### **ORIGINAL RESEARCH**

# A study to measure and evaluate the thickness of anterior facial bone of maxilla using cone beam computed tomography- A guideline for implant placement

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#### ABSTRACT

**Introduction:** The purpose of this study is to measure and evaluate the thickness of Facial and palatal alveolar bone and bony curvature of maxillary anterior teeth to provide valuable guidelines for choosing proper implant fixture with regards to diameter, length and axis of surgical drilling procedure and anatomical dimensions of the buccal bone wall of the aesthetic maxillary anterior region for immediate implant placement, based on CBCT images. **Material and methods**: The study consist of total number of 100 Petients which are devided into Two main groups Group =A (Male) And Group=B (Female) aged between 20 to 40 years of agehaving all the maxillary anterior teeth without any periodontal diseases and systemically healthy, dentulous patients are selected for the study. **Results**: Comparison of the mean values of facial bone, palatal bone and alveolar bone width of left and right maxillary central incisor, lateral incisor and canine are measured and evaluated we found that canine has more bone thickness as compared to central incisors and lateral incisors and there is no statistical deference between males and female and left and right side of maxilla. **Conclusion**: The results of this study may provide insight on the usefulness of CBCT in providing a base line data for selecting the appropriate site for implant placement in terms of facial bone and palatal bone thickness, alveolar bone width. CBCT enables accurate measurement of bone quality and quantity along with measuring the distance from anatomic structures, due to its three-dimensional nature. CBCT proves to be a valuable diagnostic aid in pre implant radiological assessment.

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#### INTRODUCTION

Dental implant offers the most long term solution for missing teeth replacement, replicating the root and crown of the natural tooth. This procedure reserves both the gingival mucosa and the remaining alveolar bone without damage to adjacent teeth.<sup>1</sup>

According to the conventional protocol of dental implant, a period of 3-4 months is required for socket healing, followed by implants insertion, then additional 3-4 months are needed for implant integration with surrounding bone. Moreover, one additional step is required to load the prosthetic abutment<sup>2</sup>.

The advantages of the immediate implant placement include, less surgical intervention procedures, so reduction in therapy time, preservation of the bone and gingival tissues, and psychological confidence for the patient. In spite of the advantage of the immediate implant placement, it is still a challenging treatment option for the clinician and presents a higher incidence of complications.

In the first 3 months after dental extraction, this resorption is more noticeable. However, bone remodeling may last for 12 months but less intense, resulting in dimensional change<sup>3</sup>.

In some opinions, the buccal alveolarbone thickness should be at least 2 mm to prevent labial gingival recession and to achieve an optimal biologic and esthetic outcome.<sup>4</sup>

Hence in most situations, bone augmentation procedure has been recommended with immediate implant placement in the aesthetic zone.<sup>5</sup>

Recently, several studies have been published discussing if there is enough thickness in the labial alveolar bone for immediate implant placement in an anterior maxillary region.

Nevertheless, the existing studies only include anterior teeth. There is not enough research regarding the premolars although they play a role in the aesthetic region.

Therefore, this study is designed to investigate the thickness of the buccal alveolar bone of maxillary anterior teeth in a sample of using Cone beam computed tomography (CBCT) at different levels.

The maxillary anterior segment plays an important role in having a better smile and thus enhancing the patient's self-confidence. In order to obtain a favourable outcome in cosmetic dentistry such as orthodontic and implant treatments, special attention must be paid to the morphological features of periodontal tissue such as buccal bone and covering soft tissue thickness<sup>1</sup>. A thick biotype provides a higher aesthetic of the implant and better covers the prosthetic components of the implant and also plays an important role in the outcome of periodontal treatments such as root covering procedures. In the treatment of implants with fresh socket technique, the width of the facial alveolar bone is an important factor for long-term success<sup>(7)</sup>. Initial thickness of the maxillary bone plays an important role in determining the final level of hard and soft tissues following a tooth extraction, as well as selecting the appropriate technique (immediate/early/delayed) for implantation, and reducing subsequent complications<sup>(8)</sup>.

