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Biologic width - knowledge key for restorative dentistry: A Review

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***Abstract*---**Aim: To elaborate the importance of the concept of biologic width in terms of restorative dentistry. Background: Biological width is the natural distance (combine heights) between the base of the healthy gingival sulcus or epithelial attachment to the tooth and the height of the alveolar bone or connective tissue. For better description of relationship between the periodontal tissues and conservative procedures is to restore form, function, esthetics, and comfort for the dentition. Most of the dentists are aware of biological width, its maintenance and its importance during application of crown lengthening. However, this review will elaborate on its importance in restorative dentistry. This article reviews the anatomy, categories, evaluation, violation, methods to correct the violation of biologic width

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and its relationship to periodontal health and restorative dentistry. Review Results: Respecting the biologic width and designing restorations accordingly is crucial. Biologic Width is the dimension of space that the healthy gingival tissues occupy above the alveolar bone. Incorrectly placed margins of restorations are a common cause of biologic width violation. This can lead to gingival inflammation and bone loss, thereby damaging the periodontal health as well as reducing the life of the restoration. Conclusion: A satisfactory understanding of the relationship between periodontal tissues and restorative dentistry is supreme to safeguard satisfactory form, function, esthetics, and comfort of the teeth and its supporting structures. Meticulous care must be taken in designing the margin of the restorations to maintain the periodontium. Clinical significance: Biological width is a key aspect in maintaining the periodontium. Any encroachment of biological width would affect the healthy status of the periodontium. In the case of extensive caries, sub-gingival perforation and post and core placement in endodontic therapy, the concept of biologic width gains its importance.

***Keywords*---**biologic width, restoration, restorative dentistry.

Introduction

The concept of the biologic width (dentogingival unit) was first commenced by a research conducted by Gargiulo, Wentz, and Orban in which the distance between the apical end of the gingival sulcus and the crest of the alveolar bone was measured on several cadaver specimens.[1,2] Later on, the term 'biologic width' was introduced by Cohen to describe the space over the tooth surface, occupied by the connective tissue and epithelial attachments and this parameter being equivalent to the distance between the bottom of the gingival sulcus and the alveolar bone crest.[3]Khuller N and Sharma N (2009)[4] defined BW as the dimension of the soft tissue, which is attached to the portion of the tooth coronal to the crest of the alveolar bone. Nevin and Skurow (1984)[5] defined it as the sum of the combined supra crestal fibers, the junctional epithelium and the sulcus. The dimension of biologic width is not constant, it depends on the location of the tooth in the alveolar, varies from tooth to tooth, and also from one surface of the tooth to another. Hence the objective behind conducting this review is to elaborate the importance of biologic width in terms of restorative dentistry.

Historical perspective

In 1961, Garguilo et al.[2] evaluated the average vertical dimensions of the biological width. From 30 autopsy specimens, 287 individual teeth were studied and the alveolar crest, the connective tissue attachment, the epithelial attachment, and the sulcus depth were measured. They reported the mean sulcus depth of 0.69 mm, epithelial attachment of 0.97 mm, and connective tissue attachment of 1.07 mm. The biologic width was calculated to be 2.04 mm. Thus, on average, it is essential to maintain 3 mm distance from the bone crest to the cement-enamel junction in healthy teeth or until the end of the preparation or the

margin of restoration in restored teeth. Vaeck et al.[6] evaluated 171 cadaver tooth surfaces and found that the biological width increased antero-posteriorly and 15% of restoration that impinge the biologic width had a biologic width of less than 2.04 mm.

Function of Biologic width

Biologic width serves as protective mechanism for underlying bone. The function of junctional epithelium was investigated by Sanz[7] in a comparative histologic study of healthy and infected implant sites, revealing high transmigration of inflammatory cells in sulcular epithelium of infected sites. A case control study showed significant increase of T-lymphocytes in sulcular epithelium in peri-implantitis human biopsies when compared with healthy peri-implant tissue.[8] Chavrier in his histologic biopsy study on the connective tissue around implants revealed predominance of type 1 collagen fiber.[9] Some animal studies revealed migration of leukocytes through junctional epithelium toward bacterial plaque. Accumulation of these cells in the presence of infection may demonstrate the possible defence mechanism of biologic width.[9,10] The evidence of protective peri-implant seal abilities may be found in the peri-implantitis models in animal studies which confirm that combination of plaque accumulation and biologic width injury can result in crestal bone loss around implants. The primary significance of biologic width to the clinician is its importance relative to the position of restorative margins, and its impact on postsurgical tissue position. During restorative preparation, if the apical margin is placed within the biologic width (i.e., too close to the bone), there is likely to develop a zone of chronic inflammation.

