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Evaluation of Dimensional Changes of Supraosseous Gingiva Following Crown Lengthening

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Abstract

Background and aims. Clinical studies on dimensional changes of supraosseous gingiva (SOG) following crown lengthening surgery have yielded different results. The aim of the present study was to evaluate the alterations in SOG dimension following crown lengthening surgery.

Materials and methods. This clinical study included 20 patients with 20 teeth needing surgical exposure for proper restorative treatment. Clinical parameters, including GI, PD, SOG, KG (keratinized gingiva) and BL (bone level) were recorded at baseline and two months after treatment. Surgical crown lengthening procedures were carried out on all the teeth. After a two-month period of healing, the parameters were measured again.

Results. The amount of KG at the baseline and two months after treatment were 5.00 ± 0.85 and 4.15 ± 0.9 mm, respectively (P = 0.001). The FGM at baseline, immediately after suturing, and two months later were 4.07 ± 1.36 mm, 5.46 ± 1.15 mm and 5.16 ± 1.1 mm, respectively (P = 0.004). The mean bone reduction was 1.69 ± 0.52 mm. The mean SOG at interproximal site at baseline and two months after surgery were 3.87 ± 0.7 mm and 3.22 ± 0.5 mm, respectively (P = 0.001). The mean tissue regrowth at interproximal sites was 2.2 ± 0.5 mm.

Conclusion. Following surgical crown lengthening, vertical dimension of SOG significantly decreased within two months after treatment. TPS is a reliable and accurate technique for measuring the apico-coronal dimension of SOG.

Key words: **Crown lengthening, gingiva, periodontal treatment.**

Introduction

The preservation of healthy periodontium is necessary for the long-term success of a restoration. At the same time, the esthetic and restorative needs of patients should always be balanced. Extensive subgingival caries, tooth fracture, inadequate crown length and preexisting margins of failing restoration in a deep subgingival location make it impossible to prepare well-defined restoration margins that are easily accessible for impression making.[1,2]

In such circumstances any attempt to gain access or retention by extending preparations too deep subgingivally leads to biologic width invasion with subsequent

gingival inflammation, loss of attachment, and alveolar bone resorption.[3-6]

In order to facilitate restorative treatment and to prevent periodontal breakdown, surgical crown lengthening with apically position flap and osseous resection have been recommended.[7-9] Many clinical studies have suggested the surgical removal of the periodontal support, to the extent of leaving a 2.5-5-mm distance from the level of planned margins to the level of the new location of alveolar bone crest.[9,10] Gargiulo et al[11] reported considerable variations in the length of supracrestal soft tissue in dentogingival complex and a mean of 2.73 mm for total length of this complex in a histologic study. Clinical studies on supraosseous dimensional changes of (SOG) following crown lengthening surgery have yielded different results. Lanning et al[12] and Smukler et al[13] reported that the biologic width (BW), following crown lengthening surgery, is re-established to its original vertical dimension. Bragger et al[14] reported that position of marginal gingiva during healing period remains stable and coronal growth of gingival tissue is minimal. However, Perez et al[15] reported a reduced vertical dimension of SOG following crown lengthening surgery. Oakley et al[16] reported different results on the dimensional changes in SOG in mandibular and maxillary teeth after crown lengthening surgery in an animal study. Therefore, the aim of the present study was to evaluate the alterations in SOG dimensions following crown lengthening surgery.

Materials and Methods

This clinical study included 20 patients (15 females and 5 males, with a mean age of 32.5 years) with 20 teeth which needed surgical exposure for proper restorative treatment. The exclusion criteria were proximity of the tooth to edentulous ridge, systemic diseases that contraindicate periodontal surgery, diabetes, history of periodontitis and smoking. Patients received an explanation about the purpose of the study and provided written informed consent. Prior to surgery all the patients underwent professional tooth cleaning and received oral hygiene instructions. For each patient, an acrylic stent was made and vertical grooves were made at interproximal and mid-buccal aspects of tooth in order to standardize the location of the probe during measurements. All the measurements were made with a standard periodontal probe (CP-15UNC SE, Hu-Friedy, Chicago, IL) with an endodontic marker; the distance between the marker and probe tip was measured by digital calipers (Digital Calipers, LG, Japan). The following clinical parameters were recorded two weeks after initial periodontal treatments:

- Gingival index (GI) (Silness and Loe)[17]
- Probing depth (PD) at interproximal surfaces
- Bone level (BL), measured via transgingival probing (TGP) from the reference stent to the alveolar bone crest after local anesthesia
- Direct bone level (DBL), measured from the stent to alveolar bone crest during surgery after flap elevation
- Supraosseous gingiva (SOG), measured from the tip of the interdental papilla to the alveolar bone crest
- Biologic width (BW), calculated by subtracting PD from SOG
- Keratinized gingiva (KG), the distance from the mid-buccal gingival margin to MGJ