Because bone resorption occurs in the direction of tooth movement, the reduced volume of the alveolar bone is sometimes associated with minimal thickness. Biological and biomechanical factors determine potential side effects of orthodontic treatment such as external root resorption, dehiscence, fenestration, and gingival recession <sup>(9)</sup>

To avoid the occurrence of dehiscence and fenestration, knowing the alveolar morphology before orthodontic treatment is of particular importance. Therefore, the evaluation of periodontal biotype is also important in orthodontic treatments. Buccal surface bone thickness and covering gum are also pivotal in fixed orthodontic treatments, especially nonextraction treatments leading to upper incisor protrusion<sup>(10)</sup>. Moreover, miniscrew placement in the maxillary anterior segment for the correction of problems such as excessive overbite requires knowledge of the thickness of soft tissue and bone in this segment. there are also various methods for measuring soft tissue thickness such as injection needle, transgingival probing, histology sections, cephalometric probes, radiography, transplantation ultrasonic instruments, and cone-beam computed tomography (CBCT)<sup>(11)</sup>. The CBCT is a convenient technique for dental and soft tissue anatomy and has the advantages of high diagnostic value and accurate measurement of periodontal width<sup>(12)</sup>.

The aim of this study is to measure and evaluate the thickness of buccal and palatal alveolar bone and buccal bony curvature of maxillary anterior teeth to provide valuable guidelines for choosing proper implant fixture with regards to diameter, length and axis of surgical drilling procedure and anatomical dimensions of the buccal bone wall of the aesthetic maxillary anterior region for immediate implant placement, based on CBCT images.

#### METHODOLOGY

A total number 100 patients aged between 20 to 40 years of age areselected and they are further divided into two groups as follows.

## Group A = (n = 50) Male patients age between 20 to 40 years.

### Group B = (n = 50) Female patients age between 20 to 40 years.

#### **INCLUSION CRITERIA**

- Patients free from any systemic illness.
- Patients should be 20 to 40 years of age.
- No history or presence of periodontal disease/bon loss in the maxillary anterior teeth.

#### **EXCLUSION CRITERIA**

- Maxillary anterior teeth which are impacted, overlapped, extracted, lacked clear bony boundaries were excluded from the study.
- Patients with dental implants, endodontic or prosthetic restorations at anterior maxillary teeth are excluded.
- Patients having history of trauma or receiving osseous/regeneration procedures in the maxillary anterior region are excluded from the study.

#### **STUDY POPULATION**

One hundred patients (50 males and 50 females), aged between 20 and 40 years (mean age of 35.9 years), is included in this study. Written informed consents is obtained from all the patients. The patients presented with all pristine anterior maxillary teeth (13, 12, 11, 21, 22, 23) isselected. A total of 100 CBCT images are taken and around 600 teeth are analysed (6 teeth per subject). The subjects met the following inclusion criteria: no history or presence of periodontal disease/bone loss in the upper anterior dentition, no improper tooth alignment, and no marked buccal gingival recession. On the other hand, scans with periapical or lateral inflammatory lesions or those showing mal-alignment or with large restorations or root canal treatment related to the studied teeth were excluded.

### RADIOGRAPHIC IMAGE ANALYSIS OF CBCTS

All high resolution CBCT images were obtained by NewTomGiano unit (NNT VEIWER) with a  $8 \times 5$  cm field of view (FOV) and exposure parameters of kVp = 90, mAs = 14.64, exposure time = 3.6 s. The image acquisition protocol consisted of 360° rotation with an X-ray tube and a flat panel amorphous silicon detector. The CBCT volumes obtained were displayed with a 0.250-mm thickness.The images are obtained in DICOM format and were transferred to HP Windows 11, i5-1035G1 CPU @ 1.00GHz 1.20 GHz,21H2 Version at 1366×768 and the measurement are done.

## MEASUREMENT AND EVALUATION OF THE CBCTS

Measurements were performed on corrected sagittal cuts that show the entire tooth from the incisal edge till the root apex as well as the nasal floor.All CBCT scans were obtained with 1 mm slice thickness and the tomographic scanner (mm field of view, kV, mAs, pitch of mm). A software program (CS 3D Imaging software) was used to reconstruct the images and perform the measurements.

For each of the three right and left maxillary anterior teeth (central incisor, lateral incisor, and canine), the following measurements are obtained according to the recommendations .

