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THE CORRELATION BETWEEN FACIAL SOFT AND HARD TISSUE THICKNESS IN THE ANTERIOR MAXILLARY REGION IN SMOKERS AND NON-SMOKERS

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ABSTRACT

Background: Gingival and bone thickness is a prognostic agent in various therapeutic and regenerative procedures in dental procedures, in addition to recognition of a periodontal biotype in patients have a major meaning in the optimal design of preventive and therapeutic management mainly in periodontal and implant treatment. The aim to this study compares facial soft and hard tissue thickness in the anterior maxillary region in smokers and nonsmokers.

Methods : In this cross-sectional study 70 subjects who were periodontally healthy with at least 4 intact teeth in the anterior maxilla enrolled; They were divided into two equal groups of smokers and non-smokers, The thickness of gingiva was measured using an endodontic finger spreader (from 2, 5, 8 mm of the CEJ region) and the CBCT radiographs prepared from the upper anterior region, using the viewer software, the measurements were taken from the 1-distance of the CEJ to the bone crest 2-the facial bone width at the anterior maxilla (2, 5, and 8 mm from the apical to the CEJ). The information was evaluated using SPSS version 21 also the Mann-Whitney U test was used to compare differences between the two groups.

Results: The difference in the thickness of labial bone on the anterior maxillary region was not significant_between smoker and non-smoker groups ($P<0.05$), while the labial gingival biotype in smoker patients was thicker than the non-smokers and the variation was significant ($P<0.05$).

Conclusion : The mean thickness of labial bone thickness and gingival dimension in the anterior maxilla was greater in smoker patients although there wasn't a correlation between them.

INTRODUCTION

The advancement of expected and novel implant treatments for most esthetic consequences necessity a perfect comprehension, of the underlying biological processes of bone and soft tissue healing subsequent tooth extraction (1). Achieving charming esthetics in the anterior maxilla includes many clinical factors, but, is mainly correlated to the morphology of the mucosa around the implant in comparison with the contra-lateral native tooth (2). Soft tissue problems (gingival recessions) are general in implant treatment and are often related to thin gingival biotypes or facially placed implants (3). To attain aesthetic success, need to consider an ideal three-dimensional position (4), to preserve adequate labial bone upon the implant buccal surface (5, 6), and to understand tissue biotype (7). However, it appears that the width of the facial plate in the anterior region is too thin to resorb following tooth extraction. Furthermore, deficiency in the facial bone anatomy has a negative impact on esthetics and is a critical causative factor of esthetic implant complications and failures (8). However, the integrity of the hard and soft tissue dimensions is jeopardized by physiological and structural changes following tooth loss (9). Cook *et al*. found that periodontal biotype is significantly correlated to facial wall thickness (10). On the other hand in another study, no statistically notable variation was found between the facial bone and gingival thickness (11), furthermore, LA Rocca *et al*. revealed that the gingival thickness is not associated with the facial bone thickness. However, the gingival width seems to be related to the crestal bone thickness (12). Ghassemian *et al*. described that no difference in thickness of the facial bone was detected between the smokers and non-smokers (13) but another study indicated that smoking patients had thicker gingival biotype (14). In other words, it has been demonstrated in numerous studies that cotinine, a nicotine metabolic by- product, which is a known peripheral vasoconstrictor, can cause morphologic and histologic changes in the gingival, the increased in gingival thickness is one of them (15). However, the aim of this study

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was to determine the thickness of both soft tissue and essential buccal bone in the anterior maxilla and to establish a relationship between the gingival biotype and the facial bone width in smokers and non-smokers in patients who should be treated with an implant.

METHODS & MATERIAL

Patient Selection

Seventy-two healthy patients were enrolled in this cross-sectional study; the intact anterior maxillary teeth were randomly designated, had implant placement in one of the posterior areas and were assessed by two calibrated and independent reviewers. These patients were seeking periodontal or treatment at the Department of Periodontics Islamic Azad University, dental branch of Tehran from January 2014 to July 2015. This study was approved by the Ethics Committee of Faculty of Dentistry (approval number: 25051) and was carried out in compliance with the Helsinki declaration. Informed consent was obtained from participants before their enrollment in this study.

