

CLINICAL BIOLOGICAL WIDTH DIMENSION AROUND DENTITION OF A SELECTED SAUDI POPULATION

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ABSTRACT

Biologic Width (BW) is the physiologic dimension of the junctional epithelium and connective tissue attachment located between the base of the sulcus and the alveolar bone crest. The purpose of the study is to find the average biological width around teeth of selected Saudi patients and to correlate these dimensions with the periodontal status. The data was gathered by measurements from 50 Saudi male patients with age ranging from 20-50 years old. The Ramfjord teeth (six teeth) were selected for each patient and clinical parameters such as plaque index, bleeding index, tooth status, probing depth were evaluated. The distance from gingival margin to crest of bone at three buccal sites per tooth; which were the mesiobuccal, buccal and distobuccal areas were measured. Clinical biological width was calculated by subtracting Probing depth from the distance between gingival margin to crest of bone. The results showed that the average biological width for this study was 1.24 mm with a highest value at the mesiobuccal area (1.4 mm). The mean Plaque index was 0.64, the mean bleeding index was 0.47 and the mean probing depth was 2.44 mm. It can be concluded that the term clinical biological width is more reliable to be used clinically, and creation of 1.24 mm at maximum from proposed margin of restoration when restoring fractured or carious teeth during surgical crown lengthening is recommended to maintain the dimension of clinical biological width.

INTRODUCTION

Biologic width (BW) is the physiologic dimension of the junctional epithelium and connective tissue attachment located between the base of the sulcus and the alveolar bone crest.' It is important in fostering gingival health and encroachment on it by restoration may cause break down and apical migration of the attachment apparatus. , which is a response to the inflammatory process caused by bacterial plaque which accumulates at the inaccessible restoration margin.'

In 1921 Gottlieb discovered the epithelial attachment of the gingiva and served as a basis for a better understanding of the biology of the dental supporting tissues in health and disease.'

In 1961 Gargulio *et al.* in their classical study established the dimension of the dentogingival junction in humans. They measured the dentogingival junction in 30 human jaws obtained from autopsies, with age ranging from 19-50 years, 287 teeth with a total of 325 surfaces were measured during the four phases of eruption (phase I: average age 24.5 years, phase II: average age 31.4 years, phase III: average age 32.3 years and phase IV: 39.7 years) and determined that the epithelial attachment length was 0.97 mm, and the connective tissue attachment length was 1.07 mm, so the dentogingival junction dimension equaled 2.04 mm. The most constant part of dentogingival junction dimension was the connective tissue attachment and the most variable part was the epithelial attachment.³

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In 1994 Vacek undergone his study of the dimension of the dentogingival junction on 10 human cadavers with an age ranging 54-78 years, utilizing 171 surfaces and concluded that the epithelial attachment was at a mean of 1.14 mm and the connective tissue attachment was at a mean of 0.77 mm. And that the connective tissue attachment was of variable width.'

Ingber *et al* (1977) emphasized the maintenance of biologic width when restoring teeth. They concluded that a space of 3 mm coronal to the alveolar crest is necessary to permit healing and proper restoration of the tooth, and that violation of the **BW** would lead to periodontal reactions.⁵ In 1988 Ramfjord questioned the surgical creation of a 2-3 mm biological width apical to a proposed restoration margin by use of osteotomy. He felt that bone should be removed to the minimum extent to ensure the access for the margin placement.⁶ This concept required that patient maintain excellent plaque control and good oral hygiene which is not the case in a lot of dental treated patients.

The Biological width dimensions reported by Gargulio *et al.* (1961) were histological measurements which were done in prepared specimens.³ Up to our knowledge and literature search, we failed to find any study that reported a clinically measured biological width dimensions.

The purpose of the present study is to find the average clinical biological width dimension around teeth of selected Saudi patients; and to correlate these dimensions with the periodontal status of the measured teeth.

