Original Article

Assessment of the Labial Alveolar Bone Thickness Overlying Maxillary Anterior Teeth in Different Age Groups, Genders, and Sides of the Arch: A Cone Beam Computed Tomographic Study

Naheed Imran[1], Asma Sattar[1], Imran Khattak[1], Sana Arbab[1], Munawar Aziz[1] and Syed Amjad Shah[2]

ABSTRACT

Objective: To evaluate the thickness of labial alveolar bone at the maxillary anterior teeth region in various age groups and to document the effect of gender and the side of the arch using images obtained by cone-beam computed tomography (CBCT).

Study Design: Cross-sectional retrospective study.

Place and Duration of Study: This study was conducted at the Radiology Department of Khyber College of Dentistry Peshawar, Pakistan (KCD), from 4th November 2021 to 3rd May 2022.

Methods: After the Institutional Review Board (IRB) approval, 350 CBCT images fulfilled the inclusion criteria and were included in the study. The thickness of the labial alveolar bone was measured perpendicular to the long axis of the tooth in a sagittal plane at bone crest level and 2mm, 4mm, and 6 mm apical to CEJ for each tooth in the maxillary anterior region. $P \leq 0.05$ was considered as statistically significant.

Results: The study included a mean age of 39.0 ± 12.6 years and an age range from 18-60 years. The sample was composed of 37.1% males and 62.9% females. The results revealed a significant increase in labial bone thickness with age, particularly 4 mm apical to the CEJ. Maxillary central incisors exhibited the highest thickness, while lateral incisors had the thinnest labial bone. No significant gender difference was found, but lateral asymmetry was observed.

Conclusion: This study reveals age-related changes and regional variations in labial alveolar bone thickness overlying the maxillary anterior teeth. The results emphasize the importance of considering these factors in dental treatment planning to optimize outcomes. Lateral asymmetry emphasizes the need for individualized evaluation of each side during clinical procedures. These insights can guide dental practitioners in making informed decisions for improved treatment and esthetic results.

Key Words: Labial Alveolar Bone Thickness, Maxillary Anterior Teeth, Cemento-Enamel Junction (CEJ), Facial Bone Crest, Dental Implants, Cone Beam Computed Tomography (CBCT).

Citation of article: Imran N, Sattar A, Khattak I, Arbab S, Aziz M, Shah SA. Assessment of the Labial Alveolar Bone Thickness Overlying Maxillary Anterior Teeth in Different Age Groups, Genders, and Sides of the Arch: A Cone Beam Computed Tomographic Study. Med Forum 2024;35(1):42-46. doi:10.60110/ medforum.350109.

INTRODUCTION

[1.] Department of Oral Biology / Oral & Maxillofacial Surgery[2], Peshawar Medical & Dental College, Peshawar, KPK.

Correspondence: Dr. Naheed Imran, Oral Biology Department, Peshawar Medical & Dental College, Peshawar, KPK.
Contact No: 03149601906
Email: naheedimran.13293@gmail.com

Received: July, 2023
Accepted: August, 2023
Printed: January, 2024

The important function of the labial bone is to support the stability of the tooth root and periodontium in the anterior maxillary region. However, following tooth extraction, there is a risk of resorption of the labial bone, which can lead to various complications in implant therapy(1). For long-term aesthetic outcomes in the front maxilla, adequate horizontal and vertical bone volume is necessary(2).

A study conducted in 2018 by Al-Tarawneh et al. aimed to determine the thickness of the labial alveolar bone for the maxillary front teeth in the Amman population. They measured the thickness at three different levels (coronal third, middle third, and apical third) for the central incisors, lateral incisors, and canines. The results showed varying thickness levels for the labial bone at each level and for each type of tooth. For

example, at the coronal third, the labial bone thickness was around 0.7mm for the central incisors, 0.73 for the lateral incisors, and 0.74mm for the canines. In the middle third, the labial bone thickness was approximately 0.69mm for the central incisors, 0.61mm for the lateral incisors, and 0.53mm for the canines. At the apical third, the labial bone thickness was roughly 0.6mm for the central incisors, 0.49mm for the lateral incisors, and 0.4mm for the canines[3].

