ASSESSMENT OF BIOLOGICAL WIDTH OF ABUTMENT TOOTH RESTORED WITH FULL VENEER CROWN FOLLOWING SURGICAL CROWN LENGTHENING

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Abstract

Maintenance of sound periodontal anatomy, especially biological width, is a key to a successful Prosthesis. In case of insufficient clinical crown height, surgical crown lengthening proposed to expose sufficient tooth structure to allow proper tooth preparation with retentive crown placement without violating biologic width. This study aimed to evaluate the dimensional changes of the biological width of the abutment tooth restored with full veneer crown after surgical crown lengthening. A quasi-experimental study carried out in 30 patients for 06 months. One tooth from each sample was selected and repeatedly measured before and after surgical crown lengthening with a periodontal probe. Baseline measurements were considered as a control group, and follow up measurements were as a case group. After the baseline examination, surgical crown lengthening was done with both rotary and hand instruments. During 01, 03, and 06 months follow up periods, the free gingival margin, base of the gingival sulcus, and bone level showed apical displacement than baseline, which was statistically significant ($p \leq 0.001$). The biological width was reestablished to the baseline value at the end of 06 months with coronal exposure of the tooth.

Keyword: - *Biological width, crown lengthening, periodontium, prosthesis*

1.INTRODUCTION

Periodontium is the principle tooth-supporting structure consisting of the gingiva, periodontal ligament, cementum, and alveolar bone [1]. Preservation of healthy periodontium is essential for long term success of a restored tooth [2]. Prerestorative preparation of periodontal tissue assures form, function, and esthetic of masticatory apparatus and patient's comfort [3]. Potential damage results in the periodontium when restorative margins placed subgingivally [4].

Galguilo et al. [2] described the dimensions and relations of the dentogingival junctions in humans; the biologic width is the vertical soft tissue zone in between alveolar crest and apex of the gingival sulcus. This zone consists of junctional epithelium and connective tissue with an averages dimension of 2.04 mm in all healthy dentition [5]. Biologic width acts as a barrier to prevent penetration of microorganisms into the periodontium [6][7]. It had been reported that subgingivally placed restorations without considering biologic width were associated with gingival inflammation and alveolar bone resorption [8][9][10]. Surgical crown-lengthening exposes enough sound tooth structure and reestablishing the biological width at a more apical level [11]

In contemporary dentistry, reestablishing conditions with insufficient tooth structure were frequently challenged dentists in treatment planning. Without surgical crown lengthening, these teeth need to be orthodontically extruded or extracted and restored with a bridge or implant. All options are costly, lengthy, and not wholly biologic. But Surgical crown lengthening not only overcome most of the limitations of the previous study, but also more biologic, time-consuming, and inexpensive. However, the changes in biological width before and

after surgical crown lengthening followed by fixed prosthesis are needed to be clinically justified. Therefore, this study aimed to evaluate the dimensional changes of the biologic width of abutment tooth for 06 months, where surgical crown lengthening performed, and the repeated assessment of changes before and after crown placement was recorded.

2. MATERIALS AND METHODS:

This Quasi-Experimental study comprised 30 participants, required surgical crown lengthening in endodontically treated teeth, and selected from the outpatient department of prosthodontics, faculty of dentistry, Bangabandhu Sheikh Mujib Medical University (BSMMU), Shahbag, Dhaka, Bangladesh. The period of this study was one (01) year, and Sampling was carried out by convenience sampling procedure.

2.1 Inclusion criteria:

participants with

(i) inadequate tooth structure for placement of the crown,
(ii) short clinical crown but adequate root length,
(iii) grossly destructed endodontically treated teeth,
(iv) required subgingival restoration and,
(v) the age range from 19 to 50 years.

2.2 Study Procedure:

As per the inclusion criteria, 30 patients were selected. Before selection, a written consent, patient's chief complaints, clinical signs, detailed medical and dental history taken, and satisfactory periodontal therapy performed. One tooth from one patient assigned for repeated measurements of periodontal tissue with a graduated periodontal probe (Figure 1- A & B). A customized acrylic stent used as a fixed reference point (FRP) (Figure 1-C). Baseline measurements considered as the control group. After Baseline examination, surgical crown lengthening had been doing under local anesthesia (Figure 1-D). Gingivectomy and level of the osseous crest were lowered with hand and slow speed rotary instruments based on biological width. The periodontal pack was provided in the crown lengthening area after hemostasis and removed after seven days. Clinical parameters were recorded after one month, and teeth were restored with full veneer crown (Figure1-E, F, G). Subsequently, after 3 and 6 months of surgery, clinical parameters were assessed (Figure1- H, I, J, K, L, M, N, O, P). All teeth were measured in 4 positions -/: mesiobuccal, mesiolingual, distobuccal, and distolingual.