After local anesthesia (lidocaine/epinephrine 1:80.000, Daroopakhsh Co., Iran), an inverse bevel incision and full-thickness flap procedures were performed and extended at least one tooth mesially and distally. Osseous surgery was carried out by hand and rotary instruments under sterile saline irrigation in a way that positive architecture of bone would be maintained. The remnant of periodontal ligament and connective tissue on root surface were removed with a fine flame-shaped finishing bur.[6,13,16] To determine the amount of bone to be removed, the amount of BW was added to the amount of supracrestal tooth structure necessary for proper placement of restorative margins. The flaps were positioned over the bony crest at buccal and lingual surfaces and stabilized by continuous sling sutures which resulted in exposure of interdental alveolar bone crest. The surgical areas were covered with periodontal dressing (Co-Pack, GC America Inc., Alsip, IL, USA). All the surgeries and measurements were carried out by the same periodontist.

Antibiotics (500-mg amoxicillin capsules for 5 days) and analgesics (400-mg ibuprofen tablets) were prescribed for all the patients. Rinsing with 0.2% chlorhexidine gluconate twice a day was recommended for a two-week period. Periodontal dressing and sutures were removed after 10 days and the teeth were cleaned professionally the same day. Plaque control regimen and inter-dental brush were reinstituted a week later. During the two-month healing period professional tooth cleaning was carried out if needed. After two months of healing, the parameters, GI, PD, SOG, BL and BW, were measured again.

Statistical Analysis

Means were calculated for all the parameters at baseline and two months after surgery. Data were analyzed by paired sample *t*-test, Wilcoxon singed ranks test and ANOVA. Pearson correlations were calculated to test

the reliability of TSP measurements versus DBL measurements.

Results

All the patients completed the study uneventfully. Clinical parameters are shown in Table 1. During the study period, GI had a statistically significant reduction (from 0.70 ± 0.47 to 0.37 ± 0.50) (P = 0.008). The amount of KG at baseline and two months after surgery were 5 ± 0.85 and 4.15 ± 0.9 mm, respectively (P = 0.001). The mean PD values recorded at interproximal sites at baseline and two months later were 2.34 ± 0.51 mm and 1.87 ± 0.5 mm, respectively (P ≤ 0.05). Within two months the position of FGM underwent alterations that are shown in Tables 1 and 2. The FGM at baseline, immediately after suturing and two months later were 4.07 ± 1.36 mm, 5.46 ± 1.15 mm and 5.16 ± 1.1 mm, respectively (P = 0.004).

The mean BL at baseline and two months later were 5.85 ± 0.92 mm and 7.69 ± 0.82 mm, respectively (P = 0.001). The mean DBL at baseline was 5.89 ± 0.93 mm. There was a 0.99 correlation (r) between BL at baseline and DBL immediately after flap elevation.

The mean DBL at baseline and immediately after osseous surgery were 5.89 ± 0.93 mm and 7.55 ± 0.83 mm, respectively (P=0.001). The mean bone reduction was 1.69 ± 0.52 mm.

The mean SOG at interproximal site at baseline was 3.87 ± 0.7 mm and within the two months after surgery changed to 3.22 ± 0.5 mm (P = 0.001). The mean BW at baseline and two months after surgery were 1.52 ± 0.51 mm and 1.35 ± 0.5 mm, respectively (P = 0.192). The mean tissue re-growth at interproximal sites was 3.22 ± 0.5 mm. Mean reduction of PD, BW and SOG were 0.47 mm (P = 0.016), 0.17 mm (P = 0.192) and 0.65 mm (P = 0.001), respectively.

The mean distance from the reference point of the stent to free gingival margin (FGM) on buccal surface at baseline, immediately after suturing and two months after surgery were 4.07 ± 1.36 mm, 5.46 ± 1.15 mm and 5.16 ± 1.1 mm, respectively (P = 0.004).

