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Research / Araştırma Makalesi

Evaluation of Crestal Mucosa Thickness and Alveolar Hard Tissue Measurements in CBCT Images Before Implant Placement

İmplant Yerleştirilmesinden Önce KIBT Görüntülerinde Krestal Mukoza Kalınlığının ve Alveolar Sert Doku Ölçümlerinin Değerlendirilmesi

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ABSTRACT

Background: This study aimed to evaluate crestal mucosa thickness, alveolar cortical bone thickness, crest height, and width on CBCT images and compare these measurements across various patient groups and edentulous locations.

Methods: A total of 318 edentulous sites from 100 patients (50 females and 50 males) scheduled for dental implantation were assessed. CBCT images were evaluated using One Volume Viewer Software, and measurements were taken from vertical cross-sectional views aligned with the alveolar ridge. Crestal mucosa thickness (CMT), cortical bone thickness (CBT) at the alveolar crest, alveolar ridge width at 5 mm apical to the crest, buccal and lingual/palatal CBT and alveolar bone height were measured. Statistical analysis was conducted using SPSS software.

Results: Mucosa thickness in the alveolar crest did not significantly differ across regions (p>0.05). Patients aged ≥65 years exhibited significantly reduced alveolar crest height and buccal, lingual, and palatal CBT. Alveolar ridge width and lingual/palatal CBT were lower in females than males (p<0.001 and p=0.013, respectively).

Conclusion: This study highlights the utility of CBCT in assessing both surrounding soft and hard tissues, facilitating treatment planning for dental implant procedures

Keywords: Alveolar bone thickness, Cone beam computed tomography, Crestal mucosa thickness, Dental implantology, Dental implant treatment planning

ÖZ

Amaç: Bu çalışmanın amacı, KIBT görüntülerinde krestal mukoza kalınlığını, alveolar kortikal kemik kalınlığını, kret yüksekliğini ve genişliğini değerlendirmek ve bu ölçümleri çeşitli hasta grupları ve dişsiz konumlar arasında karşılaştırmaktır.

Gereç ve Yöntemler: Dental implantasyon planlanan 100 hastanın (50 kadın ve 50 erkek) toplam 318 dişsiz bölgesi değerlendirilmiştir. KIBT görüntüleri One Volume Viewer Yazılımı kullanılarak değerlendirilmiş ve ölçümler, alveolar sırtla hizalanmış dikey kesit görünümlerinden alınmıştır. Krestal mukoza doku kalınlığı (KMK), alveolar krestin kortikal kemik kalınlığı (KKK), bukkal ve lingual/palatal KKK, kretin 5 mm apikalindeki alveolar kret genişliği ve alveolar kemik yüksekliği ölçülmüştür. İstatistiksel analiz SPSS yazılımı kullanılarak gerçekleştirilmiştir.

Bulgular: Alveolar kretteki mukoza kalınlığı, bölgelere göre istatistiksel olarak anlamlı bulunmamıştır (p>0.05). 65 yaş üstü hastalarda alveolar kret yüksekliği ve bukkal, lingual ve palatal KKK anlamlı derecede azalmıştır. Alveolar kret genişliği ve lingual/palatal KKK erkeklerde kadınlardan daha yüksektir (sırasıyla p<0.001 ve p=0.013).

Sonuçlar: Bu çalışma, dental implant prosedürleri için tedavi planlamasını kolaylaştıran çevredeki hem sert hem de yumuşak dokuları değerlendirmede KIBT'nin yararlılığını vurgulamaktadır.

Anahtar Kelimeler: Alveolar kemik kalınlığı, Dental implantoloji, Dental implant tedavi planlaması, Konik işınlı bilgisayarlı tomografi, Krestal mukoza yüksekliği

Introduction

Dental implants are a commonly used, highly successful, and predictable therapeutic option for supporting prostheses.[1] Implant lifespan is contingent upon the preservation of healthy peri-implant tissues.[2] Expectable peri-implant crestal bone stability has been found to depend on several variables, including soft tissue size and amount of keratinized tissue, abutment height, platform switching, implant insertion depth, occlusal load, and implant design and surface configuration.[3] The crestal mucosa's initial thickness is one of these factors.