Figure 1: Representative photographs of surgical crown lengthening. Surgical acrylic stent (A); Initial (B); Preoperative measurement (C); After surgical crown lengthening (D); BL after crown lengthening (E); One month follow up (F); After crown insertion 1month (G); FGM 1month (H); AL 1 month (I); BL 1 month (J); FGM 3 month (K); AL 3 month (L); BL 3 month (M); FGM 6 month (N); AL 6 month (O); BL 6 month (P).

2.3 Evaluations:

The following assessments were performed as follows:

a. Distance from the fixed reference point (FRP) to the free gingival margin (FGM).
b. Distance from the fixed reference point (FRP) to the base of the gingival sulcus (BGS)
c. Distance from the fixed reference point (FRP) to crestal alveolar bone level (B L) before ostectomy.
d. Distance from the fixed reference point (FRP) to alveolar bone level (BL) after ostectomy.
e. Sulcus depth was calculated by (FRP to BGS) – (FRP to FGM) 6. Biological width was calculated by (FRP to BL) – (FRP to BGS).

2.4 Data Processing:

All data were recorded in millimeters. After completing, the data were presented in the form of tables. Statistical analysis of the results was done by using computer-based statistical software, SPSS 20.00 version (SPSs Inc. Chicago, USA). Paired student t-test and repeated measurement ANOVA were performed. 95% confidence interval (p-value <0.001) were followed for the testing level of significance.

3. RESULTS:

Table 1 showed the results of the study. The assessment of free gingival margin showed that changes in mean values from baseline to 01, 03, and 06 months which were 2.88, 4.67, 4.97, and 4.87, respectively. The mean values at 03 and 06 months were nearly the same, which were 4.97 and 4.87. At all follow-up sites, there was an apical displacement of the apex of the free gingival margin than baseline measurement. Furthermore, the base of the gingival sulcus (BGS) showed that there was a difference of mean value from baseline to 01, 03, and 06 months which were 4.49, 5.61, 5.84 and 5.67 respectively. At all follow-up sites, there was the apical shift of gingival tissue than baseline measurement.

The assessment of sulcus depth (SD) showed that there was a decrease in the mean sulcus depth from baseline to 01, 03, and 06 months which were respectively 1.61, 0.94, 0.87 and 0.81. Repeated measure ANOVA showed significant changes in SD from baseline to 6 months (P<0.001). But Comparisons between follow up periods showed non-significant changes. The assessment of bone level (BL) showed an apical shift from baseline to 01, 03, and 06 months which were respectively 6.00, 7.40, 7.72, and 7.62. The bone level was in a more apical position in 03 and 06 months. However, the mean values of attachment Level (AL) were 1.70, 1.79, 1.89, and 1.75, respectively [Table- 2]. There is no significant difference in mean value from baseline to 01, 03, and 06 months. Repeated measure ANOVA and comparisons between follow up periods showed non-significant changes in BW from baseline to 6 months. (P>0.001).

Table-1: Results of the study

Variables	Baseline (n=30)	1 month (n=30)	3 months (n=30)	6 months (n=30)
Free Gingival margin (FGM)	2.88±0.53	4.67±0.65	4.97±0.53	4.87±0.54
Base of Gingival Sulcus (BGS)	4.49±0.53	5.61±0.59	5.84±0.65	5.67±0.59
Sulcus depth	1.61±0.36	0.94±0.52	0.87±0.47	0.81±0.49
Bone Level (BL)	6.00±0.56	7.40±0.66	7.72±0.63	7.62±0.61
Attachment Level (AL)	1.70±0.12	1.79±0.53	1.89±0.57	1.75±0.63

Table-2: Results of statistical analysis

Statistical analysis of sulcus depth	t/F value	p-value
[a]Baseline vs 1 month vs 3 month vs 6 month	19.581	<0.001 [s]
[b]1 month vs 3 month	1.012	0.320 [ns]
[b]1 month vs 6 month	1.678	0.110[ns]
[b]3 month vs 6 month	2.260	0.065[ns]