The inclusion criteria were as follows: Presence of at least six teeth in the maxillary anterior region, the absence of redness, attachment loss, probing pocket depth≤3mm. All the smoker patients that used at least 10 cigarettes per day for an interval of over 5 years were included in the Smoking group. The smoker patients who smoked (≥1 packs/day) over the 12 months previous to the time of the study, and a smoking amount was calculated as packets/year (number of a cigarette per day × smoking year).

The exclusion criteria: 1.The presence of restorations & prosthetic crowns; 2. Root canal treatments; 3. Apical root surgery; 4. Periapical lesion within the area; 5. Tooth malposition; 6. Prosthetic crowns; 7. Crowding or the misalignment of the anterior teeth; 8. Facial asymmetry; 9. An abnormal overbite and overjet; 10. Periodontal procedures performed in the last 6 months; 11. Traumatic history in the anterior area; 12. Facial asymmetry; 13. Pregnancy or breastfeeding; 14. Medications affecting gingival tissue and bone; 15. Decayed teeth; 16. Orthodontic therapy; 17. Gingival enlargement in the anterior maxilla; 18. Gingival recession in the anterior maxilla; 19. Missing or impacted broken tooth.

C.B.C.T Measurement

The lips and cheeks were retracted by a sterile plastic retractor. The C.B.C. T scans were obtained using dental x-ray system Soredex, Helsinki Finland with 12 cm x 8 cm field of view and 200 mm voxel size.

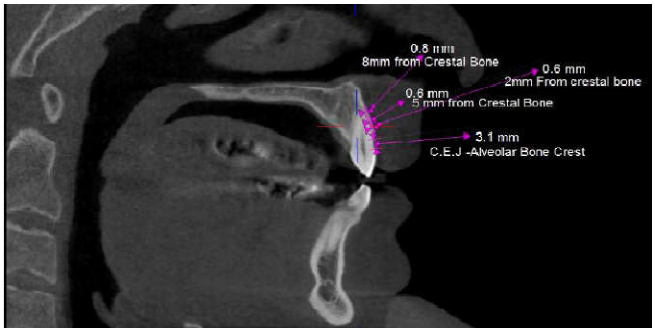

Figure 1 Measurement of facial bone thickness at the level of bone crest and at 2, 5 and 8 mm apical to the alveolar bone crest; and the distance from the C.E.J to bone Crest

A software program was used to reconstruct the images and perform the measurements. Two skilled and trained observers were calibrated using 10 randomly selected scans. Each of the two observers measured 72 scans independently at the exact same slice and magnification. The facial bone thickness (the six maxillary anterior teeth) in the sagittal plane were measured at the bone crest and at 2, 5 and 8 mm apical from the C.E. J to bone crest were also measured on C.B.C. T scans (figure1).

Assessment of Gingival Thickness

Gingival biotype (thin or thick) was evaluated according to Kan *et al*. (7), 22 Gingival thickness was assessed mid-facial halfway between the mucogingival junction and 2mm from marginal gingival, using the spreader fitted with an endodontic rubber stopper and the measurements were recorded with the help of a steel ruler calibrated at 1 millimeter. After anesthetizing the labial gingiva with a Lidocaine gel (10%), the width of the labial gingiva was resolved at 2, 5, 8 mm distance from the gingival margin, the endodontic spreader was inserted into the labial gingiva, perpendicular to the long axis of the tooth until it contacted the facial bone (figure2). Also, the thickness of gingiva was recorded for 6 maxillary anterior teeth. Measurement errors were decreased by permitting two clinicians to perform the evaluations two times for each area and the most frequently measured and recorded readings were chosen as the ultimate analysis.

