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Assessment of supracrestal tissue attachment variation in patients with chronic periodontitis before and after treatment: A clinical-radiographic study

Procena varijacija pripoja suprakrestalnog tkiva kod bolesnika sa hroničnim periodontitisom pre i posle lečenja: kliničko-radiografska studija

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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 supracrestal tissue attachment (SCTA) is essential because there is a frequent need for restoration or prosthesis after periodontal surgical and non-surgical therapy. The aim of the present study was to evaluate the SCTA variations in a patients with 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 findings of the SCTA were assessed before and after treatment at 3-month and 6-month intervals. **Results.** Comparison between clinical and radiographic findings of the SCTA showed a significant difference in patients with periodontitis ($p < 0.05$). This difference was not significant after treatment of patients with shallow pockets with scaling and root planing ($p > 0.05$), but showed a significant difference in patients with moderate pockets treated by open flap debridement ($p < 0.05$). **Conclusion.** Progression in periodontal disease causes 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 the supracrestal 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:
periodontics; debridement; surgical flaps; gingival recession; dental scaling; radiography, dental.

Apstrakt

Uvod/Cilj. Zdravi periodoncijum podrazumeva zubno-gingivni spoj. Periodontalna bolest počinje da se javlja kada se poremeti integritet spoja epitela. Procena suprakrestalnog tkivnog spoja (SKTS) je od velikog značaja jer često postoji potreba za restorativnim ili protetičkim radovima nakon hirurgije periodoncijuma ili nehirurške terapije. Cilj ove studije bio je da se procene varijacije SKTS kod bolesnika sa hroničnim periodontitisom pre i posle lečenja. **Metode.** Trideset zdravih bolesnika sa periodontitisom bilo je uključeno u studiju; 15 bolesnika je bilo podvrgnuto klasičnom, nehirurškom lečenju periodontitisa, a 15 režanj operaciji. Suprakrestalni tkivni spoj procenjivan je radiografski i klinički pre i tri i šest meseci posle lečenja. **Rezultati.** Poređenje između kliničkog i radiološkog nalaza SKTS pokazalo je značajnu razliku kod bolesnika sa periodontitisom ($p < 0,05$). Ova razlika nije bila značajna nakon lečenja bolesnika sa plitkim džepovima tretiranih na klasičan, nehirurški način ($p > 0,05$), ali je bila značajna razlika kod bolesnika sa umerenom dubinom džepova lečenih režanj operacijom ($p < 0,05$). **Zaključak.** Progresija periodontalne bolesti dovodi do smanjenja dimenzija SKTS koji se normalizuje nakon lečenja periodoncijuma. Kod postojanja plitikih džepova, potrebno je oko tri meseca da

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se postigne prvobitna dimenzija SKTS primenom klasičnog, nehirurškog metoda lečenja. Kod umereno dubokih džepova, normalna dubina STS postiže se šest meseci posle režanj operacije.

Ključne reči:
periodontologija; debridman; režnjevi, hirurški; gingiva, povlačenje; zub, uklanjanje mekih i tvrdih naslaga; radiografija, stomatološka.

Introduction

Periodontium is a subject to morphologic and functional variations, as well as changes associated with age [1]. Therefore, changes taking place in one of the periodontal component may have significant consequences on other components with respect to maintenance and regeneration [2]. 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 [3]. The attachment of the junctional epithelium to the tooth is reinforced by gingival fibers, referred to as the dento-gingival unit [4]. Attachment loss happens when junctional epithelium starts to migrate apically – this is a best example of how structure regulates function [3].

Dento-gingival junction to the tooth surface is composed of a fibrous, supracrestal connective tissue attachment and an epithelial attachment (junctional epithelium) [5]. This anatomical structure has been termed as "Supracrestal tissue attachment" [6] (SCTA) previously known as "biological width" and introduced as an important concept in periodontics and restorative dentistry [7]. 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 [5].

One of the first changes in 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 [3].

The SCTA 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 [8]. Considerable variability has been shown to exist in the SCTA dimensions in cross-sectional studies of autopsy materials with no overt periodontal pathology [5, 9]. 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[10–12]. Very few studies, however, have been done on measurement of the SCTA before and after flap surgery in humans with periodontal pockets [13, 14]. 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 planing (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 planing (SRP) followed by periodontal flap surgery (PFS) under local anesthesia (Figure 1).