Marginal bone levels typically stabilize within the first year of functional loading, with annual crestal bone loss (CBL) exceeding 0.2 mm deemed undesirable thereafter.[1,4] However, some studies suggest that a CBL of 1.5-2 mm in the first year may be considered a physiological process.[5,6] A CBL associated with a "biological width" during wound healing can result from a thin mucosa during implant placement.[7]

An animal study conducted by Berglundh and Lindhe in 1996 demonstrated the importance of maintaining a consistent soft tissue connection around dental implants, which necessitates a minimal peri-implant mucosa thickness.[8] Systematic reviews and recent clinical investigations have shown that thick original mucosa (>2 mm) around the implants is linked to considerably reduced changes in crestal bone in short-term.[3,9] Despite various methods proposed for measuring Crestal Mucosa Thickness (CMT), they are often invasive and not universally suitable.[9,10] Cone Beam Computed Tomography (CBCT) offers an accurate assessment of tissues with reduced radiation exposure, shorter exposure time and lower output.[11] Particularly in recent years, CBCT has been employed reliably and successfully in evaluating dentogingival soft tissues.[12]

This study aimed to examine CMT, crest height and width, and alveolar CBT on CBCT images and compare different patient groups and edentulous regions.

Material and Methods

The research protocol of this study received approval from the Health Sciences University, Gülhane Scientific Research Ethics Committee (2024-76).

CBCT scans from 100 patients who visited the Gülhane Faculty of Dentistry Periodontology Clinic for implant treatment between January 2023 and January 2024 were retrospectively examined.

The inclusion criterion was the clear visualization of all hard and soft tissue borders in the edentulous crests where implant planning was conducted. Exclusion criteria for CBCT images included inadequate image clarity for precise measurement. Additionally, patients with any of the specified criteria were excluded from the study: history of soft tissue grafting surgery at the implant site prior to CBCT, age under 18 years, total tooth loss, presence of medical conditions affecting soft

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tissue or bone wound healing (including osteoporosis or uncontrolled diabetes mellitus), current use of bisphosphonates, previous bone grafting procedures or history of socket preservation surgery before CBCT imaging.

Evaluation of CBCT images

Measurements were conducted using a 30-inch DellTM 3008WFP desktop computer with a resolution of 1920 x 1200 pixels and a 32-bit display, equipped with a 12th Gen Intel (R) Core (TM) i5-1240P processor running at 1.70 GHz (Dell Inc, Round Rock, Tx, USA).

One Volume Viewer Software (i-Dixel 2.0, J. Morita Mfg. Corp., Kyoto, Japan) was utilized for image analysis and measurements. Vertical cross-sectional views in the middle of each edentulous area were examined, and measurements were corroborated in sagittal sections.

The following parameters were assessed on CBCT images: (a) Crestal bone thickness at the alveolar crest (CBT); (b) Crestal mucosa thickness at the alveolar crest (CMT); (c) Buccal CBT at 5 mm apical to the alveolar crest; (d) Lingual/palatal CBT at 5 mm apical to the alveolar crest; (e) Width of the alveolar ridge at 5 mm apical to the alveolar crest; and (f) Alveolar crest height (implantable bone height). All measurements were recorded in millimeters.

An experienced periodontologist (Ö.S.A.) conducted the assessment of CBCT scans, measuring the aforementioned parameters. To ensure the feasibility, standardization, and reproducibility of the data collection process, a pilot test was conducted, involving the measurement of 15 images. Subsequently, after a 15-day interval, the entire measurement process was repeated. Intraobserver agreement was evaluated using the inter-class correlation coefficient (ICC). The obtained ICC values, ranging from 0.96 to 0.99, indicate highly consistent results, demonstrating the robustness of the measurements.