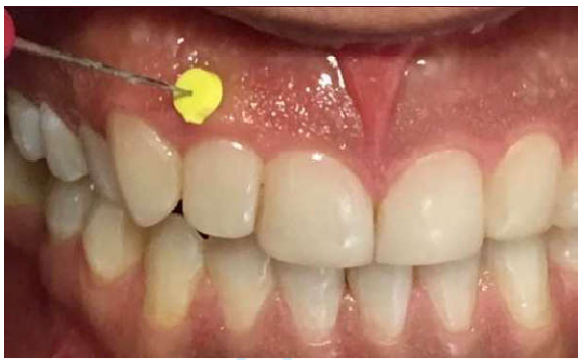

Figure 2 Gingival thickness was measured using an endodontic finger spreader at 2, 5, and 8 mm below the marginal gingival of maxillary anterior teeth

Sample size

Based on past studies and existing constraints, according to Nowzari *et al*. Kydd *et al*. and Ankita *et al*.(16,17,18) using Comparison Option, two sample size determinations with Mini Tab software, and $\alpha = 0.05$ determine the minimum sample size required for 70 samples. (STD = 1.3 and d = 0.5).

Statistical analysis

The data were analyzed using SPSS version 21, also the Mann-Whitney U test was used to compare differences between two groups (smokers and non-smokers), for statistical analysis by recording the distance from the CEJ to the alveolar bone crest; and the Spearman's correlation coefficient was used for statistical analysis of the data and comparisons. $P < 0.05$ was considered statistically significant.

RESULT

The patients who took part in this study were 34 males and 38 females, aged between 34 to 56; mean age for smoker group was (45.57 ± 10.88 and for the non-smoker group was (45.43±10.66), (Table1); Also The mean and SD of gingival

thickness at 2 mm apical to the gingival margin (gingival biotype) was 0.73±0.27,1.30±0.51mm for central incisors, 0.82±0.30,10.94±0.47 mm for lateral incisors and 0.52±0.24, 10.30±0.51 mm for canine teeth in the non-smoker and smoker group, (table 2, 3,4).

Table 1 Population distribution by age, gender

Group	minimum	maximum	Mean ± SD
smoking	26	66	45.43±10.661
Non-smoking	27	66	45.57±10.885
	Female	Male	Total
smoking	16(43.2%)	21(56.8%)	37(100%)
Non-smoking	22(62.9%)	13(37. 1%)	35(100%)

Table 2 The mean ± SD of gingival thickness at 2 mm below the gingival margin

Gingival thickness	Smoking	Non- smoking
Right Central incisor	48.47±1648.00	19.09±630.00
Right Lateral incisor	51.26±1794.00	18.26±621.00
Right canine	49.44±1780.00	20.74±705.00
Left Central incisor	51.11±1891.00	21.06±737.00
Left Lateral incisor	51.28±1846.00	20.29±710.00
Left canine	48.74±1706.00	20.85±709.00

Table 3 The mean ± SD of gingival thickness at 5mm below the gingival margin

Gingival thickness	Smoking	Non- smoking
Right Central incisor	48.68±1655.00	18.88±623.00
Right Lateral incisor	51.06±1787.00	18.47±628.00
Right canine	49.32±1775.50	20.87±709.50
Left Central incisor	51.65±1911.00	20.49±717.00
Left Lateral incisor	51.61±1858.00	19.94±698.00
Left canine	48.94±1713.00	20.65±702.00

Table 4 The mean ± SD of gingival thickness at 8mm below the gingival margin

Gingival thickness	Smoking	Non- smoking
Right Central incisor	48.15±1637.00	19.42±641.00
Right Lateral incisor	50.91±1782.00	18.62±633.00
Right canine	48.53±1747.00	21.71±738.00
Left Central incisor	51.28±1897.50	20.87±730.50
Left Lateral incisor	51.15±1841.50	20.41±714.50
Left canine	49.06±1717.00	20.53±698.00

Table 5 The mean ± SD of facial bone thickness at 2mm below the crestal bone

Facial bone thickness	Smoking	Non- smoking
Right Central incisor	35.07±1192.50	32.89±1085.50
Right Lateral incisor	35.34±1237.00	34.65±1178.00
Right canine	34.94±1188.00	36.03±1297.00
Left Central incisor	37.59±1391.00	35.34±1237.00
Left Lateral incisor	36.49±1313.50	35.50±1242.50
Left canine	36.16±1265.50	33.81±1149.50