In 2020, Porto OC et al. studied only the upper canines in the Brazilian population and reported a mean labial alveolar bone thickness of 1.49 ± 0.86 mm using CBCT[4]. A study conducted by Xu et al. in 2020 analyzed the labial bone thickness in the Chinese population and found no significant difference between males and females at three different points along the root: 4mm apical to the CEJ, the middle of the root, and the root apex[5].

Another study conducted on the population of Cairo, Egypt by Ahmed and El Beshlawy (2019) found a noticeable variation in the height and width of the alveolar ridge between male and female participants with males having greater measurements compared to females. However, no significant difference was found between various age groups[6].

To the best of our knowledge, there has been no prior research conducted on the thickness of the labial alveolar bone in the maxillary anterior teeth in the population of KPK, Pakistan. The study aims to provide dental practitioners with a better understanding of the significance of labial bone thickness in implant cases, to decrease the likelihood of complications such as perforation, fenestration, and dehiscence following implant placement, which may occur as a result of thin labial alveolar bone.

METHODS

The study proposal underwent review and was accepted by the Institutional Ethical Committee at Riphah International University. The Head of the OPD and Radiology Department at Khyber College of Dentistry (KCD) granted permission for data collection, and the hospital administration approved and facilitated the study. The CBCT images used in the study were referred by other dentists for various investigations, such as dental implant therapy, impacted tooth extraction, or orthodontic therapy. The data collection and examination were performed by one examiner, and the interpretation was done by an oral and maxillofacial surgeon.

The inclusion criteria included the CBCT images of both genders with the presence of maxillary anterior teeth bilaterally and age ranging from 18-60 years. On the other hand, teeth that had undergone prosthetic crowns or restorations, bridge abutments or implants in the anterior maxilla, endodontically treated or decayed teeth or teeth with root resorption and presence of any skeletal discrepancies or congenital dental problems e.g. cleft lip or palate were excluded from the study.

CBCT images were imported to the computer using Planmeca Romexis software (used in KCD). All images used in the present research were obtained using the following range of scanning parameters. Voxel dimension = 4mm, Voltage = 120 kV, Acquisition time = 9 seconds, Current = 5 - 8 mA, DAP (Dose area product) = 761 - 1218mGy*cm^2, CTDI (Computed tomography dose index) = 4.0 - 6.4mGy.

The labial bone plate thickness was assessed by measuring it in a sagittal plane in the facio- palatal direction perpendicular to the tooth root's long axis. The measurements of the labial wall thickness were noted for each tooth at different levels, including the bone crest level, 2mm, 4mm, and 6mm apical to CEJ in the facio-palatal direction.

This was a retrospective study that followed the ethical standards set by the responsible committee of the institution and was conducted following the principles of the Helsinki Declaration of 1964, as revised in 2013. The confidentiality and anonymity of participants included in the study were ensured. Standardized research protocols were followed.

The statistical analysis was performed using SPSS version 25. Descriptive statistics, including mean values, standard deviations (SD), percentages, and charts, were used to analyze the data. An independent t-test was applied to determine any statistically significant differences between the same tooth and measurement point on the right and left sides. Another independent t-test was also applied to assess any differences in measurements between males and females. A one-way ANOVA test was used to examine any significant differences in various variables among different age groups. A P-value of ≤ 0.05 was considered statistically significant for all tests.

RESULTS

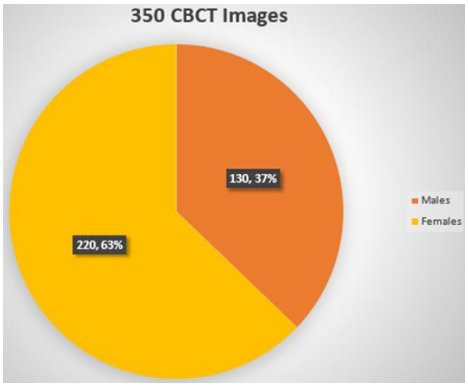
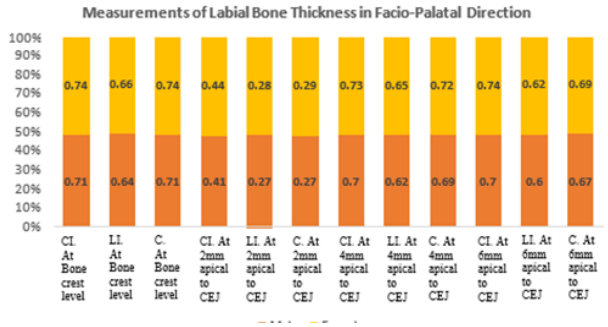


Figure No. 1: Frequency distribution of males and females.