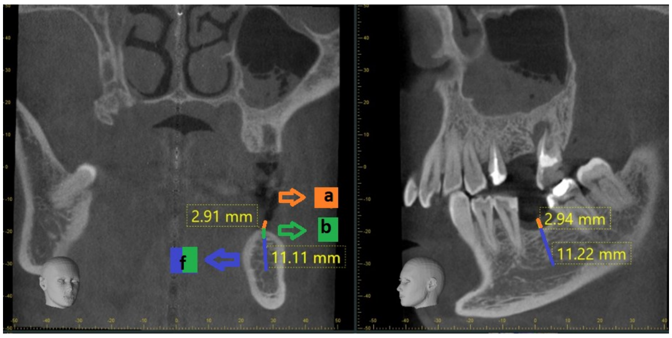

Figure 1. (a) crestal soft tissue thickness at the alveolar crest (orange zone); (b) cortical bone thickness at the alveolar crest (green zone); (f) alveolar crest height (green zone+blue zone)

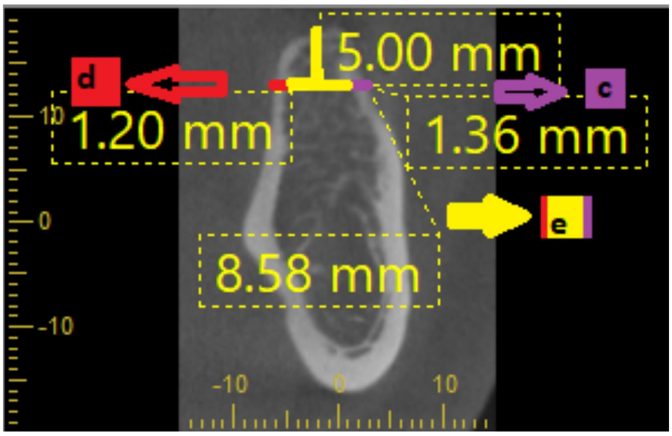

Figure 2. (c) buccal cortical bone thickness at 5 mm apical to the alveolar crest (purple zone), (d) lingual/palatal cortical bone thickness at 5 mm apical to the alveolar crest (red zone), and (e) width of the alveolar ridge at 5 mm apical to the alveolar crest (red zone+yellow zone+purple zone)

Statistical analysis

The data were analyzed using descriptive statistics, including number, mean, percentage, median and standard deviation. The reliability of the measurement scale was assessed. The normality assumption was evaluated using the Shapiro-Wilk test at the outset of the statistical analysis. the Independent Sample T-test was employed to compare two independent groups with normal distribution. The Mann-Whitney U test was utilized in cases where the normality assumption was not met. When comparing three or more independent groups with a normal distribution, the ANOVA test was applied, while the Kruskal-Wallis test was used when the normality assumption was violated. Post Hoc Bonferroni and Adjusted Bonferroni tests were subsequently conducted to pinpoint the group or groups contributing to observed differences. Spearman's correlation was utilized to evaluate the relationship between continuous variables that did not adhere to the criteria for normal distribution. All statistical analyses were performed using the IBM SPSS 25 software.

Results

In **Table 1**, descriptive statistics calculated for the demographic characteristics of the respondents are given.

Table 1. Distribution of participants according to their demographic characteristics

			n	%
Gender	Female		177	55.8
	Male		140	44.2
Age groups	≤40		75	23.7
	41-64		191	60.3
	≥65		51	16.1
Region	Maxillary anterior		34	10.7
	Mandibular anterior		5	1.6
	Maxillary premolar		71	22.4
	Mandibular premolar		48	15.1
	Maxillary molar		51	16.1
	Mandibular molar		108	34.1
		Min.-Max.	Mean ± S.D.(M.)	
Age		13-75	50.15±14.98(54)	

Mann-Whitney U and Independent Sample T tests were used to compare CBCT measurements according to gender (**Table 2**). As a result of the analyses, statistically significant differences were determined between the lingual/palatal CBT at 5 mm apical to the alveolar crest and alveolar ridge width at 5 mm apical to the alveolar crest according to gender ($p<0.05$).

No statistically significant differences were found between the soft tissue thickness in the alveolar crest, CBT in the alveolar crest, buccal CBT at 5 mm apical of the alveolar crest, and crest height according to gender ($p>0.05$).