Dental radiographs of the study teeth were made and their pre-operative clinical presentation was photographically documented. Occlusal stents for positioning the wire pins were fabricated with self-cured acrylic resin. They were 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: Probing Pocket Depth (PPD) – measured as the distance from the gingival margin to the fundus of the periodontal pocket by using the University of Michigan "O" probe William marking (Hu-Friedy Mfg. Co, Chicago, Illinois, United States); Probing Bone Level (PBL) – measured as the distance between the gingival margins to the crest of the bone by bone sounding under local anesthesia; Clinical Supracrestal Tissue

Attachment (C-SCTA) – calculated as the difference of the above two measurements. Parameters were recorded at

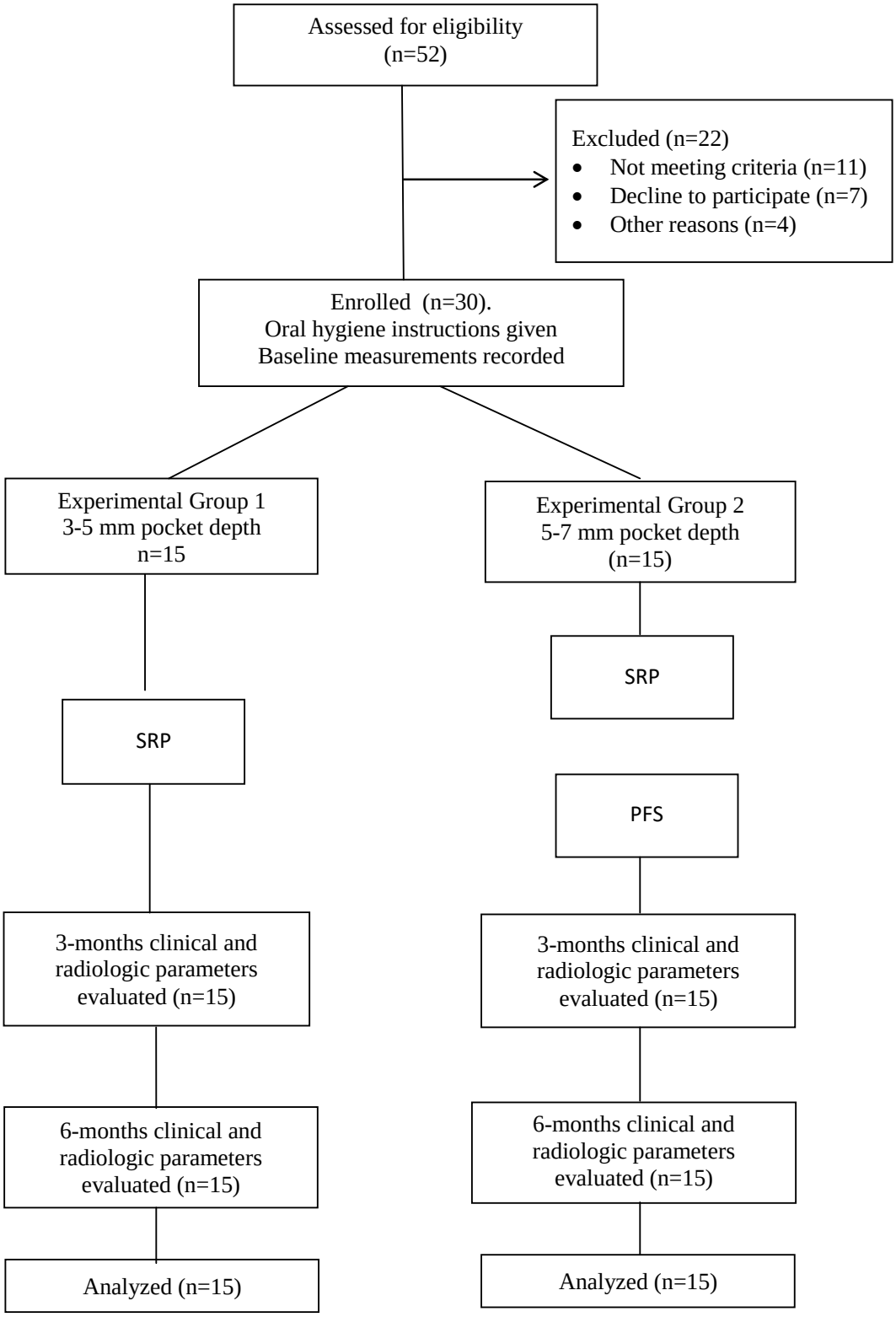

Fig. 1 – Flow chart of the study design.
For abbreviations see under Table 1.

baseline, 3 months and 6 months after the selected treatment for the assessment of the SCTA.

Standardized radiovisiographs (RVG) (Drsuni™ Digital Imaging software, San Jose, CA, USA) were taken with the RINN XCP system™ (Dentsply Sirona, Pennsylvania, USA) at baseline, and 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

