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Is buccolingual angulation of maxillary anterior implants associated with the crestal labial soft tissue thickness?

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B. T. Le, A. Borzabadi-Farahani, W. Pluemsakunthai: Is buccolingual angulation of maxillary anterior implants associated with the crestal labial soft tissue thickness?. Int. J. Oral Maxillofac. Surg. 2014; 43: 874–878.

Abstract. We aimed to examine the relationship between crestal labial soft tissue thickness (CLSTT, measured with a digital calliper at the crestal level of casts) and implant buccolingual angulation (IBLA). The records of 22 females and 10 males treated with two bone-level implants (3.3–4.6 mm) between the maxillary canines were evaluated. IBLA was recorded as cingulum, incisal, or labial based on the screw access hole position on provisional restorations. Postoperative implant labial bone thickness (ILBT) at the crestal (2 mm from crest) and mid-implant levels were measured on sectional cone beam computed tomography scans. The mean (SD) ridge width at the crestal level was 6.81 (0.98) mm. Mean (SD) CLSTT for implants with cingulum, incisal, and labial angulations were 2.98 (0.84), 2.24 (0.51), and 1.71 (0.72) mm, respectively. Significant differences were detected between CLSTT of implants with cingulum and incisal, as well as cingulum and labial angulations ($P < 0.01$). Of implants with cingulum, incisal, and labial angulations, 3.4%, 20%, and 53.3%, respectively, had a CLSTT < 2 mm. Overall, 74.2% of CLSTT variance could be predicted by IBLA and ILBT at the crestal and mid-implant levels. A significant association between CLSTT and IBLA was noted when ILBT (crestal level) was <2 mm ($P < 0.01$). Implants with labial angulations carry a higher risk of soft tissue complications when the crestal implant labial bone thickness is <2 mm.

Key words: buccolingual implant angulation; labial bone thickness; maxillary anterior; crestal labial soft tissue thickness; soft tissue biotype.

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The morphological assessment of mucogingival soft tissue dimensions around implants is of great interest to patients and clinicians. It has been reported that thinner gingival tissue thickness around a dental implant is more friable, less vascularized, and more prone to gingival recession.[1–3] Thinner crestal gingival thickness has been associated with increased marginal bone loss around dental implants.[4,5] In addition, crestal gingival thickness is also a crucial factor in abutment material selection, with thinner gingival thickness exhibiting more discoloration.[6]

Implant position and angulation can have a significant effect on the aesthetic outcome. Therefore implants must be accurately placed in a three-dimensional (mesiodistal, labiolingual, and apico-coronal) position with the goal of achieving a proper emergence profile for the final

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restoration. When the implant position is not accurate, the aesthetic result is often compromised. Implants placed too deep in an apico-coronal position or too labial often result is an unnaturally long restoration.[7] The design of the prosthetic restoration should be planned to achieve appropriate implant location with adequate thickness of bone around the implant.[8] However, a lack of adequate bone volume may necessitate implant placement in non-ideal locations and with various angulations. So far, the effect of various buccolingual implant angulations on the crestal labial soft tissue thickness (CLSTT) in aesthetic areas has not been investigated. Therefore, the objective of this study was to assess the relationship between the CLSTT and the buccolingual angulations of maxillary anterior implants.

The null hypothesis for this study was that there would be no differences in the CLSTT of implants with three different buccolingual angulations.

Materials and methods

Institutional Review Board Services approval was granted for the present study. The material for the study was kept anonymous so that patients could not be identified. The inclusion criteria for this study included consecutive patients who received single-unit implants in the anterior maxillary area (central or lateral incisor areas) and had complete data sets (clinical data, intraoral photographs, radiographs, and study casts). All implants were placed at the bone level and had screw-retained provisionals placed to guide soft tissue formation prior to delivery of the final restoration. The records of 32 patients were selected and used for this retrospective study. One operator (BTL) placed the implants under investigation in this study; they were 20 Astra, 18 Straumann, 12 BHZ, 6 Zimmer, 6 Biomet, and 2 Lifecore implants.

