ORIGINAL ARTICLE

CBCT Analysis of Cortical and Corticocancellous Bone of Mandible at apical area of teeth

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ABSTRACT

Background: Thickness of bone is an important factor in many surgical procedures like miniplate screw fixation in fracture of jaw, dental implant placement and endodontic surgeries. CBCT imaging is more reliable and precise in assessment of buccal alveolar bone dimensions at apical areas of mandible for precise placement of these hardware and performing periapical surgeries.
Aim: To evaluate the cortical bone thickness in adult mandibular bone at the level of apices of various teeth and the total thickness of corticocancellous bone at the same level in Pakistani patients, to facilitate clinicians in planning the procedures preoperatively.
Methods: Seventy CBCT scans were selected for study, which were available in the department of Oral and Maxillofacial surgery from period of Jan 2018 to Jan 2020. All scans were done with the same protocol using Planmeca Romexis 3D max version 5.2R in 12-bit grayscale and a voxel size of 0.3 mm. A digital scale was used to measure mandibular buccal cortical bone thickness and buccal bone thickness at the level of root apices.
Results: Thickness of the cortical bone increases from anterior to posterior aspect of mandible gradually. Buccal bone thickness also increases from central incisor region to second molar area except at the level of second premolar.
Conclusion: Buccal alveolar bone thickness at the level of teeth root apices can vary among populations. Thickest buccal bone is present in the area of the second molar, where longer implants and screws can be used.
Keywords: CBCT, mandible, cortical thickness, cortico cancellous thickness, apices of teeth

INTRODUCTION

Thickness of bone is a matter of concern in many surgical procedures like miniplate screw fixation in fracture of jaw, dental implant placement and endodontic surgeries[1,2]. Open reduction internal fixation (ORIF) with miniplate is a standard procedure for majority of maxillofacial trauma. Length of miniscrews is determined based on thickness of buccal bone at various locations of jaws. Among maxillofacial traumatic injuries mandible is frequently fractured bone alone or in combination with other facial bones due to its prominant position. Most accepted technique for ORIF is based on Champy's principle[1]. Professor Maxine Champy proposed ideal lines of osteosynthesis based on compression, tension and rotational forces in various areas of mandible. He suggested application of monocortical miniplate along these ideal lines of osteosynthesis[3]. Frequently these lines overlays the root apices of mandibular teeth. Thus fixation based on this principle can damage the root apices. Ellis et al reported 1.5% root injury during fixation of mandibular fractures. Roots of mandibular teeth are more liable to injury than roots of maxillary teeth because identification of root contours is relatively difficult due to presence of thick buccal bone[4].

Knowledge of buccal bone thickness at various locations of mandible plays an important role in different dental procedures such as dental implant, endodontic surgery, tooth extraction and orthodontic teeth movement[5].

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Complications uring periapical surgery can be minimized by knowing buccal bone thickness at the level of tooth apex. Thickness of the buccal bone also affects tooth movement, degree of root resorption and time of treatment. Moreover, length of mini-implants for anchorage in orthodontics also determined by thickness of the buccal bone[6,7]. Buccal bone thickness is the basic determinant of primary stabilization of implants and implant selection[2]. Bone grafts are frequently used for various reconstructive procedures. Autogenous bone augmentation is still a gold standard. Buccal bone thickness of mandible varies at various locations hence plays a decisive role in graft harvesting from jaw[8].

The purpose of this study is to determine the mandibular buccal bone thickness at the level of root apices of teeth in Pakistani patients. It will help determining the maximum length of monocortical screws that can be safely placed for the treatment of mandibular fractures without injuring the roots of teeth and availability of quantity of corticocancellous bone graft. To our knowledge, few studies are available.

MATERIALS AND METHODS

This was a retrospective study conducted after getting ethical board approval from College of Dentistry, The University of Lahore. The sample size of 70 cases was estimated using 95% confidence level, d = 0.2 with an expected mean mandibular thickness as 5.85±0.78.