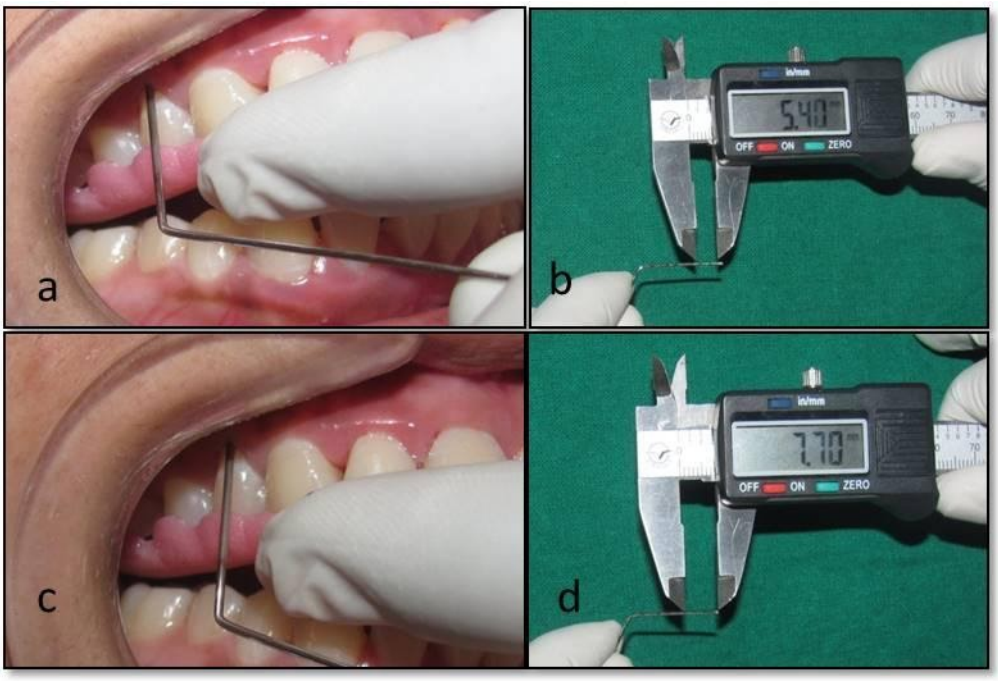

Fig. 2 – Calculation of clinical supracrestal tissue attachment: a) Wire pin placed in pocket; b) Pocket depth measured using vernier caliper; c) Bone sounding; d) Bone level measured using vernier caliper.

Fig. 3 – a) Radiograph with wire pins placed interdentally; b) Interdental supracrestal tissue attachment measured.

stent in position (Figure 3). The distance was calculated and measured by the radio-visiographic analyzing tool. Landmarks were identified on the radiographs as: Radiographic Supracrestal Tissue Attachment (R-SCTA) – it was measured as the distance from the apical tip of the radio-opaque marker to the alveolar crest; 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-SCTA and R-SCTA.

The patients were 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. Postoperative medications were prescribed to the patients for five days. One week following the 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. Postoperative patient's evaluation was done clinically and radiographically at 3 months and 6 months.

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.

