Is Biologic Width of Anterior and Posterior Teeth Similar?

Amir Alireza Rasouli Ghahroudi[1], Afshin Khorsand[1], Siamak Yaghobee[1,2], and Farideh Haghighati[1]

[1] Department of Periodontology, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, Iran

[2] Department of Periodontology, Dental Implants Research Center, Tehran University of Medical Sciences, Tehran, Iran

Received: 12 Dec. 2012; Accepted: 10 Jun. 2013

Abstract- The biologic width (BW) includes attached epithelial cells and connective tissue attachment complex being very important in the periodontal health during prosthetic treatments as invading this zone can cause bone resorption and gingival recession. The present study investigated biologic width values in the normal periodontium in anterior and posterior teeth. 30 patients that referred from restorative department to periodontics department of Tehran University of medical sciences who need crown lengthening procedure on their teeth with no history of orthodontic, prosthodontic and periodontal treatment were randomly enrolled in this cross-sectional trial. Sulcus depths (SD) as well as the distance between free gingival margin and the bone crest (FB) of anterior and posterior teeth were measured by UNC-15 probe and compared. periodontium thickness was also assessed. The data were subjected to Student t test. Mean BW in the 43 anterior and 47 posterior teeth was measured and not significantly different (1.4651±0.39 mm vs. 1.6312±0.49 mm) was observed; however, BW was significantly more in the teeth with thick periodontium compared to those with thin periodontium (1.703±0.5 vs. 1.408±0.35; *P*=0.002). BW not only is different in individuals but also could be dissimilar in different teeth and should be calculated independently prior to restorative treatments.

Acta Medica Iranica, 2014;52(9):697-702.

Keywords: Gingiva; Biologic width; Restoration margin; Attached gingivae; Tooth; Tooth Preparation; Prosthodontic

Introduction

Teeth and their surrounding tissues are in the balance status trying to remove different microbial floras called as healthy dentogingival unit while the restorative treatments possibly interrupt this balance. Teeth and gingivae contain a vulnerable section namely biologic width, however; most dentists enter this area when performing restorative treatments being unable to interpret it exactly.

Biologic width is composed of junctional epithelium and supracrestal connective tissues both acting as a biologic seal surrounding the teeth to protect subgingival connective tissue from microorganisms' actions and their products and support alveolar bone simultaneously. Width of each two sections is about 1mm while the biologic width has been reported to be about 2mm in the previous studies (1).

Free gingival width and junctional epithelium change from active tooth eruption to passive eruption period during adulthood, however, the width of the connective tissue fibers above the bone crest joining the cement did not undergo any alterations. Additionally; dimensions of the complex joining the tooth together is variable, and this complex exists around the healthy teeth (2,3). However, biologic width can be different in individuals remaining a fixed amount in each person (4,5). Any restorative work involving this area such as additional preparations of the marginal gingiva in the apical directions or replacement of the restoration in the area causes damage to the biologic width. These services lead in bone crest resorption and apical migration of the attachment epithelium till the natural primary biologic width would regain. Different time intervals were also reported to achieve the natural biologic width in patients. Gingival recession occurs rapidly when the gingivae have thin margins causing restorations' edges, and cements appear consequently. However, this process develops during several months or years with the thick gingival margins. In these patients, gingival margins demonstrate hyperplastic appearance together with the chronic inflammation.

Corresponding Author: A. Khorsand
Department of Periodontology, Faculty of Dentistry, Tehran University of Medical Sciences, Tehran, Iran
Tel: +98 21 88779130, Fax: +98 21 26218191, E-mail address: a_afshin_khorsand@yahoo.com

Biologic width is a new term for an older unproved entity based on the quantitative autopsy values (6). it is reported the distance between junctional epithelium bases to the alveolar bone crest to be approximately 1 mm when no treatment were done while the junctional epithelium length being significantly different. Overall lengths of the supracrestal attachment including epithelium and connective tissue have been reported about 2mm (5,6).

