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Please cite this article ASSESSMENT OF SUPRA CRESTAL TISSUE ATTACHMENT VARIATION IN PATIENTS OF CHRONIC PERIODONTITIS BEFORE AND AFTER TREATMENT: A CLINICAL-RADIOGRAPHIC STUDY.

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Brief summary:

The supra crestal tissue attachment is an essential concept in the periodontics and restorative dentistry. The dimension of supra crestal tissue attachment is directly related to the periodontal disease severity. Assessment of the supra crestal tissue attachment is crucial because after treatment of periodontitis there is a frequent need for restoration or prosthesis.

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Abstract

Background/Aim. Healthy periodontium comprises the dento-gingival junction. Periodontal disease starts to appear when the integrity of the junctional epithelium is disturbed. Assessment of the supra crestal tissue attachment (SCTA) is essential because there is a frequent need for restoration or prosthesis after periodontal surgical and nonsurgical therapy. The aim of the present study is to evaluate the SCTA variation in a patient of chronic periodontitis before and after treatment. Methods. Thirty systemically healthy patients with periodontitis were enrolled in the study. Fifteen patients were subjected to scaling and root planing and 15 to open flap debridement. Radiographic and clinical supra crestal tissue attachment was assessed before and after treatment at 3 and 6 months interval. Results. Comparison between clinical and radiographic SCTA shows a significant difference in patients with periodontitis (p<0.05). This difference is not significant after treatment of patients with shallow pockets with scaling and root planing (p>0.05) but shows a significant difference in patients with moderate pockets treated by open flap debridement (p<0.05). Conclusion. Progression in periodontal disease will cause a reduction in the SCTA dimension, which regains its original dimensions after periodontal therapy. It takes around 3 months for the shallow pockets to regain supra crestal tissue attachment to the original dimension when treated by scaling and root planing. Whereas moderate pockets regain it after 6 months when treated with open flap debridement.

Key words: chronic periodontitis, open flap debridement, scaling root planing, supra crestal tissue attachment.

Introduction

Periodontium is subject to morphologic and functional variations, as well as changes associated with age. Therefore, changes taking place in one of the periodontal component may have significant consequences on other components with respect to maintenance and regeneration. The junctional epithelium forms a collar around the cervical portion of the tooth. The role of junctional epithelium is especially crucial because it seals off periodontal compartment from the oral environment. The attachment of the junctional epithelium to the tooth is reinforced by gingival fibers, referred to as the dento-gingival unit. Attachment loss happens when junctional epithelium starts to migrate apically - this is a best example of how structure regulates function.

Dento-gingival junction to the tooth surface is composed of a fibrous, supracrestal connective tissue attachment and an epithelial attachment (junctional epithelium). This anatomical structure has been termed as “Supra crestal tissue attachment” (SCTA) [previously known as “biological width”] and was introduced as an important concept in periodontics and restorative dentistry. Histologic dimensions of the SCTA were comprehensively evaluated on teeth from autopsy specimens of subjects 19 to 50 years of age; having an average width of 1.07 mm for connective tissue and 0.97 mm for the junctional epithelium. These dimensions varied considerably with age and level of apical migration of the epithelial attachment.
One of the first changes of periodontitis is migration of the junctional epithelium along the root surface, resulting in formation of a periodontal pocket. The ensuing inflammatory response leads to the degradation of the underlying connective tissue, first around blood vessels and then spreading into adjacent regions, resulting in structural and functional disintegration of the gingiva.

The supracrestal connective tissue attachment is an important, but variable, component of the periodontal support, which may provide periodontal stability to teeth that lack alveolar bone support, as well as providing an unusually large SCTA. Considerable variability has been shown to exist in the dimensions of the SCTA in cross-sectional studies of autopsy materials with no overt periodontal pathology. Various clinical and experimental studies are available in the literature, investigating the effect of the periodontal surgical procedure on healing and regeneration of the SCTA. Very few studies, however, have been done on measurement of the SCTA before and after flap surgery in humans with periodontal pockets. So, the purpose of this study was to determine the SCTA variation in patients with chronic periodontitis and pockets before and after treatment.

