

Crestal Soft Tissue Thickness before Implant Placement and Its Relationship with Crestal Cortical Bone Thickness: A CBCT Based Retrospective Study

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Abstract

Background: Adequate peri-implant mucosal thickness has been associated with improved marginal bone stability. This study quantified crestal soft tissue thickness at edentulous implant sites using CBCT and examined its relationship with crestal cortical bone and buccal/lingual cortical plates 5 mm apical to the crest.

Methods: Retrospective analysis of CBCT scans from 10 adults (21 edentulous sites). Measurements (mm): (1) crestal soft tissue at the alveolar crest; (2) crestal cortical bone at the crest; (3) buccal and lingual cortical plates 5 mm apical. Descriptive statistics and Pearson correlation ($\alpha = 0.05$) were used.

Results: Mean crestal soft tissue thickness was 2.41 mm (median 2.2; range 1.41–4.87). Anterior sites were

thicker than posterior (2.74 ± 0.28 vs 2.08 ± 0.19 mm). Mean crestal cortical bone was 1.42 mm (median 1.40). Buccal and lingual cortical plate means at 5 mm apical were 1.29 mm and 1.69 mm, respectively. Crestal soft tissue thickness positively correlated with crestal cortical bone ($p < 0.001$).

Conclusions: More than half of implant sites exhibited thick crestal soft tissue (> 2 mm). Crestal soft tissue thickness was significantly associated with crestal cortical bone thickness but not with buccal/lingual plates 5 mm apical. Pre-surgical CBCT assessment provides actionable, non-invasive information for implant planning.

Keywords: CBCT Scans, Crestal Soft Tissue, Implant Placement, Lingual Plates.

Introduction

Peri-implant tissue stability depends on both hard and soft tissue determinants, including implant design, platform switching, abutment height, occlusal loading, and the quantity/quality of peri-implant mucosa. Animal and clinical data suggest that thicker initial mucosa (>2 mm) reduces early crestal bone remodeling. Traditional measurement methods rely on intraoperative probing or punches and cannot guide pre-surgical planning. Cone-beam computed tomography (CBCT) enables non-invasive visualization of ridge anatomy, supporting both hard and soft tissue assessment prior to implant placement.

Materials and Methods

Design and Patients: Retrospective cross-sectional analysis of adult patients (≥ 18 years) with edentulous sites planned for implants and a pre-operative CBCT. Inclusion: generally healthy; measurable crestal soft tissue; no prior grafting at the site.

Exclusion: systemic risks affecting healing (e.g., bisphosphonates, uncontrolled diabetes/osteoporosis).

CBCT Acquisition: Sirona Orthophos SL (85 kV, 10 mA, 14 s), voxel 0.2 mm^3 , 16-bit grayscale, FOV $60 \times 80 \text{ mm}^2$. Images reviewed on HP Envy laptop. Cross-sections perpendicular to the ridge were measured in Planmeca Romexis, Galileos Viewer, and MNT Viewer.

Outcomes and Measurements: (1) crestal soft tissue thickness at the alveolar crest; (2) crestal cortical bone thickness at the crest; (3) buccal and lingual cortical plate thickness 5 mm apical to the crest. Statistics: descriptive metrics (mean, median, SE) and Pearson correlation (two-sided $\alpha = 0.05$; 95% CIs). Sites were analyzed as observational units.

Results

Cohort: 10 patients (5 females, 5 male; mean age 48.4 years, range 38–66) contributed 21 edentulous sites (maxillary anterior 6; mandibular anterior 5; maxillary posterior 4; mandibular posterior 6). No site received prior grafting; 6 patients wore provisional prostheses.

Crestal soft tissue thickness: overall mean 2.41 mm (median 2.20; range 1.41–4.87). Females 2.64 mm; males 2.27 mm. Anterior sites were thicker than posterior (2.74 ± 0.28 vs 2.08 ± 0.19 mm). Four-group means: maxillary anterior 2.83 ± 0.45 ; mandibular anterior 2.64 ± 0.36 ; mandibular posterior 2.20 ± 0.26 ; maxillary posterior 1.88 ± 0.23 mm.

Crestal cortical bone thickness: mean 1.42 mm (median 1.40; range 0.50–4.97). Anterior 1.50 mm vs posterior 1.33 mm. Five-millimeter apical plates: buccal 1.29 mm; lingual 1.69 mm.

Correlations: crestal soft tissue thickness positively correlated with crestal cortical bone ($p < 0.001$). No positive correlation with buccal/lingual plates at 5 mm apical.

Discussion

CBCT-based pre-surgical evaluation revealed that most implant sites had thick crestal soft tissue (>2 mm) and that anterior regions tended to be thicker than posterior. The significant association between crestal soft tissue and crestal cortical bone suggests a coordinated crest-level soft-hard tissue unit, whereas deeper buccal/lingual plates (5 mm apical) showed no such association.

Clinically, knowing the crestal mucosal thickness aids decisions on abutment height, platform switching, and whether soft tissue augmentation is indicated to mitigate early marginal bone remodeling. Limitations include the small retrospective sample, unmodeled intra-patient clustering, and the absence of longitudinal outcomes.

Conclusions

1) A majority of sites exhibited thick crestal mucosa (>2 mm). 2) Crestal soft tissue thickness correlated positively with crestal cortical bone thickness (p < 0.001) but not with buccal/lingual plates at 5 mm apical. 3) Anterior sites tended to present thicker crestal soft tissue than posterior sites.