Stenly (1955) reported junctional epithelium length to be variable from 0.1 to 1.4mm (7); Eissman et al. (1971) concluded biologic width to be about 2mm (8), and Maynard and Wilson (1981) calculated the distance between the restoration margins to the gingival margin to be about 0.5mm requiring crown lengthening (CL) otherwise (9). Vacek *et al.*, (1994) measured dento-gingival unit dimensions and reported biologic width to be in the range of 0.75mm-4.3mm (10). In addition, Alpistie-Illueca (2004) calculated the dentogingival unit in the buccal surfaces of the maxillary anterior teeth and reported biologic width to be about 2±0.72mm reporting different values for the gingival unit dimensions (11). Additionally; Mankoo (2003) stressed the importance of biologic width for the success of implant treatment in edentulous ridges (12).

Some studies added sulcus depth of 1mm to the biologic width. This theory suggests that if a restoration placed more apical than 1mm regarding normal free gingival margin, the biologic width and the alveolar crest will loss, and epithelial attachment will be lingering apically consequently (6).

It has shown; inflammation incidences near the alveolar crest because of improper restorative margins could result to bone resorption, so; in the cases of restorative preparation that possibly will involve the gingival margins; the most attention must be to protect the biologic width (13). In the periodontal surgical operations, when a tooth is prepared in the region prior to the completion of biologic width, gingival recession or inflammatory responses will be developed.

Furthermore, in the surgeries including bone nude or sutures maintaining the tissues in the surfaces near to the bone edge, all increase wound healing time and maturation of biologic width promoting new aesthetic difficulties especially in the anterior regions for the patients.

Periodontal tissue destruction possibly leads in tooth loss, then; periodontal, prosthetic treatments will be required in these cases. Furthermore, restorative treatments increase periodontal disease involvement in the patients underwent these treatments. In these cases, the first treatment phase includes the diagnosis of the etiologic factors followed by periodontal and prosthetic treatments. Tooth is supporting structures such as keeping biologic width and making access to perform suitable health-related habits are two important factors in the success of restorative treatments.

Along with the importance of biologic width in the restorative treatments and its role to keep healthy periodontal tissues, the present study compared the biologic width in the anterior and posterior teeth with thin and thick periodontium in Iranian subjects.

Material and Methods

The present cross-sectional observational clinical trial was conducted according to the guidelines of the Helsinki Declaration of 1975, revised in 2000. The research protocol was approved by the Ethics Committee of the Dental Research Center of Tehran University of Medical Sciences. The study population consisted of patients referred from restorative department to the Department of Periodontics, Tehran University of Medical Sciences, between March 2009 and August 2010 intended for CL procedure before doing restorative process on target anterior and posterior teeth that met the inclusion and exclusion criteria of the study. The following inclusion and exclusion criteria were applied.

Inclusion criteria

- Patient with healthy periodontal tissues with three adjacent teeth candidate for restorative or prosthetics treatment
- No bleeding on probing based on the Ainamo and Bay index (1976)
- Age over 18 years
- Good oral hygiene; O'Leary oral plaque index <15%
- Normal sulcular depth (less than 3mm)
- No history of periodontal surgery
- No history of orthodontic treatments

Exclusion criteria

-Using any medicine could cause gingival enlargement
- Active caries lesions or restorations at the cervical part of the teeth including the cementoenamel junction (CEJ)
- Any teeth which has been restored by crown
- Smoking habit
- Systemic conditions precluding periodontal surgery

- Systemic conditions affecting the periodontium
- A history of mucogingival or periodontal surgery in the area

The sample size was determined by a statistical power analysis. Considering a significance level of .05 along with assuming a standard deviation of 0.60 (based on previous pilot study), a total sample size of at least 74 teeth in 28 patients would be able to detect a 0.05-mm intergroup difference. For possible drop out 30 patients were enrolled.