Statistical analysis of attachment level	t/F value	p-value
[a]Baseline vs 1 month vs 3 month vs 6 month	0.738	0.531 [ns]
[b]1 month vs 3 month	-2.303	0.029[s]
[b]1 month vs 6 month	0.505	0.617 [ns]
[b]3 month vs 6 month	1.784	0.085 [ns]

[a] Repeated measure ANOVA test, [b]Paired student t-test, s = Significant, ns = Not significant

4. DISCUSSION:

4.1 Positional changes of the Free Gingival Margin (FGM):

In this study, free gingival margin showed apical displacement in follow up periods. Almost similar findings were reported to the studies of Shobha K.S. et al. (2012) [7], Ganji KK et al. (2012) [4], Lanning SK et al. (2003) [11], Bragger U et al. (1992) [12] There was a more significant apical shift in the free gingival margin, which may be due to differences in the follow-up periods. However, other contradicting studies did not show distinct coronal changes in the periodontal tissues by Carnevale G et al. (1983)[13], Wilderman MN et al. (1970) [14] and Kalkwarf KL et al. (1986) [15]. The differences between the present studies with that of the previous study may be due to differences in the surgical crown lengthening technique or may be associated with the participant's oral hygiene quality.

4.2 Changes in the Base of Gingival Sulcus (BGS):

There was apical displacement at the follow-up periods than baseline measurement which were similar to the studies of Shobha K.S. et al. (2012) [7], Ganji KK et al. (2012) [4], Lanning SK et al. (2003)[11], and Bragger U et al. (1992) [12]. There was also a more significant loss of attachment in the follow-up periods than baseline measurement.

4.3 Changes in Sulcus Depth (SD):

There was a decrease in the mean sulcus depth at the follow-up periods than baseline measurement, which may be due to a more significant apical shift in the free gingival margin. Findings showed that there was a statistically significant reduction in sulcus depth ($P \leq .001$) when compared from baseline to 06 months, which coincide with the results observed by Shobha K.S. et al. (2012) [7], and Ganji KK et al. (2012) [4]. But comparisons between follow up periods shows minimal changes in sulcus depth, which was not statistically significant, which may lead to the reestablishment of bone level and gingival connective tissue into a more definite position and strong oral hygiene maintenance of the patients.

4.4 Changes in the Bone Level (BL):

In this study, the alveolar Bone Level showed apical shift at the follow-up periods than baseline measurement. Similar findings were reported in the respective studies by Shobha K.S. et al. (2012) [7], and Ganji KK et al. (2012) [4]. It can be said that apical shifting might disturb to achieve a better clinical outcome, but predictable stability may be observed in properly maintained patients

4.5 Changes in the Attachment Level:

There were minimal changes in mean values of attachment level, which were not statistically significant when compared from baseline to follow up periods. The attachment level was healed up to its usual dimension without significant changes which were similar with the studies of Shobha K.S. et al. (2012) [7], Ganji KK et al. (2012) [4], Lanning SK et al. (2003) [11], Oklay et al. (1999) [16], Carnevale et al. (1983) [13], and Ingber JS et al. (1977) [17]. Comparisons of attachment level between follow up periods also showed non-significant changes. So, biological width reestablished gradually in the follow-up periods to its usual dimension.

In this study, there was no statistically significant change in biological width compared from baseline to follow up periods and in between follow-up periods. So, after surgical crown lengthening, the biological width was restored to its original vertical dimension by 06 months, which also accompanied by the gaining of the supracrestal tooth structure (Table 2).

5. CONCLUSION:

The biological width of the abutment tooth was reestablished to its original dimension without affecting periodontal tissue following surgical crown lengthening. Following surgical crown lengthening tooth structure was exposed, which was sufficient to fabricate a full veneer crown. Apical displacement of free gingival margin occurred without significant changes in periodontal tissue.

6. ETHICAL ISSUE:

The research protocol was approved, and permission for the study was granted from the Institutional Review Board of Bangabandhu Sheikh Mujib Medical University (BSMMU/ 2014/ 4370)

7. CONFLICT OF INTEREST:

The authors declare no conflict of interest.

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