In this study, a sample of 1000 cone-beam computed tomography (CBCT) images were collected from Khyber College of Dentistry.

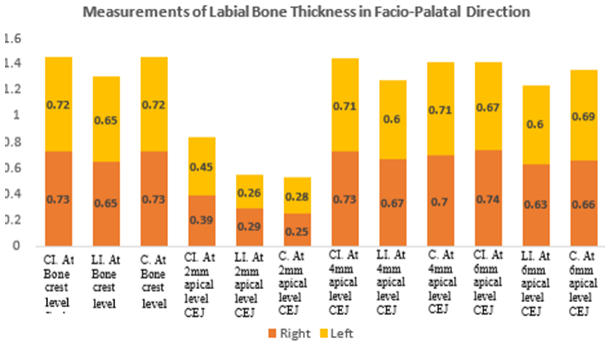
Table No. 1. Comparison between the labial bone thicknesses of maxillary anterior teeth at all the examined parameters.

Tooth	Levels	Right	Left	Overall Mean ± SD	P-value
Maxillary Central Incisor	At Bone crest in F-P direction	0.73±0.18	0.72±0.18	0.73±0.18	0.986
	At 2mm apical to CEJ	0.39±0.42	0.45±0.42	0.42±0.42	0.002
	At 4mm apical to CEJ	0.73±0.23	0.71±0.23	0.72±0.23	0.438
	At 6mm apical to CEJ	0.74±0.16	0.67±0.16	0.71±0.16	0.068
Maxillary Lateral Incisor	At Bone crest in F-P direction	0.65±0.17	0.65±0.18	0.65±0.18	0.94
	At 2mm apical to CEJ	0.29±0.36	0.26±0.36	0.28±0.36	0.628
	At 4mm apical to CEJ	0.67±0.20	0.60±0.28	0.64±0.24	0.00
	At 6mm apical to CEJ	0.63±0.16	0.60±0.24	0.62±0.21	0.00
Maxillary Canine	At Bone crest in F-P direction	0.73±0.15	0.72±0.17	0.73±0.16	0.000
	At 2mm apical to CEJ	0.25±0.38	0.28±0.39	0.27±0.39	0.73
	At 4mm apical to CEJ	0.70±0.22	0.71±0.22	0.71±0.22	0.795
	At 6mm apical to CEJ	0.66±0.26	0.69±0.15	0.68±0.21	0.000



CI: Central Incisor; LI: Lateral Incisor; C: Canine.

Figures No. 2: Show a comparison between Genders at Bone crest level; at 2mm, 4mm, and 6mm apical to Cementoenamel junction.



CI: Central Incisor; LI: Lateral Incisor; C: Canine.

Figure No. 3: Frequency distribution according to labial bone thickness at bone crest level and 2mm, 4mm, and 6mm apical to CEJ in Facio-Palatal Direction.

Following the application of the inclusion criteria, a total of 350 cone beam computed tomography (CBCT) images were selected for analysis. The study population consisted of 130 (37.1%) male and 220 (62.9%) female participants between the ages of 18 to 60 years, with a mean age of 39.0 ± 12.6 years. The study evaluated 2100 anterior teeth in the maxillary region, including 700 central incisors, 700 lateral incisors, and 700 canines.

It is worth noting that the labial bone thickness was greater at 4mm apical to CEJ than at 6mm for all examined locations. Moreover, the maxillary central incisors showed the highest values among the examined regions, while the lateral incisor regions showed the thinnest labial bone as illustrated in Table 1.

In terms of the comparison between gender and labial bone thickness, there was no statistically significant difference found between males and females (P value > 0.05), as illustrated in Figure 2.

Significant differences were observed between the right and left sides for all examined locations (P value <0.05) (Figure 3).

In terms of the correlation between age groups and the examined parameters, a highly statistically significant difference found (P value = 0.000), as shown in Figure 4. This indicates that there are significant variations in the labial bone thickness in maxillary anterior teeth among different age groups.