The significance of this study is that reference data will be available for dental professionals concerning clinical biological width dimension around teeth, so those dimensions should not be violated during dental treatment. As well this study may be considered as a pilot for researcher if any interested to establish a norm concerning biological width dimension in specific ethnic group.

MATERIALS AND METHODS

The data for this study was obtained from 50 Saudi male patients attending the outpatient clinic of the College of Dentistry, King Saud University, Riyadh. The age of the subjects ranged from 20-50 years with a mean of 27.26 years.

The study protocol was approved by College of Dentistry Research Committee (CDRC) for testing in human subjects. All patients involved in this study signed a consent form which shows the purpose of the study, the use of local anesthesia and lack of side effects. During the course of the study fliers were posted to encourage volunteers to participate in the study which was very effective in patient recruitment.

The measurements were conducted by two examiners who were trained and calibrated by specialist periodontist. The measurement was carried out by applying topical anesthesia to the injection site followed by local anesthesia by buccal infiltration in the mucogingival junction to six teeth which were the Ramfjord teeth". The teeth were maxillary right first molar (16), maxillary left central incisor (21), maxillary left first premolar (24), mandibular left first molar (36), mandibular right central incisor (41) and mandibular right first premolar (44). In case any of those teeth were missing, the neighboring tooth was taken as an alternative. Those Ramfjord teeth were considered as a representative of mouth instead of full mouth scoring (Ramfjord 1959).'

Using a periodontal probe (Williams) with markings at 1, 2, 3, 5, 7, 8, 9 and 10 mm, the following parameters were measured in three specific sites on the buccal surface of the tooth, which were mesiobuccal (MB), buccal (B) and distobuccal (DB) areas:

- 1- Tooth status:** presence of caries, restoration checked.
- 2- Plaque index (PI):** presence of plaque in the apical one third of the buccal surface of each tooth was marked as 1 and absence was marked as 0 (dichotomous scale).
- 3- Bleeding index (BI):** presence of bleeding on probing was marked as 1 and absence was marked as 0.
- 4- Probing depth (PD):** the distance from the gingival margin to the base of the sulcus.
- 5- Gingival margin to crest of the alveolar bone (G-C):** the distance from gingival margin to the crest of the alveolar bone by applying pressure during probing until bone is felt (transperiodontal sounding).

TABLE 1: DESCRIPTIVE STATISTICS FOR CLINICAL BW, PI, BI AND PD AT PATIENT LEVEL

	N	Minimum	Maximum	Mean	Standard Deviation
BW	50	0.89	1.61	1.2456	0.1885
PI	50	0.17	1.00	0.6444	0.2179
BI	50	0.00	0.89	0.4711	0.2104
PD	50	1.89	3.06	2.4478	0.2718

N: Number of patients, BW: Biological Width dimension in millimeter

PI: Plaque index score, BI: Bleeding index score, PD: Probing Depth in millimeter

18 sites per patient were measured on 6 teeth, with total of 900 sites on 300 teeth for all 50 patients. After which the biologic width which represents the distance from base of the sulcus to the crest of the bone was calculated by subtracting the PD from G-C.

In 2003 Lanning et al.⁸ described a technique of measuring the biological width by presurgical bone sounding and this will give the biological width dimension clinically for any particular tooth and this method of periodontal sounding is our choice to be used for this clinical study.¹ Deas et al.⁹ (2004) used the same technique of periodontal sounding proposed by Lanning et al.⁸ and reported no harm of this technique to the patients of their study.⁶

Statistical analysis:

Descriptive statistical analysis used to report averages in mm of **BW, PI, BI** and **PD** representing all patients. In addition to the above more descriptive analysis where done to report **BW** dimension findings using the unit of analysis (averages in mm) per site, tooth type and patient. Pearson correlation used to report correlations between **BW** and other periodontal status parameters (**PI, BI** and **PD**).