Table 2. Distribution and comparison of CBTC measurements according to gender

	Gender	Mean.±S.D.(M.)	Test Statistic	p
Crestal soft tissue thickness	Female	2.47±0.80(2.34)	11246.0	0.158
	Male	2.60±0.83(2.45)		
Crestal cortical bone thickness	Female	1.57±0.96(1.28)	12360.5	0.971
	Male	1.53±0.99(1.43)		
Buccal cortical bone thickness 5 mm apical to the alveolar crest	Female	1.51±0.97(1.32)	11507.0	0.276
	Male	1.61±0.94(1.41)		
Lingual/palatal cortical bone thickness 5 mm apical to the alveolar crest	Female	1.67±0.80(1.48)	10371.0	**0.013***
	Male	2.03±1.62(1.80)		
Alveolar ridge width 5 mm apical to the alveolar crest	Female	6.75±2.71(6.28)	9273.0	**<0.001***
	Male	7.88±2.61(7.70)		
Crestal height	Female	14.00±3.81(14.04)	0.189‡	0.850
	Male	13.91±4.20(14.20)		

**p<0.05 and ‡: Independent Sample T test*

Kruskal-Wallis and ANOVA tests were used to compare CBCT measurements based on age (**Table 3**). The analyses revealed statistically significant differences in buccal CBT at 5 mm apical to the alveolar crest, lingual/palatal CBT at 5 mm apical to the alveolar crest, and crest height according to age ($p<0.05$).

Bonferroni tests indicated a statistically significant difference in buccal CBT at 5 mm apical to the alveolar crest between the ≤40 and ≥65 age groups ($p=0.023$). In a similar way, significant differences were observed in lingual/palatal CBT at 5 mm apical to the alveolar crest between the ≥65 and ≤40, and 41-64 age groups ($p=0.005$ and $p=0.001$, respectively). Additionally, crest height showed a significant difference between the 41-64 and ≥65 age groups ($p=0.002$).

However, no statistically significant differences were found in the soft tissue thickness in the alveolar crest, cortical bone thickness in the alveolar crest, and alveolar ridge width at 5 mm apical to the alveolar crest based on age ($p>0.05$).

Table 3. Distribution and comparison of CBTC measurements according to age

	Age	Mean ±S.D.(M.)	Test Statistic	P
Crestal soft tissue thickness	≤40	2.52±0.76(2.52)	4746	0.093
	41-64	2.58±0.84(2.40)		
	≥65	2.34±0.80(2.29)		
Crestal cortical bone thickness	≤40	1.38±0.83(1.33)	2876	0.237
	41-64	1.64±1.01(1.34)		
	≥65	1.47±1.01(1.23)		
Buccal cortical bone thickness 5 mm apical to the alveolar crest	≤40	1.68±0.82(1.54)[a]	7158	**0.028***
	41-64	1.55±0.90(1.28)[a.b]		
	≥65	1.40±1.28(1.23)[b]		
Lingual/palatal cortical bone thickness 5 mm apical to the alveolar crest	≤40	1.90±1.07(1.69)[b]	14165	**0.001***
	41-64	1.93±1.38(1.67)[b]		
	≥65	1.34±0.69(1.38)[a]		
Alveolar ridge width 5 mm apical to the alveolar crest	≤40	7.58±2.72(7.57)	4799	0.091
	41-64	7.32±2.75(6.74)		
	≥65	6.50±2.54(6.35)		
Crestal height	≤40	14.07±3.75(14.61)[a.b]	5.942†	**0.003***
	41-64	13.48±4.03(13.44)[a]		
	≥65	15.60±3.75(16.15)[b]		

**p<0.05 and †: ANOVA test*

ANOVA and Kruskal-Wallis tests were applied to compare CBCT images according to different regions of the mouth (**Table 4**). The analyses revealed statistically significant differences in the CBT in the alveolar crest, buccal CBT at 5 mm apical to the alveolar crest, lingual/palatal CBT at 5 mm apical to the alveolar crest, alveolar ridge width at 5 mm apical to the alveolar crest, and crest height ($p<0.05$).

Regarding CBT in the alveolar crest, significant differences were observed between the maxillary molar and maxillary anterior, mandibular molar and mandibular premolar groups, as well as between the maxillary premolar and mandibular molar and mandibular premolar groups ($p=0.007$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, and $p<0.001$). Similarly, significant differences were found in buccal CBT at 5 mm apical to the alveolar crest between the mandibular molar and mandibular premolar, maxillary molar, maxillary anterior, and maxillary premolar groups ($p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, and $p<0.001$).