Review Results

Evaluation of Biological Width

Clinical Evaluation: Biological width is determined in clinics using periodontal probe. 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.[11]

Bone Sounding: The level of the alveolar crest must be determined preceding to any considerations regarding aesthetic crown lengthening so as to determine the feasibility, surgical aspects, and treatment sequence. The biologic width can be done following the administration of a local anesthesia, a measuring instrument (probe) is utilized to puncture and penetrate the mucosa until contact is made with the underlying bone (referred to as "sounding to the bone") and subtracting the sulcus depth from the resulting measurement. During this periodontal evaluation, bone sounding assists in determining the level of the alveolar crest and thus the need for osseous contouring[12,13]

Radiologic Evaluation: Radiographic interpretation can be very helpful to the clinicians in identifying interproximal violations of biologic width. However, radiographs are not diagnostic on the mesio-facial and disto-facial line angles of

teeth, because of tooth superimposition.[16] H. Sushama and Gouri have described a new innovative, parallel profile radiographic (PPR) technique to measure the dimensions of the dento gingival unit (DGU). The authors assume that the PPR technique could be used to measure both length and thickness of the DGU with accuracy, as it was simple, concise, non-invasive, and a reproducible method.[13]

Profiles of Biologic Width: 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.[14]

- Normal crest patients: The mid facial 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 4.5 mm.[15]

Radiographic interpretation can also be used for identification of inter proximal violations of biological width but they are not diagnostic because of tooth superimposition.[16]

	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

Violation of Biologic Width

The effect of crown margin location on plaque and gingival health is well documented.[17] Increases occur in gingival health parameters with margin location apical to gingival tissue. What seems to be the most critical factor is the relationship between the supracrestal fibre attachment and margin location. Once we prepare a tooth apical to the base of the sulcus and place margins into the zone of the biologic width, specifically the connective tissue attachment, we have violated important biologic principles regarding the long-term gingival health. Therefore, the most important parameter for intra crevicular dentistry is locating the base of the sulcus.[2,5]

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.[18]

Signs of biological width biological width violation:[2]

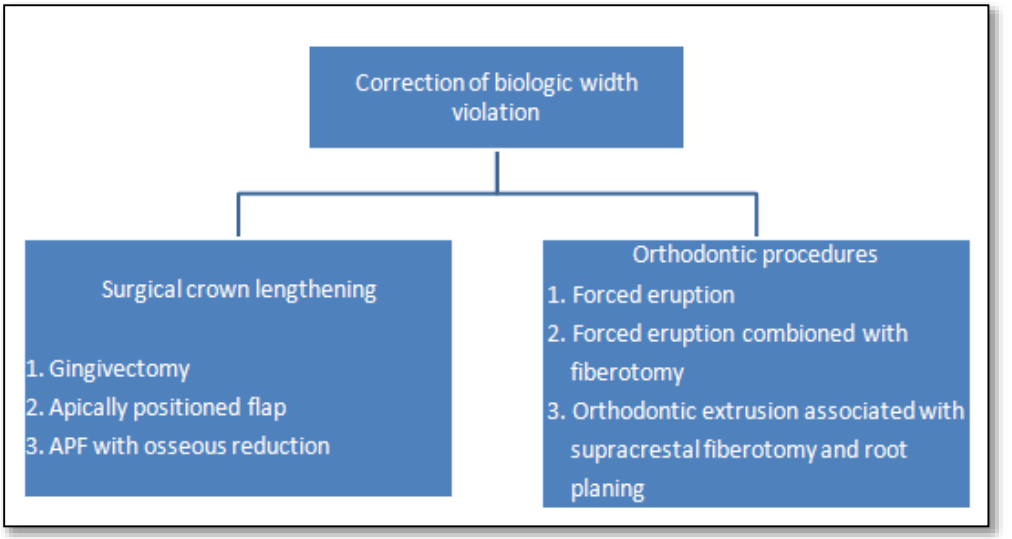
1. Chronic progressive gingival inflammation around the restoration.
2. Bleeding on probing.
3. Localized gingival hyperplasia with minimal
4. Bone loss.
5. Gingival recession
6. Pocket formation
7. Clinical attachment loss.
8. Alveolar bone loss.

Waerhaug[19] stated that subgingival restorations are plaque-retentive areas and are in accessible to scaling instruments. They will continue to accumulate plaque even after adequate supragingival plaque control measures are carried out. Flores-de-je-Coby et al[20] demonstrated that subgingival margin showed increased plaque, gingival index scores, and probing depths. More spirochetes, fusi forms, rods, and filamentous bacteria were found to be associated with subgingival margins.