Methods

The study design was reviewed and approved by the ethical review board of the institution. The patients (mean age 38 ± 10.57 years) meeting the selection criteria were randomly recruited from the out-patient Department of Periodontology and Implantology. The study design was explained to the patients and informed consents were obtained. Patients with at least 20 teeth in the oral cavity, the presence of periodontal pockets in the range of 3-7 mm in at least 10 teeth and with radiographic evidence of horizontal bone loss were included in the study. Patients diagnosed with aggressive periodontitis, angular osseous defects, tobacco users, pregnant and lactating women, systemically compromised, and for whom surgery is contraindicated were excluded from the study.

Thirty selected patients were divided into two groups, depending on the selected criteria. Study group 1 consisted of patients with periodontal pockets in the range of >3 to <5 mm. This group underwent non-surgical periodontal therapy comprising of scaling and root planning (SRP), performed under local anesthesia. Study group 2 consisted of patients with periodontal pockets in the range of ≥5 to 7 mm. This group underwent surgical periodontal therapy comprising of Scaling and Root Planning (SRP) followed by Periodontal Flap Surgery (PFS) under local anesthesia (Figure 1).

Dental radiographs were made of the study teeth and their pre-operative clinical presentation was photographically documented. Occlusal stents for positioning the wire pins were fabricated with self-cured acrylic resin. It was used to measure the different clinical parameters and recorded to the nearest millimeter (Figure 2).

Baseline measurements were done clinically and radiographically. Clinical examination was done in the buccal and lingual gingival sulcus. Radiographic examination was done in the mesial and distal gingival sulcus. The clinical parameters were recorded as; (1) Probing Pocket Depth (PPD) - measured as the distance from the gingival margin to the fundus of the periodontal pocket by using University of Michigan “O” probe will William marking (Hu-Friedy Mfg. Co, Chicago, Illinois, United States); (2) Probing Bone Level (PBL) - measured as the distance between the gingival margins to the crest of the bone by bone sounding under local anesthesia; (3) Clinical Supra Crestal Tissue Attachment (C-SCTA) - calculated as the difference of the above two measurements. Parameters were
recorded at baseline, 3 months and 6 months after the selected treatment for the assessment of supra crestal tissue attachment.

Standardized radiovisiographs (RVG) (Drsuni™ Digital Imaging software, San Jose, CA, USA) were taken with the RINN XCP system™ (Dentsply Sirona, Pennsylvania, USA) at baseline, 3 months and 6 months postoperatively. Radiographs were standardized by using bisecting angle technique with a film holder device. Radiographs were taken after inserting a radiographic marker (wire pin) into the mesial and distal gingival sulcus while keeping the acrylic stent in position (Figure 3). The distance was calculated and measured by the radio-visiographic analyzing tool. Landmarks were identified on the radiographs as: (1) Radiographic Supra Crestal Tissue Attachment (R-SCTA) - it was measured as the distance from the apical tip of the radio-opaque marker to the alveolar crest; (2) Alveolar Crest (AC) - it was defined as the crossing of the silhouette of the interdental bone with the root surface. The average of the mesial and distal scores was the R-SCTA. A Total Supra Crestal Tissue Attachment (T-SCTA) was calculated by making the average sum of C-RSTA and R-SCTA.

The study was divided into two groups: The patients in the Study group 1 underwent non-surgical periodontal therapy comprising of scaling and root planing. Patients were excluded from the Study group 2, if the residual pockets were less than 5mm after phase I therapy. After re-evaluation, patients underwent conventional periodontal flap surgery (Split papilla flap), which was performed under local anesthesia. Post-operative medications were prescribed to the patients for five days. One week following surgery, the surgical area was examined thoroughly for any postoperative complication related to healing. Patients in both groups were recalled after 1 month, 3 months and 6 months post-treatment. At each visit, oral hygiene instructions were re-enforced and oral prophylaxis was done whenever necessary. Post-operative patient’s evaluation was done clinically and radiographically at 3 months, and 6 months.