Analyses for lingual/palatal CBT at 5 mm apical of the alveolar ridge revealed statistically significant differences between the mandibular molar and mandibular premolar, maxillary molar, maxillary anterior, and maxillary premolar groups ($p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, and $p<0.001$). Regarding the alveolar ridge width at 5 mm apical to the alveolar crest, significant differences were found between the maxillary anterior and mandibular premolar, maxillary molar and mandibular molar groups, as well as between the mandibular molar, maxillary molar and maxillary premolar groups, and between the mandibular molar and mandibular premolar groups ($p=0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, and $p=0.033$). Regarding crest height, significant differences were observed between the maxillary premolar and mandibular molar, mandibuler premolar, maxillary premolar, and maxillary anterior groups, as well as between the mandibular molar and maxillary anterior and mandibular anterior groups, and between maxillary premolar and maxillary anterior groups ($p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p<0.001$, $p=0.001$, $p=0.001$, $p=0.040$, and $p=0.05$).

However, no statistically significant difference was found in the soft tissue thickness in the alveolar crest across regions ($p>0.05$).

Table 4. Distribution and comparison of CBTC measurements by dental region

	Dental region	Mean±S.D.(M.)	Test Statistic	p
Crestal soft tissue	Maxillary anterior	2.72±1.02(2.53)	4311	0.506
	Mandibular anterior	2.22±0.99(2.14)		
	Maxillary premolar	2.59±0.78(2.46)		
	Mandibular premolar	2.42±0.79(2.26)		
	Maxillary molar	2.65±0.95(2.43)		
	Mandibular molar	2.43±0.69(2.32)		
Crestal cortical bone thickness	Maxillary anterior	1.56±1.01(1.28)	85133	**<0.001***
	Mandibular anterior	1.79±0.48(1.90)		
	Maxillary premolar	1.09±0.60(1.06)		
	Mandibular premolar	1.86±0.93(1.69)		
	Maxillary molar	0.88±0.45(0.96)		
	Mandibular molar	2.02±1.07(1.92)		
Buccal cortical bone thickness 5 mm apical to the alveolar crest	Maxillary anterior	1.18±1.42(1.02)	148979	**<0.001***
	Mandibular anterior	1.91±0.95(1.45)		
	Maxillary premolar	1.04±0.46(1.08)		
	Mandibular premolar	1.76±0.67(1.70)		
	Maxillary molar	0.92±0.36(0.94)		
	Mandibular molar	2.20±0.88(2.13)		
Lingual/palatal cortical bone thickness 5 mm apical to the alveolar crest	Maxillary anterior	1.24±0.54(1.16)	119677	**<0.001***
	Mandibular anterior	1.89±0.56(1.91)		
	Maxillary premolar	1.38±0.57(1.38)		
	Mandibular premolar	2.11±0.78(2.12)		
	Maxillary molar	1.15±0.42(1.11)		
	Mandibular molar	2.50±1.71(2.28)		
Alveolar ridge width 5 mm apical to the alveolar crest	Maxillary anterior	4.75±1.73(4.49)	74362	**<0.001***
	Mandibular anterior	6.54±2.94(6.34)		
	Maxillary premolar	6.11±2.24(5.95)		
	Mandibular premolar	6.90±2.12(6.61)		
	Maxillary molar	8.15±2.34(8.04)		
	Mandibular molar	8.55±2.80(8.29)		
Crestal height	Maxillary anterior	17.25±3.19(17.24)	82526	**<0.001***
	Mandibular anterior	20.16±3.17(19.24)		
	Maxillary premolar	14.28±3.95(14.25)		
	Mandibular premolar	14.69±2.87(15.41)		
	Maxillary molar	9.78±3.86(8.91)		
	Mandibular molar	14.08±2.94(14.17)		

**p<0.05*

Spearman correlations were employed to investigate the relationship between CBCT measurements and age (**Table 5**). The analysis revealed a statistically negative, significant, and weak correlation between the width of the alveolar ridge 5 mm apical to the alveolar crest and age, with a correlation coefficient of -0.149.