Correction of Biologic Width Violation

Encroachment of biologic width becomes of particular concern when considering the restoration of a tooth that has fractured or been carious near the alveolar crest. Also, esthetic concerns often require hiding of restorative margins below the gingival margin that is pushing them down into the gingival sulcus leading to the violation of biologic width. The biologic width has inter-personal and intrapersonal variability. There is no magic number which can be recommended and each site of each patient must be evaluated before coming to a definite conclusion.[21]

Figure 1: Different Procedures for Correcting Biologic Width Violation



In case a biologic width is violated, the following procedures should be considered (Figure 1):

Surgical Crown Lengthening

Indications [22]

a) Inadequate clinical crown for retention due to extensive caries, subgingival caries or tooth fracture, root perforation or root resorption within the cervical 1/3rd of the root in teeth with adequate periodontal attachment.
b) Short clinical crowns.
c) Unequal, excessive, or unesthetic gingival levels for esthetics.
d) Teeth with excessive occlusal wear or incisal wear.
e) Teeth with inadequate interocclusal space for proper restorative procedures due to supraeruption.
f) Restorations which violate the biologic width.
g) In conjunction with tooth requiring hemisection or root resection.

Contraindications

a) Deep caries or fracture requiring excessive bone removal.
b) Non-restorable teeth.
c) Tooth with increased risk of furcation involvement.
d) Unreasonable compromise esthetics/adjacent alveolar bone support.

Various Measures Used For Crown Lengthening:

1. Gingivectomy: External bevel gingivectomy is both successful and predictable surgical procedure and is indicated in hyperplasia or pseudo-pocket along with presence of adequate amount of keratinized tissue.[23] Internal bevel gingivectomy is carried out if reduction of excessive pocket depth and exposure of coronal tooth is required in absence of sufficient zone of attached gingiva.[4]
2. Apically Positioned Flap (APF): Apically positioned flap is recommended when crown lengthening of multiple teeth in a quadrant or sextant of dentition is required and there is a biologic width of more than 3 mm. Pocket reduction can be done at the same surgery. It should not be done for during surgical crown lengthening of a single tooth in the esthetic zone.
3. APF with Osseous Reduction: It is the most common procedure for clinical crown lengthening. It is done in inadequate zone of attached gingiva and biologic width less than 3 mm. Detailed evaluation should be done before carrying out osseous reduction as it compromises periodontal support of the tooth, causes furcation involvement, poor crown-to root ratio and gingival recession. It should not be done during surgical crown lengthening of a single tooth in the esthetic zone. In such cases, forced eruption should be considered to prevent negative architecture.

Complications after Crown Lengthening[24]

a) Poor aesthetics due to 'black triangles'
b) Root hypersensitivity
c) Root resorption
d) Transient mobility of the teeth

Orthodontic Procedures

1. Forced Eruption: In forced eruption, tooth is intentionally moved in a coronal direction using gentle continuous force. The force stretches gingival and periodontal fibers resulting in a coronal shift of gingiva and bone.[25] It was first advocated by Heithersay49 for teeth with horizontal fractures. Orthodontic extrusion was advocated in anterior area where surgical crown lengthening cannot be accomplished. It minimizes gingival recession and loss of bone support on adjacent teeth.[26,27] Orthodontic extrusion requires an activation period of 4-6 weeks and 6-8 weeks retention period for tooth to become stabilized in its new position. Additional surgical crown lengthening may be required after forced eruption. The contraindications are inadequate crown-to-root ratio, lack of occlusal clearance and periodontal complications.
2. Forced Eruption with Fiberotomy: Combination of orthodontic extrusion and severance of supracrestal fibers, termed supracrestal fiberotomy is also used for crown lengthening. If fibrotomy is performed during the forced tooth eruption procedure, the crestalbone, and the gingival margin are retrieved at their pre treatment location. Thus, the tooth gingiva interface at adjacent teeth is unaltered. Fibrotomy is performed once every 7-10 days during the phase of forced tooth eruption.[28]
3. Orthodontic Extrusion Associated with Supracrestal Fiberotomy and Root Planing (OEFRP): It is a flapless technique for crown lengthening after orthodontic extrusion. The OEFRP procedure must be carried out every 2 weeks during the entire extrusive orthodontic phase.[29]

Conclusion

The health of the periodontal tissues is dependent on properly designed restorations. Incorrectly placed restoration margin and unadapted restoration violates the biologic width. If the margin must be placed subgingivally, the factors to be taken into account are: Correct crown contour in the gingival third; correct polishing and rounding of the margin; sufficient zone of the attached gingiva; and, no biologic width violation by the margin. Repeated maintenance visits, patient co-operation and motivation are important for improved success of restorative procedures with pristine periodontal health. The maintenance of the normal structure of the biological tissues should be done and the concept of biologic width must be followed at each procedure. The periodontal health is an important key for the longevity of dental restortaions.