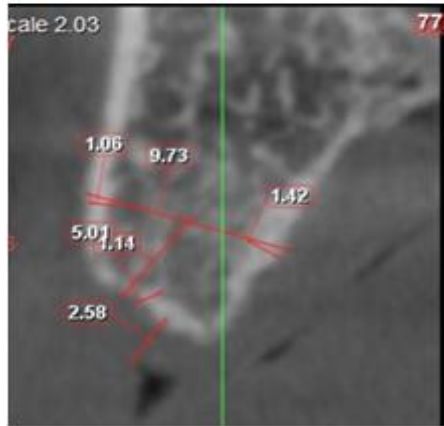


Figure 1: CBCT cross-section showing linear measurements at the alveolar crest (soft tissue and crestal cortical bone).

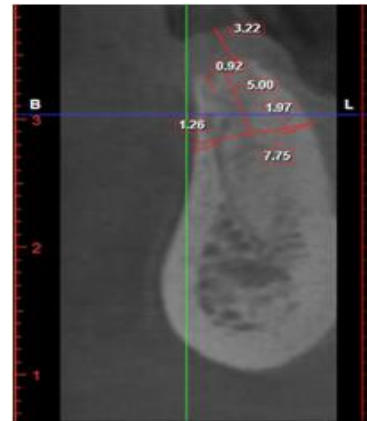


Figure 2: CBCT cross-section 5 mm apical to the crest showing buccal and lingual cortical plate measurements.

Table 1: Patient-level measurements by site

Sl. No	Gender	Age	Soft tissue thickness at the Crest				Maxillary Posterior			Mandible anterior			Mandible posterior			Maxillary anterior		
			Max Ant	Man d Ant	Max Post	Man d Post	Crestal bone thickness	Labial bone thickness at 5mm	Lingual bone thickness at 5mm	Crestal bone thickness	Labial bone thickness at 5mm	Lingual bone thickness at 5mm	Crestal bone thickness	Labial bone thickness at 5mm	Lingual bone thickness at 5mm	Crestal bone thickness	Labial bone thickness at 5mm	Lingual bone thickness at 5mm
1	M	66	2.03	1.67	1.74	2.05	1.79	0.97	1.05	0.99	1.4	2.02	1.43	2.78	2.64	0.79	1.1	0.97
2	F	64					1.52	0.57	1.37									
3	F	40		2.23						0.85	0.66	2.43	0.83	1.38	1.87			
4	M	38											1.52	2.11	2.84			
													1.71	1.72	2.08			
5	M	52	2.11	3.66	2.58		1.14	1.06	1.42	1.14	1.42	1.38				1.5	0.87	0.87
			3.37													1.2	1.08	1.81
6	F	40			3.22					0.92	1.97	1.26						
7	F	51	4.87	2.43	1.7	2.36	0.5	0.56	0.57	1.35	1.09	2.09	1.53	1.83	2.53	4.97	1.18	1.49
8	M	43	2.4													1.4	0.7	1.7
9	F	40				3.4							1.4	1.7	1.4			
10	M	50	2.2													1.4	1	1.7

Table 2: Estimated means and SEs of hard and soft tissue measurements

Estimated means and SEs of Hard tissue and Soft tissue measurements					
Demographics	Groups	Thickness of Cortical bone at the alveolar crest (mm)	Thickness of Buccal cortical plate 5mm apical to alveolar crest (mm)	Thickness of Lingual cortical plate 5mm apical to alveolar crest (mm)	Thickness of Crestal soft tissue (mm)
Gender	Male	1.33(0.084)	1.47(0.154)	1.7(0.179)	2.26(0.19)
	Female	1.54(0.445)	1.63(0.454)	1.66(0.207)	2.64(0.35)
Edentulous site	Maxillary anterior	1.87(0.627)	0.98(0.071)	1.42(0.165)	2.83(0.454)
	Mandibular anterior	1.05(0.089)	1.3(0.215)	1.83(0.222)	2.64(0.355)
	Maxillary posterior	1.23(0.279)	0.79(0.131)	1.1(0.195)	1.88(0.235)
	Mandibular posterior	1.4(0.122)	1.92(0.196)	2.22(0.221)	2.2(0.269)
	Anterior	1.5(0.354)	1.13(0.111)	1.61(0.143)	2.74(0.283)
	Posterior	1.33(0.127)	1.46(0.221)	1.77(0.234)	2.07(0.185)

Table 3: Estimated medians of hard and soft tissue measurements

Estimated median of Hard tissue and Soft tissue measurements					
Demographics	Groups	Thickness of Cortical bone at the alveolar crest (mm)	Thickness of Buccal cortical plate 5mm apical to alveolar crest (mm)	Thickness of Lingual cortical plate 5mm apical to alveolar crest (mm)	Thickness of Crestal soft tissue (mm)
Gender	Male	1.4	1.4	1.7	2.08
	Female	1.35	1.38	1.49	2.36
Edentulous site	Maxillary anterior	1.4	1.04	1.59	2.3
	Mandibular anterior	0.99	1.4	2.02	2.43
	Maxillary posterior	1.33	0.77	1.21	1.72
	Mandibular posterior	1.47	1.77	2.3	2.04
	Anterior	1.2	1.09	1.7	2.4
	Posterior	1.47	1.54	1.64	2.01

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