Results

This study analyzed variations in the SCTA of patients with chronic periodontitis before and after the treatment. SCTA measurements were recorded at baseline and 3 months and 6 months after treatment. To analyze the post-treatment effect, a paired T-test was performed at 14 degrees of freedom and at 95% confidence level. The level of significance was determined by the p value <0.05. Statistical analysis was done with the help of SPSS (Statistical Package for Social Science) version 13 (SPSS Inc, Chicago, IL, USA). The primary outcome variable of this study was to analyze variations in the SCTA before and after treatment of periodontitis. Following observation were made to meet the objective of the study: Variation in C-SCTA after SRP (group 1): The mean clinical SCTA at baseline was 2.477± 0.429, which increased to 3.202±0.237 at 3 months, and further increased to 3.262±0.230 at 6 months (table 1).

Variation in the R-SCTA after SRP (group 1): R-SCTA included the SCTA in mesial and SCTA in the distal region. The mean R-SCTA at baseline was 2.657±0.493, which increased to 3.346±0.330 at 3 months, and further increased to 3.368±0.295 at 6 months (table 1). Variation in T-SCTA after SRP (group 1): T-SCTA at baseline was 2.567±0.452 which increased to 3.310±0.293 at 3 months which further increased to 3.342±0.267 at 6 months. The differences in mean values from baseline to 3 months and baseline to 6 months were statistically significant, but they were not statistically significant from 3 months to 6 months (Table 2).
Difference in C-SCTA and R-SCTA after SRP (group 1): The differences in mean values from baseline to 3 months and baseline to 6 months were statistically significant, but they were not statistically significant from 3 months to 6 months (Figure 4). Variation in C-SCTA after PFS (group 2): The mean C-SCTA at baseline was 2.091±0.332, which increased to 2.970±0.206 at 3 months, and further increased to 3.159±0.275 at 6 months (table 4). Variation in R-SCTA after PFS (group 2): The mean R-SCTA at baseline was 2.400±0.249, which increased to 3.180±0.237 at 3 months, and further increased to 3.294±0.282 at 6 months (table 4).

Variation in T-SCTA after PFS: Mean T-SCTA at baseline was 2.245±0.283, which increased to 3.127±0.213 at 3 months, and further increased to 3.260±0.269 at 6 months. The differences in mean values from baseline to 3 months, baseline to 6 months, as well as from 3 months to 6 months, were statistically significant (table 5).

Difference in clinical and radiographic SCTA after PFS: The differences in mean values from baseline to 3 months, baseline to 6 months, as well as from 3 months to 6 months, were statistically significant (Figure 5).

Comparison between SCTA of PPD >3 to <5 mm treated by SRP and PPD ≥5 to 7 mm treated by PFS: In disease, the mean T-SCTA in PPD >3 to <5 mm was 2.567±0.452, and 2.245±0.283 in the PPD ≥5 to 7 mm. The difference between the two values was 0.322, which was statistically significant. Three months after the treatment by SRP, the mean T-SCTA was 3.310±0.293 and after treatment by PFS the mean SCTA was 3.127±0.213 - the difference between the two values (0.183) was not statistically significant. Six months after the treatment by SRP, the mean T-SCTA was 3.342±0.267 and after the treatment by PFS it was 3.260±0.269. The difference between the two values was 0.082, which was not statistically significant (Figure 6).

Discussion

Periodontal disease is a common inflammatory disease, characterized by periodontal pocket formation and the SCTA loss. Probing depth and clinical attachment loss measurements are routinely recorded at six sites around the tooth, because it is often impossible to anticipate probing depths and loss of attachment from the superficial appearance of the gingiva.

After treatment of chronic periodontitis, assessment of the SCTA is essential because there is a frequent need for prosthetic restoration. In addition, it was suggested that SCTA measurements taken from the tissues of a healthy periodontium should not be extrapolated for use in pathologic situations and after periodontal surgery. So change in the SCTA may cause failure in the future restoration or prosthesis. Perez JR et al, in a landmark study estimated the Supra-osseous Gingiva (SOG) before and after Crown Lengthening Surgery (CLS). Intra-class correlations were calculated to test for the reliability of TGP measurements versus direct-bone-level (DBL) measurements. They concluded from the study that, TGP is an accurate alternative method to DBL in clinically determining SOG dimensions.