Table 5. Relationships between CBTC measurements and age of participants

	Age
Crestal soft tissue thickness	-0.062
Crestal cortical bone thickness	0.049
Buccal cortical bone thickness 5 mm apical to the alveolar crest	-0.093
Lingual / palatal cortical bone thickness 5 mm apical to the alveolar crest	-0.063
Alveolar ridge width 5 mm apical to the alveolar crest	-0.149**
Crestal height	0.042

***p<0.001*

Additionally, Spearman correlations were used to assess the relationships between CBCT measurements (**Table 6**). The analyses showed statistically significant, positive, and moderate relationships between the CBT in the alveolar crest and the buccal CBT 5 mm apical to the alveolar crest (correlation coefficient of 0.512), and between the lingual/palatal CBT 5 mm apical to the alveolar crest (correlation coefficient of 0.540). Similarly, statistically significant, positive, and weak relationships were found between the crest height (correlation coefficient of 0.135) (p<0.05). Moreover, statistically high-level, positive, and significant relationships were observed between the buccal CBT at 5 mm apical of the alveolar crest and the lingual/palatal CBT at 5 mm apical of the alveolar crest (correlation coefficient of 0.791), as well as between the alveolar ridge width at 5 mm apical of the alveolar crest (correlation coefficient of 0.427) (p<0.05).

Furthermore, statistically significant, positive, and moderate relationships were found between the lingual/palatal CBT at 5 mm apical of the alveolar crest and the alveolar ridge width at 5 mm apical of the alveolar crest, with a correlation coefficient of 0.385 (p<0.05).

Finally, a significant, negative, and weak statistical correlation coefficient of -0.161 was observed between the alveolar ridge width at 5 mm apical of the alveolar crest and the crest height (p<0.05).

Table 6. Relationships between CBTC measurements of participants

	Crestal cortical bone thickness	Buccal cortical bone thickness 5 mm apical to the alveolar crest	Lingual / palatal cortical bone thickness 5 mm apical to the alveolar crest	Alveolar ridge width 5 mm apical to the alveolar crest	Crestal height
Crestal soft tissue thickness	-0.080	-0.040	-0.014	0.024	-0.022
Crestal cortical bone thickness		0.512**	0.540**	-0.006	0.135*
Buccal cortical bone thickness 5 mm apical to the alveolar crest			0.791**	0.427**	0.082
Lingual / palatal cortical bone thickness 5 mm apical to the alveolar crest				0.385**	0.106
Alveolar ridge width 5 mm apical to the alveolar crest					-0.161**

***p<0.001*

Discussion

We evaluated 318 sites in 100 patients who were scheduled for implant placement in this study.

CBCT is a widely used imaging technique in dentistry before implant placement. It offers detailed three-dimensional images of oral and maxillofacial structures, providing essential information about bone density, volume, and anatomical features.[13] This imaging modality plays a crucial role in treatment planning for dental implant placement by allowing dentists to assess available bone, anticipate potential challenges, and determine the optimal implant position.[14] Moreover, CBCT is invaluable for screening oral soft tissues, as it provides comprehensive three-dimensional images that facilitate the assessment of soft-tissue structures such as gums, nerves, and blood vessels.[15] In our study, we measured both soft and hard tissues on CBCT images and evaluated their relationships.

Various methods exist for measuring the thickness of intraoral soft tissues. For instance, Schwarz et al. found magnetic resonance imaging to have a comparable accuracy rate with CBCT in their study assessing anterior gingival thickness.[16] Gkogkos et al. demonstrated that CBCT-derived gingival thickness measurements are highly reproducible and comparable to those obtained using ultrasound devices.[17] Conversely, Bezerra et al. concluded that infrared thermography is not a reliable method for determining gingival phenotype.[18] In our study, we found that CBCT can effectively measure CSTT. Despite concerns about radiation exposure and cost, CBCT remains a logical choice for soft tissue measurement, given its necessity for detecting hard tissues and anatomical landmarks during implant planning.

In our study, we noted a decrease in alveolar crest height and buccal and lingual cortical bone thickness (CBT) with age. This finding aligns with the results of Damanaki et al., who observed a decrease in alveolar crest height with age in a study conducted on mice.[19] However, Farnsworth et al. found that cortical bone thickness generally increased in adults compared to adolescents, likely due to the increased functional capacity of adults.[20]

Interestingly, we found no significant changes in crest width or crest soft tissue thickness with age in our study. It's worth noting that thickness in the buccolingual direction may be higher in more resorbed crests. In contrast, Escobar-Correa et al. reported a decrease in bone width 6 mm apical to the enamel-cement junction at age.[21] This discrepancy could stem from variations in functional loads between edentulous crests and toothed regions.