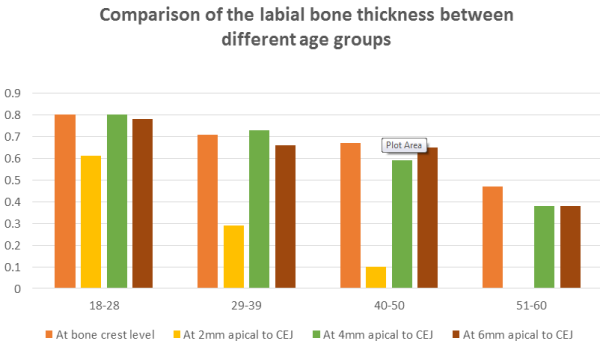


Figure No. 4: Frequency distribution between age groups at various parameters.

DISCUSSION

This study aimed to measure the thickness of the labial alveolar bone in the six maxillary anterior teeth of the

population in Peshawar, Pakistan. Cone beam computed tomography (CBCT) is commonly used to assess the bone volume and morphology before tooth extraction, to ensure adequate knowledge for future implant placement[7]. CBCT has a good reputation for image clarity and linear measurement accuracy at a lower radiation dosage compared to standard CT[8]. According to the current study analyses the mean labial alveolar bone thickness measured at 2mm, 4mm, and 6mm showed greater values at 4mm followed by 6mm apical to CEJ. The maxillary central incisors showed the uppermost values among the regions examined, followed by canine, but at all the examined parameters the thinnest labial bone was found at the lateral incisor region. These results are consistent with those seen in the majority of investigations where in maxillary anterior region the thickness of labial alveolar bone values below 1 mm were noted. According to the study by AlAli et al., 2022, more than 80% of the sites had an LBT of less than 1 mm. Similar results were found in earlier studies by dos Santos et al., 2019; Gakonyo et al., 2018, with 76% to 89% of sites having LBT of not more than 1 mm at the central incisor in maxillary region[2,9,10]. These results are reliable with the results of the current study, which found that all of the evaluated central incisors had an LBT of less than 1 mm. According to the research by H. Sheerah et al. 2019, one-third of entirely canines and nearly half of entirely incisors have bone wall thin, of less than 1mm[11]. These findings support our understanding of front maxillary sites with labial alveolar bone thicknesses of less than 1mm.

Additionally in-depth investigation of our findings demonstrated a tendency towards the existence of an increased thickness of labial alveolar bone at 4mm apical to CEJ when compared to 2mm and 6mm labial bone thickness. The data published by H. Sheerah et al. 2019 reported that the apical 3rd of the labial alveolar bone give the idea to have the most favorable thickness, which is opposite to the current study and the study done by AlAli et al., 2022; El Nahass & N. Naiem, 2015; Ghassemian et al., 2012.

In our analysis, gender did not appear to have an impact on labial alveolar bone thickness. This appears to be consistent with the outcomes of other published studies[9,12]. There have also been conflicting reports about the effect of gender on labial alveolar bone thickness, with some research reporting an increased thickness in men[11,13]. The variance of the sample and the population of interest differ, which might lead to contradictory results[11].

Additionally, unlike previous research by AlTarawneh et al., 2018; Sheerah et al., 2019, discovered significant changes in the labial alveolar bone thickness between the right and the left sides in the current study. Our research suggests that aging affects labial bone thickness, which is consistent with prior studies that found that aging was related to lower labial alveolar bone thickness values[2,10,13]. However, other research found no association between the age and the labial bone thickness[9,11].

CONCLUSION

In light of the results and limitations of this study, the following conclusions can be drawn: The thickness of the labial alveolar bone in the maxillary anterior teeth demonstrated a significant increase with age (P-value = 0.000). The greatest thickness was observed 4 mm apical to the CEJ, with the maxillary central incisors showing the highest values among the examined regions. However, the lateral incisor regions had the thinnest labial bone at the bone crest level and at 2mm, 4mm, and 6mm apical to the CEJ. The results of this study suggested that there were no statistically significant differences in labial alveolar bone thickness between males and females (P-value <0.05). Nevertheless, a highly statistically significant difference was found between the right and left sides of maxillary anterior teeth (P-value <0.05).

Author's Contribution:

Concept & Design of Study:	Naheed Imran
Drafting:	Asma Sattar, Imran Khattak
Data Analysis:	Sana Arbab, Munawar Aziz, Syed Amjad Shah
Revisiting Critically:	Naheed Imran, Asma Sattar
Final Approval of version:	Naheed Imran

Conflict of Interest: The study has no conflict of interest to declare by any author.