TABLE 2: MEAN OF CLINICAL BW DIMENSION AT SITE LEVEL IN MILLIMETER

	Mean	Standard deviation	N
mb	1.4167	0.3054	300
B	1.0967	0.2499	300
Db	1.2233	0.2769	300

N: number of sites, mb: mesiobuccal site, b: buccal sites, db: distobuccal site

RESULTS

Table 1 showed descriptive statistical analysis for our main parameters (**BW, PI, BI** and **PD**) which represent averages in mm for all sites measured in all patients. The average **BW** was 1.24 mm approximately. The plaque index was 0.64 which mean that almost more than 50% of sites examined have plaque accumulation. The bleeding index was 0.47 and this mean almost 50% of sites examined bleed on probing which is considered a major sign of gingival inflammation. The mean PD was 2.44 mm.

The site specific analysis of the BW dimension showed that the mesial site showed the highest mean width of 1.41 mm and the buccal measured the lowest of 1.09 mm (Table 2).

The tooth specific BW measurements were depicted in Table 3. The mandibular right first premolar showed the maximum BW (1.93) and the mandibular right central incisor had the lowest biological width (1.17).

The correlation between **BW** and **PI** showed no statistical significant correlation, and there was slight

TABLE 3: MEAN OF CLINICAL BW DIMENSION PER TOOTH TYPE IN MILLIMETER

	Mean	Standard deviation	N
16	1.1933	0.2784	50
21	1.3000	0.4110	50
24	1.2667	0.4096	50
36	1.2200	0.3846	50
41	1.1733	0.3246	50
44	1.3200	0.3497	50

N: number of teeth per tooth type

TABLE 4: PEARSON CORRELATIONS FOR ALL VARIABLES TO EACH OTHER.

	BW	PI	BI	PD
BW	1.000	0.183	0.340*	0.281*
Pearson Correlation				
Sig. (2-tailed)		0.203	0.016	0.001 level
N	50	50	50	50
PI	0.183	1.000	0.541**	0.098
Pearson Correlation				
Sig. (2-tailed)	0.203		0.000	0.498
N	50	50	50	50
BI	0.340*	0.541**	1.000	0.274
Pearson Correlation				
Sig. (2-tailed)	0.016	0.000		0.054
N	50	50	50	50
PD	0.281*	0.098	0.274	1.000
Pearson Correlation				
Sig. (2-tailed)	0.048	0.498	0.054	
N	50	50	50	50

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

BW: Biological Width Dimension in millimeter, PI: Plaque index score

BI: Bleeding index score, PD: Probing Depth in millimeter, N: number of patients

statistical significant positive correlation between **BW** and **BI** which was 0.34 but not reach clinical significance (Table 4). There was strong positive correlation exist between plaque index and bleeding index which mean as plaque accumulate there will be more chance of bleeding of probing.

DISCUSSION

The dentogingival unit in histological section consists of three segments; sulcus depth, attached junctional epithelium and connective tissue attachment." On the other hand the **BW** only includes; attached junctional epithelium and connective tissue fibers attachment."

The above two terms of dentogingival unit and **BW** result from intensive anatomical research using adequately prepared histological sections both; from human autopsy and animal samples.

In the present study the term clinical biological width dimension introduced since up to our knowledge and intensive literature search; there is a lack of any

reported measurements of the dimensions of **BW** using living human subjects.

The transperiodontal sounding procedure used in this study is not a new method, and it has been used in periodontal practice as well as periodontal research^{8,9,10,11} particularly before periodontal surgery and there were no adverse reactions from using such procedure. The reliability of transperiodontal sounding reported to be very good; Ursell 1989, reported a mean difference of 0.12 mm was found between transgingival probing and surgical measurements.¹⁰ Isidor et al. 1984 reported that transgingival probing was identical to surgical measurements 60% of the time and within 1mm difference of surgical measurements 90% of the time.¹¹

