in certain patients even in cases where the restoration borders are situated more than 2 mm beyond the level of the alveolar bone.

   Vacek et al. (1994) examined the biologic width phenomena and reported a range of biologic widths that were distinct to a subject. Although their average width measurement of 2 mm agreed with earlier research, they also noted variability, with biologic widths as big as 4.3 mm and as thin as 0.75 mm in certain subjects. This emphasizes the requirement for certain evaluations of biologic width for every patient to ascertain whether further biologic width—beyond 2 mm—is necessary for restorations to blend in with the gingival tissues.

3. **Bone sounding -** This is an additional method to measure biologic width. The biologic or attachment width of the patient is measured by probing to the bone level, and the sulcus depth is subtracted from the resultant value. To ensure accuracy, this process should be carried out on teeth with healthy gingival tissues, and numerous teeth should be evaluated. Bone sounding makes it possible to take into account individual patient variations in sulcus depths. This information is crucial for making a conclusive diagnosis of biologic width violations, figuring out how much correction is required, and setting guidelines for the placement of future restorations.

Figure 3: Assessement of biologic width by bone sounding

Violation of the biologic width:

In restorative dentistry, it is common to encounter situations where restorations need to be extended gingivally for various reasons:

1. Resistance and Retention: To create adequate resistance and retentive form in the preparation.
2. Contour Alterations: To make significant contour alterations due to caries or other tooth deficiencies.
3. Masking Interface: To mask the tooth–restoration interface by locating it subgingivally.
4. Aesthetic Lengthening: To lengthen the tooth for aesthetic reasons.

Nevertheless, if the restoration margin is positioned excessively beneath the gingival tissue crest, it may impede the gingival attachment mechanism, resulting in a breach of biologic width. In an effort to make space for tissue reattachment between the alveolar bone and the margin, the body may experience unpredictable bone loss and gingival tissue recession as a result. In regions where the alveolar bone surrounding the tooth is thin, this is more prone to happen. Tissue recession may be exacerbated by trauma from restorative therapies. The thickness and fibrotic nature of the gingiva as well as the gingival shape are additional characteristics that affect recession risk; thin, heavily scalloped gingiva is more likely to experience recession.[2]

The need for a subgingival restorative margin may be dictated by factors such as caries, tooth fracture, external root resorption, or the need to increase axial

height for retention. Placing the apical margin too close to the bone within the biologic width can lead to chronic inflammation. The short length of junctional epithelium in this scenario is considered a contributing factor. Some believe that a deeply placed subgingival restorative margin close to the alveolar bone crest impairs proper plaque control, promoting inflammatory changes not conducive to a healthy periodontal environment.[6]

Understanding and applying the concept of biologic width is crucial when planning restoration margins, as impinging into this critical space has been associated with plaque accumulation, gingival inflammation, deepened periodontal pockets, gingival recession, attachment loss, and crestal bone loss. In order to avoid encroaching on the biologic width, it is advised that restoration margins be positioned no deeper than 0.5–1.0 mm subgingivally and that there be a minimum of 3 mm separating the restoration from the alveolar crest[7].

Figure 4 and 5: Depicting violation of biologic width

Correction of biologic width violations:

Correction of biologic width is an indication for crown lengthening, and there are two main methods to address biologic width violations:

1. Surgical Correction:

***Procedure:** Includes surgically excising bone to create a space that permits the biologic width to be reestablished in a more apical location, away from the restoration margin.

*** Aim:** to expose the appropriate amount of crown structure in a stable and predictable manner over an extended period of time.

***Preference:** Considered a quicker treatment option when the ensuing crown lengthening results in a more aesthetically acceptable tooth length.

***Method:** A safety zone of 0.5 mm should be eliminated after the bone has been pushed away from the margin by the determined distance of the optimal biologic width for that patient

***Take into account:** There may be a chance of gingival recession following bone removal, particularly if the interproximal bone is removed. This could result in papillary recession and the formation of an unattractive triangle-shaped area under the interproximal contacts.

2. Orthodontic Correction (Extrusion):

***Indications:** If the biologic width violation occurs on the interproximal side, or if the violation occurs across the facial surface and the gingival tissue level is correct, orthodontic extrusion is advised.