The patient selection was done with the randomized sampling method, and all the measurements were done with a calibrated examiner.

The patients were numbered according to when they had presented to the department. After the patients' eligibility for enrollment in the study was confirmed (i.e., the inclusion and exclusion criteria were applied) from 60 even numbered volunteers patients in 30 patients that recruited by flip a coin; sulcular depths (SD) of three adjacent target teeth were measured in 6 points of mesiobuccal, midbuccal, distobuccal, mesiolingual, midlingual and distolingual before doing the CL procedure. After that the anesthesia injection was performed before doing the CL procedure and the distance between free gingival margin and alveolar bone crest (FB)were measured in these 6 points as well (Sounding) .all measurements were done with a UNC15 probe (Hu-Friedy, Chicago, IL, USA).The difference of these two values was recorded as biologic width (Figure 1).

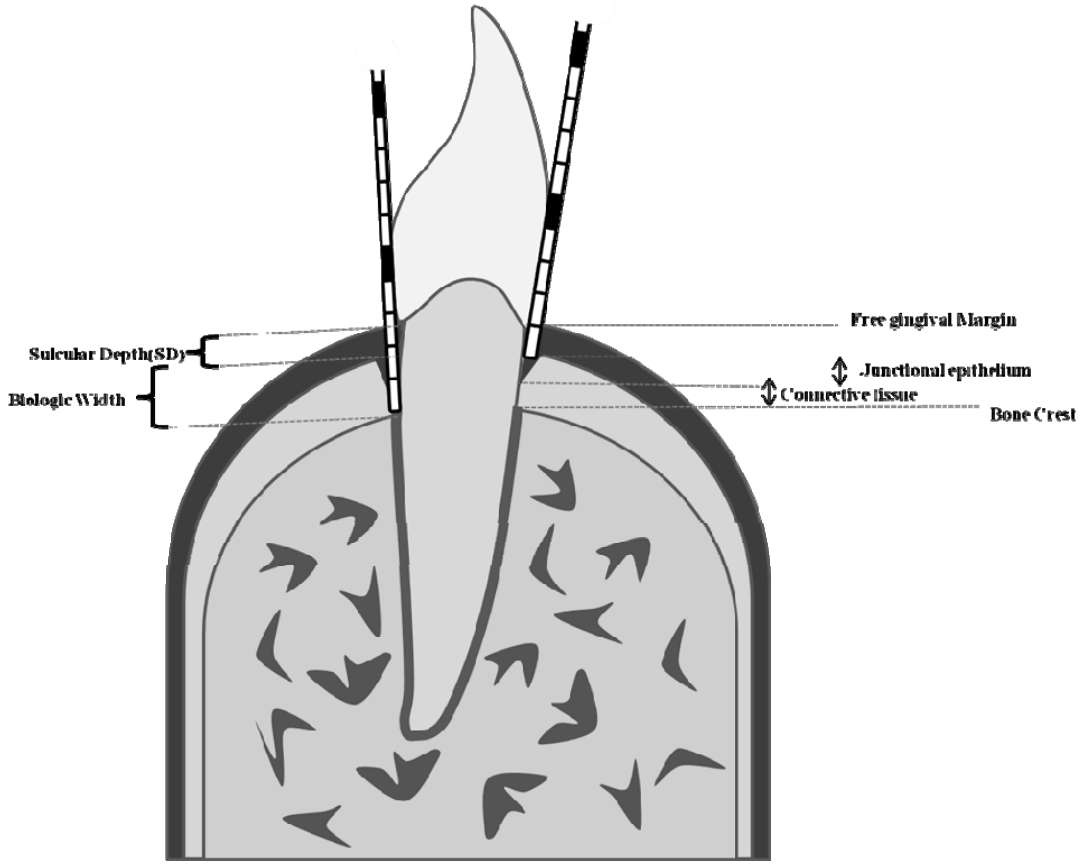

Figure 1. Schematic illustration showed the measurements used to determine the criteria provided in the study

In each patient, at least 3 adjacent healthy teeth were studied periodontally.

