Labial Bone Thickness in Area of Anterior Maxillary Implants Associated with Crestal Labial Soft Tissue Thickness

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Objectives: To explore the relationship between implant’s labial bone thickness (ILBT) and crestal labial soft tissue thickness (CLSTT).

Materials and Methods: This retrospective study used records of 32 (22 females and 10 males) patients who had 2 implants placed in their maxillary arch (64 implants; diameter range, 3.3–4.6 mm) between the canines at either maxillary lateral incisor (7 and 10) or central incisor (8 and 9) region. All patients had diagnostic and postoperative cone beam computed tomography scans; the ILBT at the crestal and midimplant levels were recorded. CLSTT was measured approximately 4 months after the placement of implants using a digital caliper at the crestal level.

Results: Mean (standard deviation) CLSTT and ILBT at crestal and at midimplant levels were 2.45 (0.88), 1.79 (0.68), and 2.33 (1.01) mm, respectively. Overall, 26 implants had prior bone augmentation. Significant relationships between the CLSTT and ILBT at crestal (Spearman’s rho = 0.720) and midimplant levels (Spearman’s rho = 0.707) were observed (P < 0.001). The determination coefficients (R²) between CLSTT and ILBT at crestal and midimplant levels were 0.649 and 0.542, respectively. Following regression equations were produced:

\[ CLSTT = 1.043 \times ILBT + 0.586 \]  
\[ CLSTT = 0.955 \times ILBT + 0.955 \]

Conclusion: Based on this study, CLSTT and ILBT were highly associated in the anterior maxillary region. (Implant Dent 2012;21:406–410)

Key Words: labial bone thickness, anterior maxillary implants, crestal labial region, soft tissue thickness

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maxillary implants and the crestal labial soft tissue thickness (CLSTT).

**Materials and Methods**

The material for this retrospective study comprised provisional study casts and sectional cone beam computed tomography (CT) images of 32 (22 females and 10 males) patients who were treated in the private practice of the first author. The material has been anonymized by the first author so that patients’ information cannot be identified. As such, ethical approval for this study was not needed. These selected patients had to have 2 implants in the maxilla placed at the same time, between the canines at either maxillary lateral incisor (7 and 10) or central incisor (8 and 9) region. To be included in the study, patients must have had soft tissue casts available at the time of temporization. The provisional casts typically arrived with the soft tissue moulage in the cast. Those implants for which soft tissue casts were not available or not obtainable from the laboratory were excluded. Overall, 64 implants were placed. Implant diameters ranged from 3.3 to 4.6 mm. The implant position was determined using the cone beam CT image (Picasso Duo; VA Tech, South Korea) and by measuring the total ridge width and comparing the diameter of the implant and the surrounding bone thickness (labial bone, palatal bone). All patients had diagnostic (pre) and postoperative sectional cone beam CT scans. Using the sectional cone beam CT images, the labial bone thickness at the crestal (2 mm from the bone crest) and midimplant levels were measured and recorded (Fig. 1). The CLSTT was measured using a digital caliper (Mitutoyo) on study casts, at the time of temporization. The provisionals typically arrived with the soft tissue moulage in the cast. Those implants for which soft tissue casts were not available or not obtainable from the laboratory were excluded. Overall, 64 implants were placed. Implant diameters ranged from 3.3 to 4.6 mm. The implant position was determined using the cone beam CT image (Picasso Duo; VA Tech, South Korea) and by measuring the total ridge width and comparing the diameter of the implant and the surrounding bone thickness (labial bone, palatal bone). All patients had diagnostic (pre) and postoperative sectional cone beam CT scans. Using the sectional cone beam CT images, the labial bone thickness at the crestal (2 mm from the bone crest) and midimplant levels were measured and recorded (Fig. 1). The CLSTT was measured using a digital caliper (Mitutoyo) on study casts, at the time of temporization, at the crestal level (Fig. 2). Prior implant site augmentation was also recorded. The measurements of CLSTT were performed approximately 4 months after the placement of implants. All measurements of the CLSTT, labial bone thickness at the crestal, and that at the midimplant levels were performed by a single examiner (B.T.L.) and reconfirmed by the other investigator (A.B.-F.).

**Statistical Analysis**

Data for the present study were entered into the Excel and subsequently transferred to the SPSS software (Statistical Package for Social Sciences Version 17.0; SPSS, Inc, Chicago, IL). CLSTT data were gender compared using the independent t test. Implants were divided into 2 groups based on prior bone augmentation (with bone augmentation and without). The CLSTT and labial bone thickness at the crestal and midimplant levels were exposed to independent t test to explore any significant differences with regards to bone augmentation. The Spearman correlation coefficients (rho) were used to assess the relationship between the implant’s labial bone thickness (at the crestal and midimplant levels) and the CLSTT. Scatter plots were used to graphically explore the relationship between the implant’s labial bone thickness and the CLSTT. The coefficients of determination (R^2) between the CLSTT and the implant’s labial bone thickness at the crestal and midimplant levels were also calculated. Regression equations for the data were also created. Any P < 0.05 was considered as statistically significant.

