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## RESEARCH ARTICLE

# EVALUATION OF THE EFFECT OF SURGICAL CROWN LENGTHENING ON PERIODONTAL PARAMETERS

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**ABSTRACT**

Aims and Objectives: Biologic width (BW) as defined by Cohen is the part of the supracrestal gingival tissues that occupy the space between the base of the gingival crevice and the alveolar crest; it includes the junctional epithelium and the connective tissue element. The purpose of this study was to evaluate the positional changes of the periodontal tissues, particularly the biological width, following surgical crown lengthening in human subjects. Materials and Methods: A clinical trial study involving 15 patients was carried out for a period of 3 months. Sites were divided into3 groups: treated (TT) sites, adjacent (AD) sites and non-adjacent (NAD) sites. Free gingival margin (FGM), attachment level, pocket depth, bone level, biological width (BW) were recorded at baseline, 1 and 3 months. Direct bone level after flap reflection was recorded before and after osseous resection at baseline only. Level of osseous crest was lowered based on BW, and supracrestal tooth structure needed using a combination of rotary and hand instruments. Results: Overall, apical displacement of FGM at TT, AD and NAD sites was statistically significant compared to baseline. The apical displacement of FGM at TT site was more when compared to that at AD and NAD sites at 3 months. The BW at the TT site was smaller at 1 and 3 months compared to that at baseline.

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## INTRODUCTION

The preservation of a healthy periodontium is critical for the long-term success of a restored tooth. Dentists must constantly balance the restorative and esthetic needs of their patients with periodontal health (Lanning, 2003). One factor that is of particular importance is the potential damage that results in the periodontium when margins are placed subgingivally. Garguilo *et al*. (1961) described the dimensions and relations of the dentogingival junction in humans; the biologic width is the zone of the root surface coronal to the alveolar crest to which the junctional epithelium and connective tissue are attached; it averages 2.04 mm. These dimensions may vary from tooth to tooth, but it is present in all healthy dentition (Maynard, 1979). It was shown that crown margins positioned subgingivally were associated with the most gingival inflammation leading to violation of biologic width, whereas supragingivally located crown margins were associated with the least gingival inflammation. Supragingival placement of restoration margins allows for ease of impression making, cleansing, (Silness, 1970) and detection of secondary caries and is associated with maintainable probing depths (Silness, 1970; Bader, 1991) Subgingival restorations can have damaging effects on the neighboring hard and soft tissues, especially when they encroach on the junctional epithelium and supracrestal connective tissue (Newcomb, 1974) These subgingivally placed restorations have been associated with gingival inflammation, loss of connective tissue attachment and bone resorption (Maynard, 1979; Block, 1987; Nevins, 1984). Removal of soft tissue and sometimes even hard tissues occurs in crown lengthening surgery. Soft tissue removal is performed when there is more than 3mm of soft tissue over the bone. In cases with less than 3mm of soft tissue or inadequate attached gingiva, bone recontouring and flap procedure are recommended. To maintain healthy periodontium, there should be a 4-mm distance from bone crest in fractured teeth and deep caries (Melnick, 2012) Although Bragger *et al*. reported that the gingival margin remained stable during the healing period and that gingival enlargement was little, [10] some evaluations showed significant reduction of SOG (supra osseous gingiva) after crown lengthening in the follow-up study 2 and 6 months later (Ayubian, 2010; Deas, 2004). Therefore, the purpose of this study was to evaluate the positional changes of the periodontal tissues, particularly the biological width, following surgical crown lengthening in human subjects over a 6-month healing period.

## MATERIALS AND METHODS

This study was an interventional case series with the observation periods of one and three months. Individuals were referred to Dentistry Department, SKIMS. Patients were screened for eligibility. Their teeth were approved according to the following criteria:

- Need of surgical exposure for appropriate prosthetic treatment
- Sub gingival caries or fracture
- Insufficient crown length for proper retention
- Uneven gingival height
- Proper prognosis and crown root ratio
- Having a single root

**The following criteria were approved for the patients:**

•No systemic disease contraindicated with gingival surgery
•No drug use, no history of periodontal disease, non-smoker. The study was sampled from 15 patients with 20 teeth which needed surgical exposure for proper restorative treatment.

**Clinical Measurements:** Two weeks before the surgery, all patients received oral hygiene instructions and also professional dental cleaning if needed. For each patient an acrylic stent was fabricated and vertical grooves were made at the interproximal and mid-buccal aspects of the teeth for standardization of the location of the probe during measurements. After local anesthesia, clinical parameters include

- Plaque index (Silness and Loe, 1964)
- Gingival index (Loe and Silness, 1963)
- Distance from the fixed reference point (FRP) to the free gingival margin (FGM)
- Distance from the fixed reference point (FRP) to the attachment level (AL) of the base of the pocket(BOP)
- After the experimental area was anesthetized, bone level (BL) was obtained via transgingival probing from the fixed reference point

The lower/apical limit of the vertical grooves was used as the fixed reference point for the vertical probing depths (Samuel E. Lynch, 1992). The following calculations were made from the clinical measurements recorded:

- Probing depth (FRP to BOP) – (FRP to FGM)
- Biological width (FRP to BL) – (FRP to BOP)

Fifteen patients were selected after the initial phases of periodontal therapy. Patients were given a brief description of the study, and a written informed consent letter was obtained from all the patients. The selected sites were divided into 3 groups:

- **Treated (TT) sites:** Sites on teeth selected for crown-lengthening
- **Adjacent (AD) sites:** Interproximal sites that shared a proximal surface with the treated tooth
- **Nonadjacent (NAD) sites:** Interproximal sites away from the treated tooth

## RESULTS

**Plaque and gingival indices:** No significant change was noted in the plaque index (PI) or gingival index (GI) at the treated, adjacent and nonadjacent sites. The mean values of PI and GI ranged from 1.32 to 1.63 and 1.32 to 1.67, respectively.