Ling et al. reported that females generally exhibit greater bone width and slightly thicker cortical bone width than males in toothed regions.[22] However, studies by Farnsworth et al. and Escobar-Correa et al. found no significant differences in bone thickness or cortical bone thickness (CBT) between genders.[20,21] Similarly, our study found no statistically significant difference in CBT according to gender. Interestingly, both buccal and lingual/palatal CBT were higher in males than in females in our study.

Implants initially placed with thicker peri-implant soft tissue tend to experience less radiographic marginal bone loss in short-term.[3,9,23,24] However, excessive vertical soft tissue thickness around implants may negatively impact peri-implant tissue health in patients with a history of periodontitis, as reported by Zhang et al..[25] In our study, the mean crestal mucosa thickness (CMT) was 2.53 ± 0.82 mm, with no statistically significant difference observed among intraoral regions. The highest values were observed in the maxillary anterior region, while the lowest values were found in the mandibular anterior region. Additionally, CMT did not correlate with any of the hard tissue parameters measured. These findings are consistent with the study by Liu et al., which also reported a weak correlation between hard tissue measurements and soft tissue thickness.[3]

The crestal bone height, which refers to the bone surrounding the neck of a dental implant, is pivotal for implant success. Insufficient bone height can result in complications like implant instability, peri-implantitis, and potential implant failure.[26] Hence, it's essential to monitor and assess crestal bone health preoperatively for long-term implant success. In our study, cortical bone thickness (CBT) in the alveolar crest exhibited no statistically significant differences based on age and gender. Interestingly, the mandibular molar regions demonstrated the highest thickness, whereas the maxillary molar regions showed the lowest values.

One significant limitation encountered in this study is the lack of information regarding the duration of edentulism in the evaluated regions, despite excluding regions with recent tooth extractions. Additionally, a notable limitation is the inclusion of posterior edentulous areas that were higher in number compared to anterior edentulous areas.

Future studies employing a larger sample size should encompass the analysis of both hard and soft tissue dimensions in both pre and post-implant surgical procedures. This comprehensive approach would provide a more robust understanding of the factors influencing implant success and guide better treatment planning strategies.

Conclusions

Over- or under-embedding of dental implants in bone can result in various complications. The use of CBCT has significantly improved the success and precision of dental implant procedures. While CBCT is primarily utilized for assessing bony structures, our study highlights its value in treatment planning by offering insights into surrounding soft tissues.

Our findings indicate that while soft tissue thickness at the alveolar crest remains relatively consistent across different regions, ages, and genders, there are notable variations. Specifically, soft tissue thickness tends to be lower in the mandibular anterior region, among individuals over 65 years old, and in females. Additionally, the statistically significant differences observed in the width of the alveolar ridge and the thickness of the lingual/palatal cortical bone 5 mm apical to the alveolar crest between genders underscore the importance of considering such factors in implant planning.

Değerlendirme / Peer-Review

İki Dış Hakem / Çift Taraflı Körleme

Etik Beyan / Ethical statement

Bu çalışmanın hazırlanma sürecinde bilimsel ve etik ilkelere uyulduğu ve yararlanılan tüm çalışmaların kaynakçada belirtildiği beyan olunur.

It is declared that during the preparation process of this study, scientific and ethical principles were followed and all the studies benefited are stated in the bibliography.

Benzerlik Taraması / Similarity scan

Yapıldı – ithenticate

Etik Bildirim / Ethical statement

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Çıkar Çatışması / Conflict of Interest

Yazarlar çıkar çatışması bildirmemiştir. | The authors have no conflict of interest to declare.

Yazar Katkıları / Author Contributions

Çalışmanın Tasarlanması | Design of Study: ÖSA (%70), SÖ (%30)
Veri Toplanması | Data Acquisition: SÖ (%40), ŞÇB (%40), SCŞ (%20)
Veri Analizi | Data Analysis: ÖSA (%40), SCŞ (%35), ŞÇB (%25)
Makalenin Yazımı | Writing up: ÖSA (%90), SÖ (%10)
Makale Gönderimi ve Revizyonu | Submission and Revision: ÖSA (%90), SÖ(%10)

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