Source of Funding: None

Ethical Approval: PRIME/IRB/2021-357 dated 10.09.2021

REFERENCES

1. Rojo-Sanchis J, Soto-Peñaloza D, Peñarrocha-Oltra D, Peñarrocha-Diago M, Viña-Almunia J. Facial alveolar bone thickness and modifying factors of anterior maxillary teeth: a systematic review and meta-analysis of cone-beam computed tomography studies. BMC Oral Health 2021;21(1):143.
2. Gakonyo J, Mohamedali A, Kabubei E. Cone Beam Computed Tomography Assessment of the Buccal Bone Thickness in Anterior Maxillary Teeth: Relevance to Immediate Implant Placement. Int J Oral Maxillofacial Implants 2018;33:880–7.
3. AlTarawneh S, AlHadidi A, Hamdan AA, Shaqman M, Habib E. Assessment of Bone Dimensions in the Anterior Maxilla: A Cone Beam Computed Tomography Study: Assessment of

Maxillary Bone Dimensions. J Prosthodontics 2018;27(4):321–8.

4. Porto OCL, Silva BS de F, Silva JA, Estrela CR de A, Alencar AHG de, Bueno M dos R, et al. CBCT assessment of bone thickness in maxillary and mandibular teeth: an anatomic study. J Appl Oral Sci 2020 Feb 7 [cited 2023 Jan 18];28. Available from: http://www.scielo.br/j/jaos/a/T763GbCy67X9Tfw5X8bVbJs/?format=html&lang=en
5. Xu D, Xie C, Yu H, Zhang Z, Zheng J, Xu S. Evaluation of factors affecting alveolar ridge height and facial bone thickness in Chinese maxillary central incisors by cone beam CT. J Dent Sciences 2021;16(1):229–35.
6. Ahmed DF, El Beshlawy DM. Assessment of anterior maxillary alveolar bone dimensions and morphology for immediate implant planning: A retrospective study using Planmeca Promax CBCT unit. Egypt Dent J 2019;65(Issue 2-April (Oral Medicine, X-Ray, Oral Biology&Oral Pathology):1267–78.
7. Di Stefano DA, Arosio P, Capparè P, Barbon S, Gherlone EF. Stability of Dental Implants and Thickness of Cortical Bone: Clinical Research and Future Perspectives. A Systematic Review. Materials 2021;14(23):7183.
8. Chandak DM. Comparative Evaluation Of Accuracy Of Dental Operating Microscope With Conventional Vernier Caliper In Conservation Of Tooth Structure For Root Canal Treatment. Clin Med 2020;7(07):7.
9. AlAli F, Atieh MA, Hannawi H, Jamal M, Harbi NA, Alsabeeha NHM, et al. Anterior Maxillary Labial Bone Thickness on Cone Beam Computed Tomography. Int Dent J2022 May 6 [cited 2023 Jan 3]; Available from: https://www.sciencedirect.com/science/article/pii/S0020653922000703
10. dos Santos JG, Oliveira Reis Durão AP, de Campos Felino AC, de Faria de Almeida RMCL. Analysis of the Buccal Bone Plate, Root Inclination and Alveolar Bone Dimensions in the Jawbone. A Descriptive Study Using Cone-Beam Computed Tomography. JOMR 2019 Jun 30 [cited 2023 Jan 3];10(2). Available from: http://www.ejomr.org/JOMR/archives/2019/2/e4/v10n2e4ht.htm
11. Sheerah H, Othman B, Jaafar A, Alsharif A. Alveolar bone plate measurements of maxillary anterior teeth: A retrospective Cone Beam Computed Tomography study, AlMadianh, Saudi Arabia. The Saudi Dental J 2019;31(4):437–44.
12. Lim HC, Kang DU, Baek H, Hong JY, Shin SY, Chung JH, et al. Cone-beam computed tomographic analysis of the alveolar ridge profile and virtual implant placement for the anterior maxilla. J Periodontal Implant Sci 2019;49(5):299–309.
13. A T, J T, B de BB, A G, Ab B, J C, et al. Buccal bone thickness of maxillary anterior teeth: A systematic review and meta-analysis. J Clin Periodontol 2020 Nov [cited 2023 Jan 3];47(11). Available from: https://pubmed.ncbi.nlm.nih.gov/32691437.