This study revealed that the average clinical biological width dimension in a selected sample of Saudi patients was 1.24 mm obtained from measuring 900 sites on 300 teeth. This measurement was less by 0.8 mm and 0.76 mm than the results obtained from histological sections reported by Gargulio et al.³ 2.04

mm and Vacek et al.⁴ 2 mm, respectively, and less by 0.67 mm than radiographic measurements reported recently by Alpiste-Illueca¹² 1.91 mm. This difference maybe explained by reported soft tissue penetration of the probe tip during probing depth measurements.^{13,14} Armitage and his colleagues used beagle dogs to evaluate the penetration of a probe using a standardized force of 25 gm; They reported that in healthy specimens, the probe penetrated the epithelium to about two thirds of its length; in gingivitis specimens, it stopped 0.1 mm short of its apical end. In humans, the probe tip penetrates to the most coronal intact fibers of the connective tissue attachment; the depth of penetration of the probe in the connective tissue apical to junctional epithelium in a periodontal pocket is about 0.3 mm.¹⁴ So, if someone considered that the probe could penetrate one third of epithelium length "about 0.3 mm apical to the base of the sulcus" up to the whole length of epithelium to the underlying connective tissue "about 1.2 mm apical to the base of the sulcus" as reported from the previous studies^{13,14} with an average of soft tissue penetration of about 0.75 mm beyond the base of the sulcus. If this added to the average clinical **BW** reported in this study the adjusted amount will be equaled to about 2 mm which will be in agreement with results reported from histological^{3,4}, radiographic measurements as mentioned previously; and this study confirmed indirectly the soft tissue penetration of probe tip during probing depth measurements as reported in the above studies.^{13,14}

The present study questioned the recommended 3 mm of additional crown lengthening when restoring fractured or carious teeth when marginal infringement on the dentogingival junction was imminent for maintenance of **BW** as reported by Ingber et al.⁵ 1977 and others. This study recommend that creation of 1.24 mm at maximum from proposed margin of the restoration is enough for maintenance of BW during surgical crown lengthening, if one considered that there will be some sort of alveolar bone resorption following periodontal flap reflection as reported by Wood et al.¹⁵ 1972 that, the mean bone loss for full thickness flap was 0.62 mm; if this amount is added to the above 1.24 mm will result in maintenance of about 2 mm the classical reported **BW** dimension. The remaining part of the dentogingival unit which is the normal clinical sulcus depth "average about 2-3 mm reported"¹⁶ will be formed

by the thickness of existing gingiva "the reported mean gingival thickness was about 1.41 mm"¹⁷ and the unavoidable soft tissue penetration of probe tip during clinical sulcus depth measurement.^{13,14}

Returning to table 1, one can observe that the clinical **BW** for some teeth was as high as 2.67 mm; meaning that normal variations occur in different individuals. In the previous studies by Gargulio³ 1961 and Vacek⁴ in 1994 they reported **BW** as low as 0.75 mm and as high as 4.3 mm, this information dictates that specific **BW** assessment should be performed for each patient when conducting a restoration and not only relying on the classical 2.04 mm measurement.

CONCLUSIONS

The following conclusions can be drawn from this study:

- 1- The term clinical **BW** is more reliable to be used clinically rather than the term biological width which is a histological term.
- 2- The average clinical **BW** dimension obtained from measurements in selected Saudi patients was at mean of 1.24 mm.
- 3- Creation of 1.24 mm at maximum from proposed margin of restoration when restoring fractured and/or carious teeth if marginal infringement on the dentogingival junction was imminent for maintenance of clinical BW during surgical crown lengthening is recommended.

ACKNOWLEDGMENT

We wish to thank Associate Professor Anil Sukumaran for his valuable advice in the preparation of this manuscript and, Associate Professor Nazeer Khan for his expert statistical advice. This study was supported by College of Dentistry Research Centre (CDRC), King Saud University, Riyadh, Kingdom of Saudi Arabia (Number # F1099).

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