Seventy CBCT scans were selected for study, which were performed in the department of Oral and Maxillofacial surgery from period of Jan 2018 to Jan 2020. All scans

were done with the same protocol using Planmeca Romexis 3D max version 5.2R in 12-bit grayscale and a voxel size of 0.3 mm.

The inclusion criteria for data collection were 1) CBCT of ethnic Pakistani individuals. 2) CBCT of patients having full dentition with no evidence of jaw bone pathology. 3) CBCT of patients having no previous orthodontic treatment. 4) CBCT scan with no excessive scatter due to existing restorations and implants.

Age and gender were recorded for each patient. A digital calibrated ruler was used to measure mandibular cortical buccal thickness and buccal bone thickness. These two distances were measured at the level of root apices of individual mandibular tooth. Cortical plate thickness is a distance between outer buccal cortex to inner buccal cortex. Buccal bone thickness is a distance between outer buccal cortex to tooth root apex.

For statistical analysis SPSS version 25 was used. Mean was calculated for the age of patients. Gender was determined in form of frequency. Thickness of cortical plate and buccal bone were shown in terms of mean and standard deviation. To assess difference with respect to gender and buccal bone measurement at different sites, Independent t-test was used. P-value ≤ 0.05 was considered statistically significant.

RESULTS

In our study mean age of the patients was 32.4±14.4 years. Minimum age was 16 years while maximum age was 73. Out of 70 patients 36(51.4%) were males and 34(48.6%) were females. Measured thicknesses of cortical bone at the level of tooth apices are given in table 1. Thickness of the cortical bone increase from anterior to posterior aspect of mandible gradually. Minimum cortical bone thickness is present adjacent to central incisor whereas maximum cortical bone thickness is present adjacent to second molar. Moreover, thickness of the buccal bone from outer cortex up to tooth apices are presented in table 2. Buccal bone thickness also increases from central incisor region to second molar area except at the level of second premolar. Buccal bone thickness adjacent to second premolar is relatively less than that of first premolar.

The results of independent sample t test revealed non-significant difference between gender and cortical plate thickness at different sites of mandible with p value >0.05 (Table 1). Similarly difference of buccal bone thicknesses at the level of tooth apices in males and females are also statistically non-significant with p value > 0.05 (Table 2).

Table 1: Thickness of buccal cortical plate at the level of tooth apices

Sites	Average thickness	Gender	Mean	St. Deviation	P value
Central Incisor	1.4 ±0.44	Male	1.50	±0.46	0.05
		Female	1.29	±0.41	
Lateral incisor	1.55±0.53	Male	1.60	±0.55	0.42
		Female	1.50	±0.51	
Canine	1.78±0.53	Male	1.88	±0.59	0.14
		Female	1.69	±0.44	
First premolar	1.8±0.57	Male	1.85	±0.64	0.63
		Female	1.78	±0.44	
second premolar	1.88±0.59	Male	1.96	±0.58	0.31
		Female	1.82	±0.56	
First molar	2.36±0.66	Male	2.34	±0.64	0.82
		Female	2.38	±0.69	
second molar	3.33±0.89	Male	3.27	±0.83	0.68
		Female	3.36	±0.96	

Table 2: Thickness of buccal bone at the level of tooth apices

Site	Average thickness	Gender	Mean	St. Deviation	P value
Central Incisor	3.48±1.00	Male	3.59	±0.97	0.44
		Female	3.40	±1.03	
Lateral incisor	3.58±1.16	Male	3.59	±1.10	0.85
		Female	3.64	±1.21	
Canine	4.08±1.35	Male	4.20	±1.49	0.56
		Female	4.01	±1.15	
First premolar	4.11±1.31	Male	4.11	±1.25	0.75
		Female	4.21	1.30	
second premolar	4.08±1.34	Male	4.12	±1.13	0.99
		Female	4.12	±1.52	
First molar	5.03±1.23	Male	5.09	±1.25	0.71
		Female	4.98	±1.24	
second molar	8.00±2.23	Male	8.08	±2.26	0.65
		Female	7.84	±2.21	