Discussion

The results of the present clinical study showed that two months after surgical crown lengthening the apicocoronal dimension of SOG decreased significantly. The mean BW after surgical crown lengthening had no significant change, meaning that the reduction of SOG is the result of reduced PD (0.47 mm). In the present study, mean SOG reduction was 0.65 mm. Perez et al[15] reported a significant reduction of 0.56 mm in apicocoronal dimension of SOG six months after healing. In a histometric study on nonhuman primates, Oakley et al[16] reported that in maxillary teeth, surgical crown lengthening resulted in a mean reduction of 0.96 mm in supracrestal soft tissue, whereas mandibular sites showed increased width of supracrestal tissues following crown lengthening surgery (0.12 mm). Lanning et al[12] reported that the biologic width (BW) at treated sites were not significantly different from baseline after 6 months. They found that the BW at all sites decreased from baseline to the 3rd month and subsequently increased from the 3rd month to the 6th month. They attributed the changes taking place between the 3rd and the 6th months to slight attachment gain and apical displacement of the bone level. In this study, because of the short follow-up period, it was not possible to monitor such alterations. They concluded that

Table 1. Mean changes in clinical parameters from baseline to 2 months after surgery

	GI¶	PD mm§	KG mm§
Baseline	0.70 ± 0.47	2.44 ± 0.74	5.00 ± 0.85
Immediately after surgery			
Two months after surgery	0.37 ± 0.50	1.87 ± 0.50	4.15 ± 0.90
P value	≤0.005	≤0.005	≤0.001

¶ P value is based on the Wilcoxon signed ranks test.
§ P values are based on the paired *t*-test.
GI: Gingival Index; PD: Probing Depth; KG: Keratinized Gingiva.

Table 2. Mean changes in the clinical parameters from baseline to two months after surgery

	FGM mm	BL mm	DBL mm	SOG mm
Baseline	4.07±1.36	5.85± 0.92	5.89 ±0.93	3.87±0.7
Immediately after surgery	5.46± 1.15		7.55±0.83	
Two months after surgery	5.16 ± 1.1	7.69 ±0.82		3.22 ± 0.5
P value ¶	0.000	0.001	0.001	0.001

¶ P values are based on paired *t*-test.
FGM: Free Gingival Margin; BL: Bone Level; DBL: Direct Bone Level; SOG: Supraosseous Gingiva.

the BW is predetermined, because the dimensions before and after surgery were the same. Other studies have demonstrated that the pre-operative dimension of SOG will not necessarily be replicated after the operation.[15,16]

In the present study, the mean bone resection was 1.69 ± 0.52 mm at interproximal sites whereas Pontoriero et al[18] reported 0.9 mm of bone resection at interproximal sites and 1.0 mm at buccal /lingual sites. Lanning et al[12] reported 2.68 mm bone resection during surgery. Such differences may have been resulted from variations in BW, different anticipated prosthetic finish line locations and experience of the surgeon. The mean bone resorption during healing period in the present study was 0.14 mm whereas Lanning et al[12] reported 0.77 mm of bone resorption during a 3-month healing period. The reason for more bone resorption reported by them might be the more extensive osseous resection in their cases and longer healing period.

In this study, 3.22 mm of supraosseous gingival tissue had formed again interproximally after a two-month healing period. Pontoriero et al[18] reported 3.2 mm of SOG re-growth after six months of healing and Perez et al[15] showed 3.12 mm after 12 months. Van der Velden[19] found 4.33 mm of gingival soft tissue formation over interdental septum 3 years after surgical crown lengthening. It seems that in the presence of good oral hygiene and absence of gingival inflammation the dimension of BW will not change in the long term.

Two months after healing we found 0.3 mm of coronal re-growth of buccal gingival margin. Pontoriero et al[18] found 2.9 mm of coronal re-growth of free gingival margin during a twelve-month observation period. Bragger et al[14] reported that during a six-month healing period the position of gingival margin was stable. These differences might be attributed to different surgical techniques, especially the position of flap margin relative to alveolar crest and/or different amounts of crestal bone reduction during surgery. Pennel et al[20] and Donnefeld et al[21] reported a mean reduction of 0.5 and 1.0 mm in the bone height following osseous surgery. Less amounts of bone resorption (0.14 mm) after two months in this study might be, firstly, related to the limited amount of bone resection and, secondly and more importantly, to the short healing period after surgery. It has been reported that the osteoblastic activity reaches its peak between the 3rd and 4th weeks after surgery.[22]

TSP has been introduced as a reliable method for measuring the dimension of supracrestal gingival tissue in clinical examinations.[18,19-23] Our results showed that the Pearson correlation for measuring SOG via TSP with DBL measurement was 0.99, meaning that TSP is a reliable and accurate method for assessing the vertical dimension of SOG during clinical examinations.

Conclusion

Within the limitations of the present study, it is concluded that following surgical crown lengthening, vertical dimension of SOG significantly decreased after a two-month healing period. There was no statistically significant difference between BW before and after surgical crown lengthening after a two-month healing period. Healing of interproximal gingival tissue showed coronal re-growth equal to 3.22 mm. TSP is a reliable and accurate technique for measuring the apico-coronal dimension of SOG.

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