In the next stage, periodontium was studied regarding its thickness based on transparency of the gingivae; when the probe's shade was observed through the gingivae during the sulcular depth measurements, it was considered to be thin; otherwise it was regarded as thick periodontium.

The data were subjected to Student t test (SPSS Software, version 20, USA) for statistical assessments and $\alpha \leq 0.05$ regarded as a significant level finally.

Examiner calibration

A total of 8 non-study patients with healthy periodontium were recruited for the calibration exercise. The single designated examiner (ARG) recorded the areas for the sulcular depth (SD) with an interval of 24 hours between the first and the second recording. The

intra-examiner repeatability for SD was measured. The K coefficient (±1 mm) was 0.94.

Results

Mean and standard deviation of the BW values in the anterior and posterior teeth of different areas was depicted in Table 1. There were no significant differences regarding the BW of anterior and posterior teeth in midbuccal, mesiobuccal, distolingual, midlingual and mesiolingual points (*P*=0.12, *P*=0.6, *P*=0.08, *P*=0.06, *P*=0.42 respectively). However, BW of the posterior teeth was significantly more than anterior teeth in the distobuccal area (1.883 mm vs. 1.453 mm; *P*=0.004). In total, the mean and standard deviation of the BW in the anterior and posterior teeth were calculated to be 1.4651±0.39 mm and 1.6312±0.49 mm respectively with no significant differences (*P*=0.81).

Mean and standard deviation of the BW in the teeth with thick and thin periodontium in different areas were shown in Table 2. The mean BW of the teeth with thin and thick periodontium were 1.402mm and 1.898mm in mesiobuccal area, respectively, being significantly higher in thick periodontium (*P*=0.001). In midlingual area, the mean BW of the teeth with thick periodontium were significantly higher than those in thin periodontium (1.773 mm vs. 1.326 mm; *P*=0.006). No other significant differences were found between the teeth with thick and thin periodontium in the distobuccal, midbuccal, distolingual and mesiolingual points (*P*=0.28, *P*=0.43, *P*=0.97, *P*=0.19 respectively). In all, the mean biologic width of the teeth having thick periodontium were significantly more than the teeth with thin periodontium (1.703±0.5 vs. 1.408±0.35; *P*=0.002).

Table 1. Mean and standard deviations of the biologic width in the different areas of the anterior and posterior teeth

tooth	group	N	Mean	Standard Deviation	Mean Standard error
Distobuccal	Anterior	43	1.453	0.5096	0.077
	Posterior	47	1.883	0.8223	0.119
Midbuccal	Anterior	43	1.5	0.6637	0.1012
	Posterior	47	1.287	0.5966	0.087
Mesiobuccal	Anterior	43	0.605	0.5728	0.0873
	Posterior	47	1.681	0.7762	0.1132
Distolingual	Anterior	43	0.419	0.5869	0.895
	Posterior	47	0.681	0.7831	0.1142
Midlingual	Anterior	43	1.384	0.5099	0.778
	Posterior	47	1.691	0.9357	0.1365
Mesiolingual	Anterior	43	1.43	0.6034	0.92
	Posterior	47	1.564	0.6562	0.957

Table 2. Mean and standard deviations of biologic width in different areas of the teeth with thick and thin periodontium

Tooth	Group	N	Mean	Standard Deviation	Mean Standard error
Distobuccal	Thin	46	1.598	0.6202	0.0914
	Thick	44	1.761	0.8105	0.1222
Midbuccal	Thin	46	1.337	0.6329	0.933
	Thick	44	1.443	0.6399	0.965
Mesiobuccal	Thin	46	1.402	0.4166	0.614
	Thick	44	1.898	0.8111	0.1223
Distolingual	Thin	46	1.435	00.7499	0.1106
	Thick	44	1.682	0.6388	0.963
Midlingual	Thin	46	1.326	0.5983	0.882
	Thick	44	1.773	0.8724	0.1315
Mesiolingual	Thin	46	1.348	0.5041	0.743
	Thick	44	1.659	0.7134	0.1076