***Procedure:** The tooth can emerge gradually, carrying the gingival tissue and alveolar bone with it, by employing a low orthodontic extrusion force. As an alternative, rapid orthodontic extrusion can be used, in which the tooth gradually erupts to the appropriate level over several weeks.

***Supracrestal Fiberotomy:** To stop the tissue and bone from moving with the tooth during rapid orthodontic extrusion, a supracrestal fiberotomy is done once a week, circumferentially around the tooth.

***Stabilization:** The tooth is stabilized for at least 12 weeks to confirm the position of the tissue and bone. Any coronal creep can be corrected surgically if necessary.

The choice between surgical and orthodontic correction depends on factors such as the nature of the biologic width violation, the desired outcome, and the patient's preferences. Both methods aim to restore the proper biologic width and achieve optimal aesthetic and functional results[11].

Figure 6 and 7: Surgical crown lengthening procedure

Figure 8: Orthodontic extrusion

CONCLUSION

The stability of teeth and the health of the periodontal ligament depend heavily on the biologic width. Restoring the periodontium's and the tooth's health should be the main objectives of any restorative procedure in order to guarantee the best possible general health and performance. Clinicians frequently deal with patients including significant caries, subgingival perforation, fragmented teeth, post and core placement in endodontic therapy, etc. in their day-to-day clinical practice. Under these circumstances, the idea of biologic breadth becomes crucial.

Clinicians need to be aware of the critical relationships between different components, paying particular attention to ideas such as biologic breadth, preservation, and crown application.

Lengthening in situations where there has been a breach of biologic width. Complications may arise from improper restorative margins that result in violations of biologic width. Orthodontic methods or surgical crown lengthening can be used to retain the biologic width in cases of such breaches.

It is imperative to stress that biologic width functions as the tooth's and the periodontium's natural seal. Maintaining oral health and avoiding consequences from breaches depend on preserving this biologic width. Clinicians must prioritize gaining a thorough understanding of these ideas in order to ensure the endurance and success of restorative treatments while protecting the overall health of the oral structures.

REFERENCE

1. Cohen ES. Atlas ofcosmetic and reconstructive periodontal surgery. PMPH-USA;2007
2. Newman MG, Takei H, Klokkevold PR, Carranza FA. Newman and Carranza's Clinical Periodontology E-Book: Newman and Carranza's Clinical Periodontology E-Book. Elsevier Health Sciences; 2018 May 29.
3. Khuller N, Sharma N. Biologic width: Evaluation and correction of its violation. J Oral Health Comm Dent. 2009 Jan; 3(1):20-5.
4. Nugala B, Kumar SB, Sahitya S, Krishna MP. Biologic width and its importance in periodontal and restorative dentistry. Journal of Conservative Dentistry. 2012 Jan 1; 15(1):12-7.
5. Bhochhibhoya A, Shrestha R. Biologic width-A Review. Journal of Nepalese Prosthodontic Society. 2020 Jul 1; 3(2):106-14.
6. Daudu OU, Ajiboye M, Ajala S, Buru ME. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 16, Issue 5 Ver. VI (May. 2017), PP 34-35 www. iosrjournals. org.
7. NEVINS M. The intracrevicular restorative margin, the biologic width, and the maintenance of the gingival margin. Int J Periodontics Restorative Dent. 1984; 4:31-49.
8. Kois JC. Altering gingival levels: the restorative connection part I: biologic variables. Journal of Esthetic and Restorative Dentistry. 1994 Jan; 6(1):3-7.
9. Majzoub ZA, Romanos A, Cordioli G. Crown lengthening procedures: A literature review.

InSeminars in Orthodontics 2014 Sep 1 (Vol. 20, No. 3, pp. 188-207). WB Saunders.
10. Ingber JS, Rose LF, Coslet JG. The "biologic width"—a concept in periodontics and restorative dentistry. Alpha Omegan. 1977;70:62–5
11. Bateman GJ, Karir N, Saha S. Principles of crown lengthening surgery. Dental Update. 2009;36(3):181-2