Observations from the study conducted by Goodson revealed that attachment loss precedes radiographic evidence of crestal alveolar bone loss during periods of periodontal disease activity. Sum total of biological width calculated by Garguilo et al, was 2.04 mm (1.77-2.43 mm). The dimension of the SCTA is known to get affected by tooth type and
position, the presence of a restoration, periodontal disease and after periodontal surgery. The authors finally concluded that there is no fixed dimension of the SCTA.

The value of the SCTA in health, as reported in the literature, is 3.39±0.8461. The T-SCTA in disease, in this study, was found to be 2.406±0.405, which shows a difference (0.962) that is statistically significant. These results are not in agreement with results of another study in which an average C-SCTA in cases of severe periodontitis was recorded to be 3.95 mm. The result from the study revealed that there is a gain in SCTA after SRP. This may be due to gain in clinical attachment level or formation of long junctional epithelium or both. This process is completed by three months as difference values up to six months were not significant.

In disease, the mean C-SCTA in the SRP group was 2.477±0.429 and the R-SCTA was 2.657±0.493, the difference of which was statistically significant. C-SCTA at baseline was lesser than R-SCTA. It means that buccal, palatal/lingual SCTA at baseline was less than mesial, distal SCTA. Comparison between clinical and radiographic SCTA revealed that in disease the mean C-SCTA in the SRP group was 2.477±0.429 and the R-SCTA was 2.657±0.493, the difference of which was statistically significant. These results are very similar to the previous study, in which the authors concluded that mesiobuccal and distobuccal SCTA were bigger than mid-lingual or mid-palatal SCTA in health. After 3 months and 6 months, the clinical and radiographic SCTA showed no statistical difference.

Patients in the study group 2 were treated by conventional flap surgery. The difference in mean values from baseline to 3 months and baseline to 6 months were statistically significant but from 3 months to 6 months were statistically insignificant. Results revealed that there was a gain in the SCTA after PFS. The gain of SCTA was more in the first 3 months but from 3 months to 6 months the gain in the SCTA was less. This may be due to gain in clinical attachment level or formation of long junctional epithelium or both. This is in agreement with the findings of another study, which leads to a concept that tissues of the dento-gingival junction are dynamic rather that static.

Comparison between clinical and radiographic SCTA revealed that, at baseline, the C-SCTA was less than R-SCTA. It means that buccal, lingual or palatal SCTA at baseline were less than mesial and distal SCTA. After 3 months, clinical and radiographic SCTA showed a statistical difference, but after 6 months, clinical and radiographic SCTA did not show statistical difference.

In disease, the mean T-SCTA in PPD >3 to <5 mm was 2.567±0.452 and in the PPD ≥5 to 7 mm 2.245±0.283. The difference between the two values was 0.322 which was statistically significant. This indicates that as the disease progresses the SCTA reduces. After 3 months and 6 months treatment by SRP and PFS, the mean change in the T-SCTA was not statistically significant. In fact, there is more SCTA after SRP than PFS at both, 3 months and 6 months intervals. As about 3 mm of SCTA is established 3 months after PFS, patients treated with Flap and resective osseous surgery for crown lengthening before restorative procedures can receive the final restoration after 12 weeks post-operatively. Following therapy, the zone of the SCTA appears to be similar in patients with initially deeper pockets (Group 2 - PFS) or with initially shallower sites (Group 1 - SRP).

**Conclusion**

The periodontal disease progression has an inverse correlation with the dimension of the SCTA. The SCTA regains its original dimensions after periodontal therapy; in cases of
shallow pockets (>3 to >5 mm) treated with scaling and root planing, it takes 3 months and may take 6 months in moderate pockets (≥5 to 7 mm) treated by periodontal flap surgery. Most changes in the SCTA occur within first 3 months and remain stable up to 6 months irrespective of the treatment protocol.

Comparison between C-SCTA and R-SCTA shows a significant difference in patients with periodontitis. This difference is not significant after treatment of patients with shallow pockets with scaling and root planing, but shows a significant difference in patients with moderate pockets treated by open flap debridement. There is no significant variation in the SCTA of the buccal and palatal/lingual areas, as well as mesial and distal areas of the gingiva.