Assessment of implant angulation and labial bone thickness

The implant position was determined using a sectional cone beam computed tomography (CBCT) scan. The CLSTT was measured using a digital calliper (Mitutoyo Corporation) at the crestal level of study casts (Fig. 1). CLSTT measurements were performed directly on the final study casts, made after the provisional stage, approximately 4 months after implant placement. The buccolingual angulation of implants was determined by the position of the screw access hole in the provisional restoration, and was recorded as cingulum, incisal, or labial position (Fig. 2). Considering the low amount of radiation, the first author performed sectional CBCT scans to assess the bone volume and implant conditions at the time of provisionalization. From the post-operative sectional CBCT scans, the implant labial bone thickness at the crestal (2 mm from the bone crest) and mid-implant levels were also measured and recorded.[9]

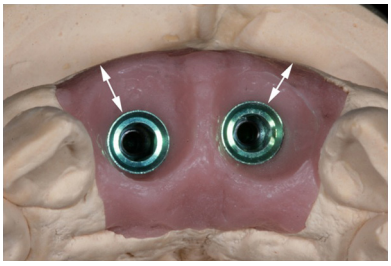

Fig. 1. Crestal labial soft tissue thickness measurements performed on the final study casts, made after the provisional stage, approximately 4 months after implant placement.

Statistical analysis

CLSTT data were compared by sex (independent *t*-test), and the different implant angulations were compared using descriptive analysis and one-way analysis of variance (ANOVA). CLSTT records for the three implant angulation groups were exposed to the test of homogeneity of variances (Levene statistic) before performing the one-way ANOVA test. Multiple comparisons of CLSTT in the three implant angulation groups were performed using post hoc tests and Bonferroni corrections. The percentages of implants with a thick CLSTT ($\geq$2 mm) were calculated for the different implant angulations. A contingency table was produced, and data for CLSTT were exposed to the χ^2 test to identify any significant differences among the implant angulation groups. Multiple regression analysis was also used to assess the predictability of variables such as implant labial bone thickness at the crestal and mid-implant levels, as well as implant angulation, for the outcome variable of CLSTT. The fit of the model was also assessed.

To further assess the relationship between the CLSTT and implant angulation, data were split into two categories based on the thickness of labial bone at the crestal level: $<$2 mm and $\geq$2 mm. Subsequently, the χ^2 test was performed in each group to determine whether there was any difference between groups with adequate ($\geq$2 mm) and less than adequate ($<$2 mm) labial bone thickness. A *P*-value of $<$0.05 was considered as statistically significant.

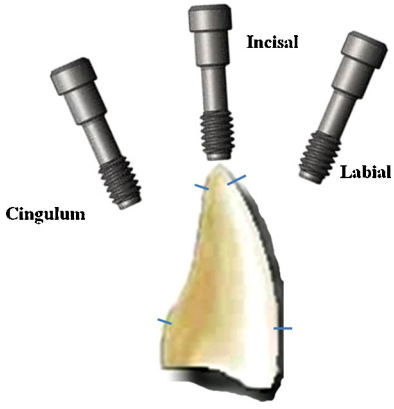

Fig. 2. Different implant angulations. Implant angulation was classified as cingulum, incisal, or labial based on the screw access hole position on the provisional restoration. By convention incisal angulation was determined only if the access to the screw hole involved reduction of the incisal edge.

Results

Patients for this study were 22 females and 10 males. These patients had two implants placed in the maxillary arch between permanent canines in either the maxillary lateral incisor (7 and 10) or central incisor (8 and 9) region. Overall, 64 implants were placed. The diameters of implants ranged from 3.3 to 4.6 mm.

The mean (SD) ridge width at crestal level was 6.81 (0.98) mm. The independent *t*-test revealed no significant difference for the CLSTT with regard to sex ($P > 0.05$). The mean (SD) CLSTT for female patients was 2.46 (0.88) and for male patients was 2.43 (0.90) mm. There were 29 implants with a cingulum buccolingual angulation, 20 with an incisal angulation, and 15 with a labial angulation. The mean (SD) CLSTT for implants with cingulum, incisal, and labial angulations were 2.98 (0.84), 2.24 (0.51), and 1.71 (0.72) mm, respectively. One-way ANOVA tests revealed significant differences in CLSTT among the implant angulation groups ($F = 16.67$, $P = 0.000$) (Table 1). There were statistically significant differences between the CLSTT of implants with cingulum and incisal, as well as cingulum and labial angulations ($P < 0.05$). Therefore, the null hypothesis for this study was partially rejected.

A thick CLSTT was seen in 80% of implants placed. Of implants with cingulum,