DISSCUSSION

CBCT has recently gained popularity in the field of dentistry. Now a days many Maxillofacial surgeons prefer CBCT because it gives multiplanar and three dimensional information hence overcoming the limitations of two dimensional imaging. It is readily available, requires significantly lower radiation exposure and cost much less than traditional CBCT[9,10]. Literature revealed that CBCT imaging is more reliable and precise in assessment of

buccal alveolar bone dimensions. Timock, et al (2011) also supported it by comparing cadaveric measurements of alveolar bone dimensions with of CBCT measurements[11]. Limited data is available[12] regarding thickness of mandibular buccal cortical bone and distance of outer cortical bone from root apices. Based on the buccal bone thickness, screw length of 4-7 mm is suggested in literature to achieve adequate fixation[7,12,13].

Katranji et al conducted a survey on 28 cadavers to measure jaw bone thickness at different levels. He conducted this study to help determine the implant width. He divided mandible in three regions anterior, premolar and molar. According to this study average width of the buccal cortical plate in anterior dentate mandible was 0.99±0.53mm, in premolars 1.20±0.41mm and in molars 1.98±0.81mm. While in our study average buccal cortical plate thickness was relatively more in all mandibular regions; 1.40±0.43mm in the region of central incisors, 1.80±0.57 mm in first premolar, 2.36±0.66mm first molar regions. This difference can be due to some difference in measuring sites[14].

Results of buccal cortical plate thickness at the level of mandibular teeth apices are comparable to the study results, conducted by Talaat et al (2014) in Sharja UAE. According to this study cortical plate thickness at the level of apex of canine was 1.91±0.6mm, first premolar 2.51±0.49 mm, Second premolar 1.74±0.5 mm, First molar 2.47±0.45 mm and Second molar 3.27±0.52 mm[8].

Moreover, our results for buccal cortical thickness are also in line with the results of a study conducted by Al-Jandan et al (2013) in University of Dammam. Buccal cortical width at apex of Canine was 1.78±0.51mm, First premolar 2.01±0.49mm, Second premolar 1.91±0.42mm, First molar 2.5±0.51mm, Second molar 3.18±0.76 mm[1]. Whereas, we found thickness of buccal bone from outer cortex to each mandibular tooth apex is almost 1-1.5 mm more than the thickness documented by both Talaat et al (2014) and Al-Jandan et al (2013) in their studies[1,8].

In Southeastern Antolian, Belgin et al (2017) also evaluated buccal cortical bone thickness in mandibular molar and premolar regions at the level of root apices. Thickness of buccal bone in our study group is approximately 1mm more at premoloar region while in molar region the average thickness is almost same as in Anatolian people[2].

Our study results show average thickness of buccal bone at the level of second premolar 4.11±1.31mm, is less than that present at the level of second premolar 4.08±1.34mm. These results are similar to the study where buccal bone thickness was 3.7±0.89mm at the apex of the first premolar, while 3.14±0.81mm at the apex of the second premolar[1]. Similar results are found in second study where buccal bone thickness was 3.56±0.72 mm at the apex of the first premolar, while 3.34±0.82mm at the apex of the second premolar[8]. But our results for the cortical plate thicknesses are in contrast to both of these studies, where cortical plate thickness is more at the apex of first premolar than second premolar[1,8].

Gender wise distribution of both cortical plate thickness and buccal bone thickness show mostly average values are smaller in females but are not statistically significant. Similar results are stated by Belgin et al[2].

CONCLUSION

Buccal alveolar bone thickness at the level of teeth root apices can vary among populations. Thickest buccal bone is present in the area of second molar. Hence longer screws can be used in this area. Similarly thicker buccal bone makes it a better choice as bone graft donor site. More local studies, with larger sample size should encouraged to support results.

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