Table 1

Mean changes in clinical and radiographic SCTA (C-SCTA and R-SCTA, respectively) after SRP

C-SCTA (mm)					R-SCTA (mm)			
Pair of measurement time	Mean difference ± SD	*t*-value	*p*	Remark	Pair of measurement time	Mean difference ± SD	*p*	Remark
Baseline and 3 month	0.725 ± 0.255	10.99	0.00	Significant	Baseline and 3 month	0.725 ± 0.255	0.00	Significant
Baseline and 6 months	0.785 ± 0.288	10.55	0.00	Significant	0.711 ± 0.311	8.83	0.00	Significant
3 month and 6 months	0.059 ± 0.198	1.15	0.26	ns	0.022 ± 0.272	0.31	0.75	ns

SCTA – supracrestal tissue attachment; SRP – scaling and rooth planing; PFS – periodontal flap surgery; SD – standard Deviation; ns – non-significant.

Table 2

Mean changes in total SCTA (C-SCTA + R-SCTA) after SRP

Pair of measurement time	Mean difference (mm)	*t*-value	*p*-value	Remark
Baseline and 3 month	0.743 ± 0.256	11.23	0.00	Significant
Baseline and 6 months	0.774 ± 0.275	10.89	0.00	Significant
3 month and 6 months	0.031 ± 0.229	0.53	0.60	ns

For abbreviations see under Table 1.

Table 3

Mean changes in clinical and radiographic SCTA (C-SCTA and R-SCTA) after PFS

C-SCTA (mm)					R-SCTA (mm)			
Pair of measurement time	Mean difference ± SD	*t*-value	*p*- value	Remark	Mean difference ± SD	*t*-value	*p*- value	Remark
Baseline and 3 month	0.878 ± 0.214	15.88	0.00	Significant	0.780 ± 0.176	17.12	0.00	Significant
Baseline and 6 months	1.068 ± 0.211	19.53	0.00	Significant	0.894 ± 0.241	14.34	0.00	Significant
3 month and 6 months	0.189 ± 0.212	3.46	0.004	Significant	0.114 ± 0.272	1.62	0.12	ns

For abbreviations see under Table 1.

Statistical analysis was done with the help of SPSS (Statistical Package for Social Science) version *13* (SPSS Inc, Chicago, IL, USA).

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 the treatment. 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 – variations in C-SCTA after SRP (group 1): the mean C-SCTA at baseline was 2.477 ± 0.429 mm, which increased to 3.202 ± 0.237 mm at 3 months, and further increased to 3.262 ± 0.230 mm at 6 months post-treatment (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 mm, which increased to 3.346 ± 0.330 mm at 3 months, and further increased to 3.368 ± 0.295 mm at 6 months post-treatment (Table 1); variation in T-SCTA after SRP (group 1): T-SCTA at baseline was 2.567 ± 0.452 mm which increased to 3.310 ± 0.293 mm at 3 months which further increased to 3.342 ± 0.267 mm at 6 months post-treatment. 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 post-treatment (Table 2).

Differences in C-SCTA and R-SCTA after SRP (group 1) were: the differences in mean values from baseline to 3 months and baseline to 6 months post-treatment were statistically significant, but they were not statistically significant from 3 months to 6 months post-treatment (Figure 4).

Variations in the C-SCTA after PFS (group 2) were: the mean C-SCTA at baseline was 2.091 ± 0.332 mm, which increased to 2.970 ± 0.206 mm at 3 months, and further increased to 3.159 ± 0.275 mm at 6 months postoperatively (Table 3). Variation in R-SCTA after PFS (group 2) were: the mean R-SCTA at baseline was 2.400 ± 0.249 mm, which increased to 3.180 ± 0.237 mm at 3 months, and further increased to 3.294 ± 0.282 mm at 6 months postoperatively (Table 3).