Discussion

Biologic width (BW) plays an important role in the health of periodontal tissue (1). Preparation of the marginal gingivae in the apical directions and replacing a restoration into BW zone causes damage to the area and could associate with the bone crest resorption and apical immigration of the attachment epithelium until the primary and natural BW re-attained. In the case of thin periodontium, gingiva withdraws rapidly resulting to the restorations' margins and its cement to appear (14).

To decrease gingival recession risk, the restoration's margins must be placed in the sulcus not

extending more than 0.5mm under the gingivae in order to protect the biologic width (1,15).

With the importance of the biologic width and its adequacy to achieve successful and longer restorations; some studies are done to calculate its values in different populations and some others stressed its importance too (1-5,14). However, no investigation has been done among Iranian population in this field, and the biologic width of the anterior and posterior teeth did not compare previously. In the present study, biologic width of the anterior and posterior teeth and the teeth with thick and thin periodontium were evaluated.

Gargiulo (1961) reported the mean junctional epithelium length, supracrestal connective fibers and normal sulcus depth to be 0.97mm, 1.07mm and 0.69mm respectively using autopsy techniques (5). This study showed more variability of the mean junctional epithelium length from one tooth to another and even in a single tooth environment while the mean connective fiber lengths were more stable.

The present study demonstrated the mean biologic width length to be variable from one tooth to another one and also in the surrounding areas of a tooth that could be due to a change in the mean junctional epithelium length. The mean normal sulcus depth was 1.4 mm in the present study being somehow different from Gragiulo results (5).

Nevins and Skurow (1984) suggested that the mean BW must be considered 3mm from the coronal alveolar crest margins including 2mm for the biologic width itself and 1mm for being confident not annoying this zone (16).

In the present study, the mean BW was 1.46mm and 1.63mm for the anterior and posterior teeth (averagely 1.54mm) that resembling Nevins and Skurow (1984) findings somehow (16). The authors believe with summing these values with 1mm for biologic width protection, correspondingly; 2.46 and 2.63 mm (averagely 2.5mm) in the anterior and posterior teeth could be considered as standard BW values in Iranian population.

Vacek *et al*., (1994) calculated dento-gingival unit dimensions using the human cadavers and reported the mean sulcus depth, junctional epithelium length and connective tissue length to be 1.34mm, 1.14mm and 0.77 respectively (10). They showed connective tissue attachment in different individuals to be less than sulcus depth and junctional epithelium length. Biologic width range was also calculated to be 0.75- 4.3mm at their study.

Alpiste-Illueca (2004) measured the sulcus depth and biologic width using probe and sounding techniques in the buccal surfaces of the teeth and reported the mean CEJ distance to the bone crest, biologic width and sulcus depth to be 2.05mm, 2.0mm and 1.12mm respectively (11).

In the present study, no attempt was done to measure the junctional epithelium length and connective tissue separately. However, the mean biologic width (ranges from 0.6 to 1.89) achieved by us was comparable to the findings of Vacek *et al*., (1994) (10) and Alpiste-Illueca (11). The slight differences in this regard can be justified through using different calculating techniques and/or populations. However; the normal sulcus depth was 1.4mm in the present study; being similar to Vacek *et al*., (1994)(10) and Alpiste-Illueca findings (11).

In the present study, the mean biologic width in the anterior and posterior teeth was comparable to each other being not significantly different (1.46mm vs. 1.63mm). Furthermore, significant differences were found between the teeth with thick and thin periodontium (1.702mm *vs.* 1.407mm). Studies have shown; a thick gingival tissue can withstand trauma and the subsequent recession, undergo a less severe inflammatory process and make the surgical result more predictable (17), however; since the establishment of BW takes longer time in thick periodontium rather than a thin one (11,15), it seems; waiting more, after periodontal crown lengthening procedure designed for restorative treatment is necessary for patients with thick periodontium.