References

1. Cohen DW, Current approaches in periodontology. J Periodontol 1964; 35:5-18.
2. Gargiulo AW, Wentz FM, Orban B, Dimensions and relations of the dentogingival junction in humans. J Periodontol 1961; 32:261-7.
3. Cohen DW. Pathogenesis of periodontal disease and its treatment. Washington DC: Walter Reed Army Medical Center; 1962.
4. Khuller N, Sharma N. Biologic width: Evaluation and correction of its violation. J Oral Health Community Dent. 2009;3:20-5.
5. Nevins M, Skurow HM. The intracrevicular restorative margin, the biologic width, and the maintenance of the gingival margin. Int J Periodontics Restorative Dent. 1984;3:31–49.
6. Vacek JS, Gher ME, Assad DA. The dimensions of the human dentogingival junction.Int J Periodontics Restorative Dent. 1994;14:154-65.
7. Sanz M, Alandez J, Lazaro P, Calvo JL, Quirynen M, van Steenberghe D. Histo-pathologic characteristics of peri-implantsoft tissues in Brånemark implants with 2 distinct clinical and radiological patterns. Clin Oral Implants Res 1991;2:128-34.
8. Wu YJ, Tu YK, Huang SM, Chan CP. Factors inluencing the presence of interproximal dental papillae between maxlaary anterior teeth [J]. J Periodontol 1961;32:261-7.
9. Günay H, Seeger A, Tschernitschek H, Geurtsen W. Placement of the preparation line and periodontal health – A prospective 2-year clinical study. Int J Periodontics Restorative Dent 2000;20:171-81.
10. Spear FM, Cooney JP. Periodontal-restorative interrelationships. Carranza‘s Clinical Periodontology. 9th ed. Ch.75. Philadelphia, PA: WB Saunders; p. 949-64.
11. Ingber JS, Rose LF, Coslet JG. The "biologic width"-a concept in periodontics and restorative dentistry. Alpha Omegan 1977;70:62-5.
12. Kois JC. Altering gingival levels: The restorative connection. Part I: Biologic variables. J Esthet Dent 1994;6:3-9.
13. Galgali SR, Gontiya G. Evaluation of an innovative radiographic technique-parallel profile radiography-to determine the dimensions of the dentogingival unit. Indian J Dent Res 2011;22:237-41.
14. Nugala B, Kumar BS, Sahitya S, Krishna PM. Biologic width and its importance in periodontal and restorative dentistry. J Conserv Dent 2012;15:12-7.
15. Kois JC. The restorative-periodontal interface: Biological parameter. Periodontol 2000. 1996;11:29-38.
16. Galgi SR, Gontiya G. Evaluation of an innovative radiographic technique – parallel profile radiography to determine the dimensions of the dentogingival unit. Indian J Dent Res 2011;22:237-41.
17. de-Jacoby Lavina F, Ziafiropoulos GG, Ciancio S. The effect of crown margin location on plaque and periodontal health. lnt J Periodont Rest Dent 1989; 9(3):197-205.
18. Sharma A, Rahul GR, GuptaB, Hafeez M. Biological width: No violation zone. Eur J Dent 2012;1:137-41.
19. Waerhaug, J. Temporary restorations: advantages and disadvantages. Dent Clin N Am. 1980;24:305–6.

20. Flores-de-Jacoby L, Zafiropoulos GG, Ciancio S. Effect of crown margin location on plaqueand periodontal health. Int J Periodontics Restorative Dent. 1989;9(3):197-205.
21. Schmidt JC, Sahrmann P, Weiger R, Schmidlin PR, Walter C. Biologic width dimensions–asystematic review. J Clin Periodontol. 2013;40(5):493-504.
22. Jorgic-Srdjak K, Dragoo MR, Bosnjak A, Plancak D, Filipovic I, Lazic D. Periodontal and prosthetic aspect of biological width part II: Reconstruction of anatomy and function. Acta Stomatol Croat 2000;34:441-4.
23. Smukler H, Chaibi M. Periodontal and dental considerations in clinical crown extension: Arationale basis for treatment. Int J Periodont Restor Dent. 1997;17:464–77.
24. Nugala B, Kumar BS, Sahitya S, Krishna PM. Biologic width and its importance in periodontaland restorative dentistry. J Conserv Dent. 2012;15(1):12-7.
25. Heithersay GS. Combined endodontic orthodontic treatment of transverse root fractures in the region of the alveolar crest. Oral Surg Oral Med Oral Pathol. 1973;36:404–15.
26. Ingber JS. Forced eruption, part II. J Periodontol. 1974;45:199-206.
27. Ingber JS. Forced eruption, part 1 J Periodontol. 1976;47:203-16.
28. Tarnow DP, Magner AW, Fletcher P. The effects of the distance from the contact point to thecrest of bone on the presence or absence of the interproximal dental papilla. J Periodontol. 1992;63:995.
29. Braga G, Bocchieri A. A new flapless technique for crown lengthening after orthodontic extrusion. Int J Periodontics Restorative Dent. 2012; 32:81–90.