**Free gingival margin:** The mean distances from the reference stent to the FGM at baseline, 1, 3 and 6 months for TT, AD and NAD sites are listed in Table 1. At all sites, there was a difference in the apical displacement of the free gingival margin from baseline to 1, 3 and 6 months (P<.0001), which was highly statistically significant.

**Table 1.**

| | Treated site | Adjacent site | Non adjacent site |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | Mean ±SD |
| Baseline | 1.85± 1.03 | 3.15± 1.43 | 2.85±1.20 |
| 1 month | 4.15± 1.65 | 4.23 ± 1.35 | 4.1± 1.33 |
| 3 months | 4.22 ± 1.45 | 4.15± 1.11 | 3.85 ± 1.45 |

**Attachment level:** The mean distances from the reference stent to the base of the sulcus at baseline, 1and 3 months for TT, AD and NAD sites are listed in Table 2. The attachment loss was greater at TT sites at baseline compared to that at AD and NAD sites at 3 months.

**Table 2.**

| | Treated site | Adjacent site | Non adjacent site |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | Mean ±SD |
| Baseline | 4.75± 1.16 | 5.03± 1.01 | 5.00±1.15 |
| 1 month | 6.15± 1.42 | 6.15 ± 1.31 | 5.72± 1.23 |
| 3 months | 6.35± 1.61 | 5.85± 1.13 | 5.85 ± 1.35 |

**Probing depth:** The mean probing depths at baseline, 1, 3 and 6 months for TT, AD and NAD sites are listed in Table 3. At treated sites, there was a decrease in the mean probing depth from baseline to 3 months, which was statistically significant (P=.001).

**Table 3.**

| | Treated site | Adjacent site | Non adjacent site |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | Mean ±SD |
| Baseline | 2.75± 1.02 | 1.83± 0.72 | 1.93±0.75 |
| 1 month | 1.75± 0.9 | 1.93± 0.81 | 1.71± 0.80 |
| 3 months | 1.83± 0.85 | 1.63± 0.67 | 1.99 ± 0.88 |

**Bone level:** The mean distances from the reference stent to the bone level at baseline, 1, 3 and 6 months for TT, AD and NAD sites are listed in Table 4. At all sites, the apical shift in the bone level was different from baseline to 1 and 3months (P<.0001), which was highly statistically significant.

**Table 4.**

| | Treated site | Adjacent site | Non adjacent site |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | Mean ±SD |
| Baseline | 6.50± 1.22 | 6.54± 1.24 | 6.54±01.23 |
| 1 month | 7.58± 0.99 | 7.93± 0.95 | 7.57± 0.92 |
| 3 months | 7.99± 0.84 | 7.83± 0.81 | 7.83± 0.85 |

**Biological width:** The mean vertical dimensions of the biological widths at baseline and at 1 and 3months for TT, AD and NAD sites are listed in Table 5. However, there was no significant difference in the biological width at all sites at 3

months compared to that at baseline (P=.817), which was statistically not significant.

**Table 5.**

| | Treated site | Adjacent site | Non adjacent site |
|---|---|---|---|
| | Mean ±SD | Mean ±SD | Mean ±SD |
| Baseline | 1.82± 0.77 | 1.57± 0.76 | 1.76±0.87 |
| 1 month | 1.73± 0.64 | 1.88± 0.66 | 1.91± 0.91 |
| 3 months | 1.69± 0.53 | 1.86± 0.65 | 1.87± 0.84 |

## DISCUSSION

Over the years, dentists have had difficulty in correctly relating the restorative margin placement to the periodontal apparatus; in the prosthetic treatment of advanced periodontal-prosthetic case, many failures have been due to the incorrect prosthetic management of the periodontal soft and hard tissues. These failures frequently have been blamed on poor oral hygiene and poor cooperation by the patient but this is not always true. It is because of violation of biologic width due to subgingival margin placement. At the majority of sites in this study, the biologic width after surgical crown lengthening was significantly smaller compared to baseline. These findings are consistent with previous studies. Lanning *et al*. (2003) demonstrated that after surgical crown lengthening, the biologic width at treated sites was reestablished to its original vertical dimension by 6 months. In addition a consistent 3mmgain of coronal tooth structure was observed at the 3rd and 6th week examination.

Oakley *et al*. (1999) and Carnevale *et al*. (1983) reported that bone resorption following surgical crown lengthening provides supracrestal tooth structure for the attachment of connective tissue, leading to reestablishment of the biological width. At treated sites, the biological width at 3 months was significantly different compared to baseline; however, at 6 months, there was no significant difference compared to baseline. In other words, the original vertical dimension of the biological width was reestablished at treated sites 6 months following surgical crown lengthening. The main objective of this study was to evaluate the positional changes of the periodontal tissues, particularly the biological width, following surgical crown-lengthening in human subjects. The results showed that there was a significant apical displacement in the free gingival margin at the treated sites, which provided adequate exposure of the crown tooth structure to be restored without impinging on the biological width. There was no statistically significant difference in biological width at all sites. The biological width was reestablished to the original vertical dimension at all sites. Sufficient space was provided coronal to the alveolar crest for the reconstruction of the supracrestal connective tissue.

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