Variations in the T-SCTA after PFS (gropu 2) were: mean T-SCTA at baseline was 2.245 ± 0.283 mm, which increased to 3.127 ± 0.213 mm at 3 months, and further

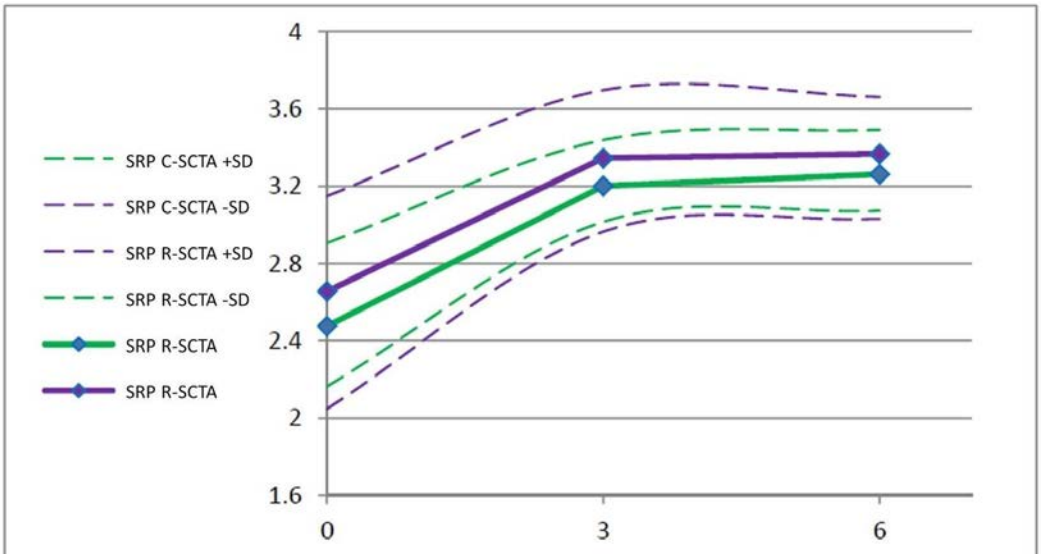

Fig. 4 Comparison between C-SCTA and R-SCTA (in mm) after SRP.
SD – standard deviation; For other abbreviations see under Table 1.

Table 4

Mean changes in total SCTA (C-SCTA + R-SCTA) after PFS

Pear of measurement time	Mean difference (mm)	*t*-value	*p*	Remark
Baseline and 3 month	0.881 ± 0.172	19.75	0.00	Significant
Baseline and 6 months	1.014 ± 0.209	18.76	0.00	Significant
3 month and 6 months	0.132 ± 0.227	2.26	0.04	Significant

For abbreviations see under Table 1.

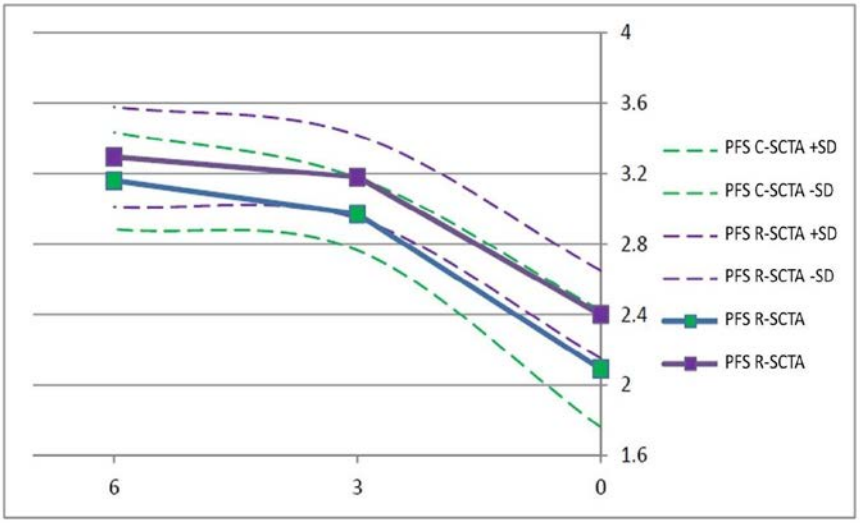

Fig. 5 – Comparison between C-SCTA and RSCTA (in mm) after PFS.
SD – standard deviation; For other abbreviations see under Table 1.

increased to 3.260 ± 0.269 mm at 6 months postoperatively. The differences in mean values from baseline to 3 months, baseline to 6 months, as well as from 3 months to 6 months postoperatively, were statistically significant (Table 4).