Table 6 The mean ± SD of facial bone thickness at 5mm below the crestal bone

Facial bone thickness	Smoking	Non- smoking
Right Central incisor	33.28±1131.50	34.74±1146.50
Right Lateral incisor	34.56±1209.50	35.46±1205.50
Right canine	36.31±1307.00	34.65±1178.00
Left Central incisor	36.89±1365.00	36.09±1263.00
Left Lateral incisor	35.60±1281.50	36.41±1274.50
Left canine	34.74±1216.00	35.26±1199.00

Table 7 The mean ± SD of facial bone thickness at 8mm below the crestal bone

Facial bone thickness	Smoking	Non- smoking
Right Central incisor	34.43±1170.50	33.56±1107.50
Right Lateral incisor	33.93±1187.50	36.10±1227.50
Right canine	36.10±1299.50	34.87±1185.50
Left Central incisor	36.89±1365.00	36.09±1263.00
Left Lateral incisor	35.43±1275.50	36.59±1280.50
Left canine	35.16±1230.50	34.84±1184.50

Table 8 The mean and standard deviation (SD) of the distance from the C.E.J to the alveolar bone crest in different teeth

location	C.E.J – crest smoking	C.E.J – crest non-smoking
Right Central incisor	34.05±1123.50	33.96±1154.50
Right Lateral incisor	35.68±1213.00	34.34±1202.00
Right canine	36.35±1236.00	34.69±1249.00
Left Central incisor	37.01±1295.50	36.01±1332.50
Left Lateral incisor	36.49±1277.00	35.53±1279.00
Left canine	35.03±1191.00	34.97±1224.00

This value in lateral incisors (1.50± 0.82) was greater than that in canine teeth (1±0.5191) (P= 0.9713); the findings of this study show the frequency of gingival thin biotypes in maxillary anterior teeth in both groups. There were definite differences in the gingival width among different teeth area and there was a significant correlation between gingival thickness indices in teeth and at different intervals (P < 0.001, r≥0. 078). Also, there was no significant difference between bone thickness in different points (P<0.001, r≥0.51), it should be added that, for example, at the points of 2mm, there was no positive correlation between bone thickness and gingival width (P <0, 05); the thickness of gingiva in smokers and non-smoker was different, but no correlation could be found between the thickness of bone in both groups (Table5, 6, 7). No variance in thickness of the facial bone was found between the smokers and nonsmokers; the smokers group had a greater distance from C.E.J to Crest versus non-smoker group, but in the CEJ- Crest, there was no significant difference between crestal bone and there was no correlation between bone thickness and gingiva, also The CEJ–bone crest distance was (2.70 ± 0.60 mm) and (2.09±0.60mm), for the maxillary central incisors in smoker and non-smoker individuals (Table8).

DISCUSSION

The purpose of this study was to determine the correlation between the thicknesses of the facial alveolar bone and the gingival thickness on the labial surface of the anterior maxilla, and the distance from the CEJ to the alveolar crest as a measure of vertical alveolar bone in smoker and non-smoker subjects. Given the original importance of esthetic considerations in dental treatment, the role of rightly realizing and identifying subjects' biotype cannot be overstated . Moreover, its aesthetic importance, the width of the gingivae and bone tissue can influence the treatment outcome (3, 7, and 19). As declared in various studies, the bone profile is closely related to gingival morphology, but there is no definitive evidence to support this issue (16,20,21); therefore, the main goal of this study was to determine the relationship between soft and hard tissue thickness and the effect of cigarette smoking on the soft tissue thickness in the anterior part of the maxilla which is very important in the esthetic and, if necessary, replacement of the tooth by the implant as a result of the treatment. Only a few studies have been published on this topic (12, 22). Therefore, it would be beneficial to have certain guidelines or substitute actual parameters for the recognition of critical cases of the thin gingival and alveolar bone thickness, which might compromise the favorable the outcome of the treatment. The data obtained from the current study revealed that the alveolar bone averages less than a 2mmlabial bone thickness in smokers and non-smokers; these outcomes were consistent with reports on Lee and Ghassemian *et al*. (20, 13); likewise, in a related study by Januariaetal. (21), the average facial bone thickness was found to be 0.50-