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Nil

Author contributions

SSA: Concept, literature search, manuscript writing, study design, data analysis, interpretation.
GA: Concept, literature search, manuscript writing, study design, data collection, data analysis.
ND: Concept, literature search, manuscript writing, study design, data collection, data analysis.
AY: Literature search, manuscript writing, study design, data collection, data analysis.
AHK: Literature search, manuscript writing, study design, data collection.
NA: Concept, literature search, manuscript writing, data collection, data analysis.

Conflict of interest statement: The authors state that there are no conflicts of interest regarding the publication of this article.

References

### Table 1
Mean changes in clinical and radiographic SCTA after SRP

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<th>Mean difference</th>
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<th>P value</th>
<th>Remark</th>
<th>Mean difference</th>
<th>t value</th>
<th>P value</th>
<th>Remark</th>
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<tbody>
<tr>
<td>Baseline and 3 month</td>
<td>0.725±0.255</td>
<td>10.99</td>
<td>0.00</td>
<td>Significant</td>
<td>0.689±0.291</td>
<td>9.16</td>
<td>0.00</td>
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<tr>
<td>Baseline and 6 months</td>
<td>0.785±0.288</td>
<td>10.55</td>
<td>0.00</td>
<td>Significant</td>
<td>0.711±0.311</td>
<td>8.83</td>
<td>0.00</td>
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<tr>
<td>3 month and 6 months</td>
<td>0.059±0.198</td>
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<td>0.26</td>
<td>Non-Significant</td>
<td>0.022±0.272</td>
<td>0.31</td>
<td>0.75</td>
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### Table 2
Mean changes in T-SCTA after SRP

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<th>P value</th>
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<tr>
<td>Baseline and 3 month</td>
<td>0.743±0.256</td>
<td>11.23</td>
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<td>Baseline and 6 months</td>
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### Table 3
Mean changes in clinical and radiographic SCTA after PFS

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<tr>
<td>Baseline and 3 month</td>
<td>0.878±0.214</td>
<td>15.88</td>
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<td>0.780±0.176</td>
<td>17.12</td>
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<td>1.068±0.211</td>
<td>19.53</td>
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<td>0.894±0.241</td>
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<td>3 month and 6 months</td>
<td>0.189±0.212</td>
<td>3.46</td>
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<td>0.114±0.272</td>
<td>1.62</td>
<td>0.12</td>
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### Table 4
Mean changes in T-SCTA after PFS

<table>
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<tr>
<td>Baseline and 3 month</td>
<td>0.881±0.172</td>
<td>19.75</td>
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<td>Baseline and 6 months</td>
<td>1.014±0.209</td>
<td>18.76</td>
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<td>Significant</td>
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<tr>
<td>3 month and 6 months</td>
<td>0.132±0.227</td>
<td>2.26</td>
<td>0.04</td>
<td>Significant</td>
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</table>
Fig 2 – Calculation of clinical SCTA: (a) Wire pin placed in pocket; (b) Pocket depth measured using vernier caliper; (c) Bone sounding; (d) Bone level measured using vernier caliper.

Fig. 3 – a) Radiograph with wire pins placed interdentally b) Interdental SCTA measured.
Fig. 4 Comparison between C-SCTA and R-SCTA after SRP.

Fig. 5 – Comparison between C-SCTA and RSCTA after PFS.
Fig. 6 – Comparison between SCTA in PPD 3-5 mm/SRP AND PPD 5-7 mm/PFS.

**Table Legends:**

Table 1: Mean changes in clinical and radiographic SCTA after SRP

Table 2: Mean changes in T-SCTA after SRP

Table 3: Mean changes in clinical and radiographic SCTA after PFS

Table 4: Mean changes in T-SCTA after PFS
Figure Legends:

Figure 1: Flow chart of the study design

Figure 2: Calculation of clinical SCTA: (a) Wire pin placed in pocket; (b) Pocket depth measured using vernier caliper; (c) Bone sounding; (d) Bone level measured using vernier caliper

Figure 3: a) Radiograph with wire pins placed interdentally b) Interdental SCTA measured.

Figure 4: Comparison between C-SCTA and R-SCTA after SRP

Figure 5: Comparison between C-SCTA and RSCTA after PFS

Figure 6: Comparison between SCTA in PPD 3-5 mm/SRP AND PPD 5-7 mm/PFS

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