**Results**

The mean ± SD for CLSTT and labial bone thickness at the crestal and midimplant levels were 2.45 ± 0.88, 1.79 ± 0.68, and 2.33 ± 1.01 mm, respectively. Overall, 26 implants had prior bone augmentation (Table 1). The CLSTT and labial bone thickness at the crestal and midimplant levels were 0.17, 0.07, and 0.23 mm, respectively, in the group without prior bone augmentation; however, the differences were not significant (P > 0.05). The independent t test revealed no significant gender difference for the CLSTT (P > 0.05) (2.46 ± 0.88 mm and 2.43 ± 0.90 mm for female and male patients, respectively). There were statistically significant associations between the CLSTT and the labial bone thickness at the crestal (rho = 0.720; P = 0.000) and midimplant (rho = 0.707; P = 0.000) levels. Figures 3 and 4 show the scatter plot of the implant’s labial bone thickness (at the crestal and midimplant levels) plotted against the CLSTT. The coefficients of determination (R^2) between the CLSTT and the implant’s labial bone thickness at the crestal and midimplant levels were 0.649 and 0.886.

\[
\text{CLSTT} = 1.043 \times \text{implant’s labial bone thickness at the crestal level} + 0.586
\]

\[
\text{CLSTT} = 0.955 \times \text{implant’s labial bone thickness at the mid-implant level} + 0.955.
\]
0.542, respectively. The following regression equations were produced:

**DISCUSSION**

Previous studies have confirmed that the level or thickness of the bone around implants can affect the soft tissue profile. For instance, the contact point location and the height of the interproximal crestal bone for a tooth or implant can influence the height of the interdental papilla. In general, the interproximal papillae are expected to fill the embrasure area if the distance between the contact points to the interproximal crestal bone is 5 mm or less. Another example is the interimplant distance or distance between the implants and adjacent teeth. For aesthetic reasons and proper appearance of the interproximal papilla, an interimplant and an interimplant-tooth distances of 3 mm and 3 to 4 mm have been recommended, respectively. A thin soft tissue biotype of <2-mm thickness has often been associated with thinner underlying bone, angular bone defects, increased susceptibility to the loss of papilla after immediate implant placement, and is more prone to recession in response to trauma and bacteria than a thick biotype. Consequently, a thin soft tissue biotype affects the implant success, particularly when immediate loading is the treatment of choice. A minimum buccal bone thickness of 2 mm is also necessary for the maintenance of the bone level, and any thickness below that demand hard tissue bone augmentation. However, the importance of soft tissue biotype for the prevention of gingival recession has been questioned recently. In the present study, high correlations (0.720 and 0.707) between the CLSTT of anterior maxillary implants and the thickness of the underlying bone in that area confirmed that the covering soft tissue was heavily influenced by the labial bone thickness. In other words, the coefficient of determination between the CLSTT and the implant’s labial bone thickness at the crestal and midimplant levels and were 0.649 and 0.542, respectively. Therefore, approximately 64.9% or
54.2% of the variation in the data for CLSTT was explained by the implant’s labial bone thickness at the crestal or midimplant levels, respectively. According to the present findings, adequate labial bone thickness at the crestal level (2 mm) of anterior maxillary implants was associated with sufficient CLSTT (~2.7 mm). This is an important clinical finding because traditionally, soft tissue graft has been used to enhance the thin soft tissue coverage around the implant.\(^3\) For the present study, we used a sectional cone beam CT scan\(^3\) that can offer some interesting advantages such as comparable level radiation to conventional radiographs, relatively reasonable cost, and the ability to investigate the 3-dimensional image, which is lacking in conventional 2-dimensional radiographs.\(^37\)–\(^39\) Cone beam CT scan proved to be reliable in quantitatively assessing the covering buccal bone thickness in natural teeth with high precision.\(^40\)–\(^43\) A potential limitation of the study can be the difficulty in measuring the thin buccal plate facing a metallic object such as an implant. However, this method has been used previously,\(^14\) and it is the only noninvasive approach to investigate the relationship between covering soft tissue and bone thickness.

A mean labial gingival recession of 0.5 to 1 mm around single implants, which is partially because of the bone remodeling after implant surgery, has been reported and seems to be a common finding after implant restorations.\(^1\)\(^,\)\(^18\)\(^,\)\(^45\)–\(^49\) Over 1 year between single implant placement and the second-stage surgery, a mean reduction in facial bone thickness and facial bone height of 0.4 mm and 0.7 mm have been reported, respectively, in the peri-implant tissues of the anterior maxillary region, which resulted in a mean apical displacement of 0.6 mm for the labial soft tissue margin.\(^48\) Consequently, a limitation of this study is that we measured the CLSTT around anterior maxillary implants and the thickness of the underlying bone after 4 months, and there may be some changes after this time point. Future long-term studies can investigate these changes.

**CONCLUSION**

The findings in this study suggest the CLSTT around implants is significantly associated with the labial bone thickness in anterior maxillary region. In other words, the thicker the bone, the thicker the CLSTT around implants and vice versa.

**DISCLOSURE**

The authors claim to have no financial interest, either directly or indirectly, in the products or information mentioned in the article.

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**REFERENCES**

facial marginal bone response: stage 1 placement through stage 2 uncovering. 