0.70.also, the labial wall widths of the central incisors, lateral incisors and canines were 1.14±0.65 mm, the findings were consistent with Ghassemian, Nowzari and Farahmand studies, which reported a thickness of bone in central teeth of 1.05 (13,16,23). The difference between the distances from CEJ to crest in smokers was another interesting finding in this survey which is in line with the findings of the studies conducted by Ghassemian and Farahmand in which it was shown that the distance from C.E.J to crest was greater in smokers (13, 23). The results of this study show that there is no significant relationship between gingival and bone thickness, which may be due to the small size of the sample; however, Younes *et al*. indicated that the correlation between facial bone and gingival tissue thickness was moderately positive(24); likewise these findings are according to other studies (Fu *et al*.2010; La Rocca *et al*. 2012; Stein *et al*. 2013),also the Fuentes *et al*., which stated that the facial bone and gingival thickness are not correlated (22,12,25,26);and Esfahanizadeh *et al*. recorded the least thickness for canines ;indicating that there was a mild relationship between labial gingival tissue and alveolar bone thickness in canines and incisors, but no such linear association was seen for the lateral incisors(27); on the other hand, Maynard & Wilson (28), pinpointed that thick a thick or thin gingiva did not necessarily have an underlying bone with coordinating thickness. Furthermore, in the current study, an increase in the thickness of the gingival in the smokers group has been observed. The findings of this study are in agreement with the studies carried by Gultekin *et al*. (29) According to which enhanced the degree of proliferation of gingival tissue occurs to the penetration of nicotine, therefore, increasing epithelial width of smokers. In his study Prebec *et al*. (30) Mentioned that the nicotine incites the collagen production. In conclusion, smoking is associated with an increased gingival thickness because of the effects of nicotine on multiple gingival components; thus increasing the thickness of the epithelium among smokers (31). However, in studies by Ankita *et al*. (18), the thickness of the gingival tissue at the facial surface was higher in smokers than in non-smokers, and Villa *et al*. (32) Analysis of gingival thickness in mid-buccal & interdental region among both groups showed increased thickness in smokers when compared to that of non-smoker; Kumar *et al*. (33), reported greater thickness epithelium among smokers in comparison with non- smokers, however, these variances were not statistically significant. However, the outcomes of this study have demonstrated a reduction in epithelial thickness among smokers in comparison with non-smokers. Finally, the results of the current study described that several facial bone and gingival thickness were different between individuals with thin and thick gingival biotypes. The outcomes of this study have demonstrated an increase in epithelial thickness among smokers in comparison with non-smokers. However, this study has various restrictions. Likewise, the examination concentrated on the measurement of gingival and labial thickness, as it appears that the labial bone and gingival thickness may have a noteworthy impact on the response to periodontal and implant treatment. More research is required to further investigate this point, and a large sample size is needed to clearly assess the effects of smoking on the gingival and bone thickness.

CONCLUSION

The present study outcomes indicate that gingival thickness was significantly different between smokers and non-smokers groups, but there was no significant difference the mean labial bone thickness between two groups; where the soft tissue was shown to correlate with bone width, due to the facial bone thickness was thin in anterior region in the maxillary ;Therefore, for most patients, adjective bone or gingival grafting procedures may be needed when installing implants in an area of aesthetic concern. Nevertheless, this implication could of clinical importance only when intervention is restricted to dental surgery, and future studies, as well as larger sample size, are required to validate these findings.

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Conflicts of Interest

All authors confirm that there are no conflicts of interest associated with the outcomes of this article, no financial interest related to this research.

Abbreviations

CBCT: cone beam computed tomography; C.E.J: cementoenamel junction

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