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

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

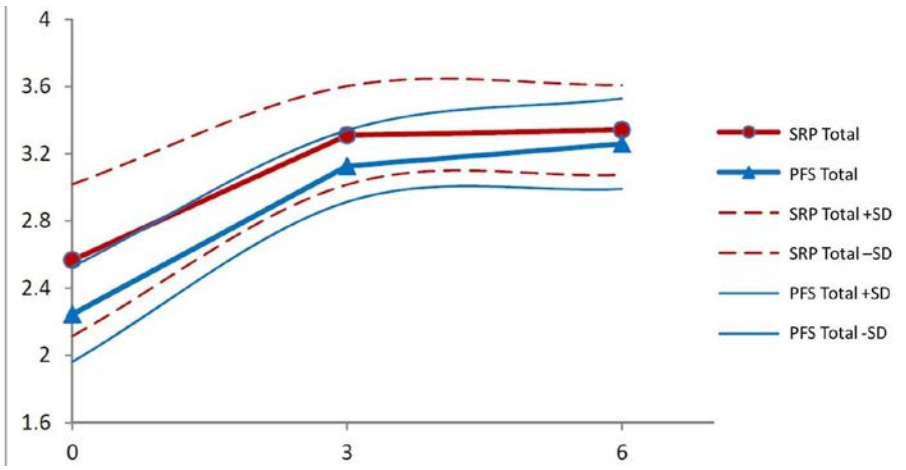

Fig. 6 – Comparison between SCTA (in mm) in probing pocket depth (PPD) 3–5 mm (treated by SRP) and PPD 5–7 mm (treated by PFS).

SD – standard deviation; For other abbreviations see under Table 1.

was 0.082 mm, 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 [15].

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, changes in the SCTA may cause failure in the future restoration or prosthesis [16]. Perez et al. [17], 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 transgingival probing (TGP) measurements *versus* direct-bone-level (DBL) measurements. They concluded that TGP is an accurate alternative method to DBL in clinical determining SOG dimensions.

Observations from the study conducted by Goodson et al. [18] 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 Gargiulo et al. [5], 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 status after periodontal surgery. The authors finally concluded that there is no fixed dimension of the SCTA.

The value of the SCTA in the health gingiva, as reported in the literature, is 3.39 ± 0.8461. The T-SCTA in the disease, in this study, was found to be 2.406 ± 0.405, with the difference (0.962) that was 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 [13]. The resulst from the study revealed that there was a gain in the SCTA after SRP. This may be due to gain in clinical attachment level or formation of long junctional epithelium or both [19]. This process was completed by three months as difference values up to six months were not significant.

In the disease, the mean C-SCTA in the SRP group was 2.477 ± 0.429 mm and the R-SCTA was 2.657 ± 0.493 mm, 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 findings revealed that in the disease the mean C-SCTA in the SRP group was 2.477 ± 0.429 mm and the R-SCTA was 2.657 ± 0.493 mm, the difference of which was statistically significant. These results are very similar to the previous study [20], in which the authors concluded that mesiobuccal and distobuccal SCTA were bigger than mid-lingual or mid-palatal SCTA in the healthy gingiva. After 3 months and 6 months, the clinical and radiographic SCTA findings 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 postoperatively were statistically significant but from 3 months to 6 months post-treatment were statistically insignificant. Results revealed that there was a gain in the SCTA after PFS. The gain of SCTA was more pronounced in the first 3 months postoperatively, 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 [21], which leads to a concept that tissues of the dento-gingival junction are dynamic rather that static.

Comparison between clinical and radiographic SCTA findings 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 findings showed a statistical difference, but after 6 months,there was no statistical difference.

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 to7 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 showed a significant difference in patients with periodontitis. This difference was not significant after treatment of patients with shallow pockets with scaling and root planing, but was significant in patients with moderate pockets treated by open flap debridement. There was no significant variation in the SCTA of the buccal and palatal/lingual areas, as well as mesial and distal areas of the gingiva.

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

Conclusion

The periodontal disease progression has an inverse correlation with dimensions 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 to7 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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Conflict of interest statement

The authors stated that there were no conflicts of interest regarding the publication of this article.

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