The authors believe though this slight difference cannot be taken into account in the clinical conditions, but this variable must be estimated separately and precisely for each patient and teeth to impede invading to the critical biological width area. Also; the authors suggest with summing these values with 1mm for sulcular depth, correspondingly; 2.46 and 2.63 mm for anterior and posterior teeth and 2.7 and 2.4 mm for thick and thin tissue profiles (averagely 2.5mm) could be considered as standard BW values in Iranian population .in addition, intended to obstruct invasion into BW at least 3.5 mm intact tooth structure (2.5mm BW and 1mm for ferule effect) is required for restorative treatments.

Under this study limitation, the mean biologic width in the anterior and posterior teeth was not significantly different; however, it was significantly more in the teeth with thick periodontium compared to those with thin periodontium. Dentists must consider biologic width zone in the subgingival restorations or subgingival teeth

preparations. Furthermore, patients' biologic width must be calculated using a probe prior to dental treatments in order to protect this zone.

References

1. Block PL. Restorative margins and periodontal health. A new look at an old perspective. J Prosthet Dent 1987;57(6):683-9.
2. Maynard JG, Wilson RD. Physiologic dimension of the periodontium fundamental to successful restorative dentistry. J Periodontal 1979;50(4):170-4.
3. Parma-Benfenati S, Fugazzotto PA, Ruban MP. The effect of restorative margins on the post-surgical development and nature of the periodontium. Part I. Int J Periodontal Rest Dent 1985;5(6):30-51.
4. Dragoo MR, Williams GB. Periodontal tissue reactions to restorative procedures. Int J Periodontal Rest Dent 1981;1(1):8-23.
5. Garguilo AW, Wentz FM, Orban BJ. Dimensions and relation at the dentogingival junction in humans. J Periodontol 1961;32(3):261-7.
6. Ramfjord SP. Periodontal considerations of operative dentistry. Oper Dent 1988;13(3):144-59.
7. Stanley HR Jr. The cyclic phenomenon of periodontitis. Oral Surg Oral Med Oral Pathol 1955;8(6):598-610.
8. Eissmann HF, Radke RA, Noble WH. Physiologic design criteria for fixed dental restorations. Dent Clin North Am 1971;15(3):543-68.
9. Mayned JG Jr, Wilson RD. Physiologic dimensions of the periodontium significant to the restorative dentist. J Periodontol 1979;50(4):170-4.
10. Vacek JS, Gher ME, Assad DA, et al. The dimensions of the human dentogingival junction. Int J Periodontics Restorative Dent 1994;14(2):155-65.
11. Alpiste-Illueca F. Dimensions of the dentogingival unit in maxillary anterior teeth: a new exploration technique (parallel profile Radiograph). Int J Periodontics Restorative Dent 2004;24(4):386-96.
12. Mankoo T. Contemporary implant concepts in aesthetic dentistry--Part 1: Biologic width. Pract Proced Aesthet Dent 2003;18(8):609-16.
13. Than A, Duguid R, Mckendrick AJ. Relationship between restorations and the level of the periodontal attachment. J Clin Periodontol 1982;9(3):193-202.
14. Waerhaug J. Effect of rough surfaces upon gingival tissue. J Dent Res 1966;35(2):323-5.
15. Becker W, Ochsenbein C, Becker BE. Crown lengthening: The Periodontal Restorative Connection. Compend Contin educ dent 1998;19(3):239-40.
16. Wilson RD, Maynard G. Intracrevicular restorative dentistry. Int J Periodontics Restorative Dent 1981;1(4):34-49.
17. Hwang D, Wang HL. Flap thickness as a predictor of root coverage: a systematic review. J Periodontol 2006;77(10):1625-34.