For each tooth The alveolar heightfrom midpoint of cementoenamel junction (CEJ) of the respective tooth to the most inferior point of nasal fossa along the long axis of the tooth in sagittal section, facial, palatal, and alveolar bone widthat 3 mm above CEJ( POINT A) were measured for selected teeth, Same was repeated at 6 mm( POINT B) and at 9 mm( POINT C). To increase the success rate of implant it is empirical to measure the cortical bone thickness at different levels, hence, these measurements were chosen.

Labial cortical bone thickness was measured from the labial/Facial limit of radicular contour up to the outermost section of cortical bone, perpendicular to the contour of the dental arch at three different reference points . Palatal cortical bone thickness was measured from palatal limit of the radicular contour up to the outermost section of cortical bone, perpendicular to the contour of the dental arch.

Alveolar bone width is measured from outermost section of cortical bone labially to outermost section of cortical bone palatally perpendicular to the contour of the dental arch.

Ateach tooth, the facial plate thickness of the alveolar bone was measured from a sagittal CBCT image view of the tooth root. The sagittal section was made at the middle of each tooth by applying the cursor in the midline that bisecting the tooth into equal halves. Reference points were used to measure alveolar bone thicknesses at three locations using a digital calliper: point A from the facial plate at the level of bone crest to the coronal root third, point B to the mid root surface, and point C to the apical third. All measurements were taken in millimetres (mm). To set fixed reference points for each tooth in the sagittal

view, the cursor was placed at the tooth's midline and in the sagittal view, the tooth root was divided equally into cervical, middle, and apical thirds. Reference points were set at the mid-point of each third, while the cementoenamel junction (CEJ) was set as a fixed reference point for measuring crest height. Crestheight (point D) was measured as the distance from the CEJ to the alveolar bone crest. This was performed using the same sagittal view as that used for measuring thicknesses and the same digital calliper as mentioned above. All measurements were in millimetres (mm). The built-in digital calliper was also used for direct bone measurements on CBCT images. All images were viewed on the same monitor and under the same lighting conditions.

Our aim was to predict alveolar, bone, buccal plate thickness before immediate implantation and to compare that value with the alveolar, bone, ridge thickness revealed by CBCT.

#### RESULTS

In the present study observed that, there is statistically very highly significant difference of bone thickness of canine at 3mm between Alveolar, Facial and Palatal bone (P<0.001). The Alveolar bone thickness of canine at 3mm is more as compare to facial and palatal bone. There is no statistical significant difference of bone thickness at 3mm of canine at Facial and Palatal bone between left and right in males and females (P>0.05).

In the present study observed that, there is statistically very highly significant difference of bone thickness of canine at 6mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness of canine at 6mm is more as compare to facial and palatal bone .There is no statistical significant difference of bone thickness of canine at 6mm of Facial and Palatal bone between left and right in males and females (P>0.05). In the present study observed that, there is statistically very highly significant difference of bone thickness of canine at 9mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness of canine at 9mm is more as compare to facial and palatal bone. There is no statistical significant difference of bone thickness of canine at 9mm of Facial and Palatal bone between left and right in males and females (P>0.05).Present study observed that, there is statistically very highly significant difference of bone thickness of central incisor at 3mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness central incisor at 3mm is more as compare to facial and palatal bone .There is no statistical significant difference of bone thickness at 3mm of central incisor of Facial and Palatal bone between in left and right side of maxilla in males and females (P>0.05).

	Boi	ne thickness of ce	mm	t-Test, P-value & Significance	
Variables	Group A	(Males)	Group A	(Females)	
	Left	Right	Left	Right	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
					Males- Lt v/s Rt. P= 0.991, NS
Alveolar Bone	$7.31 \pm 1.56$	$7.19 \pm 1.60$	$7.36 \pm 1.64$	$7.2 \pm 1.55$	Female- Lt v/s Rt. P= 0.981, NS
					Right -M v/s F P= 0.978, NS
					Left - M v/s F P=0.910, NS
					Males- Lt v/s Rt. P= 0.773, NS
Facial Bone	$1.17 \pm 033$	$1.09 \pm 0.35$	$1.06 \pm 0.30$	$1.07 \pm 0.32$	Female- Lt v/s Rt. P= 0.824, NS
					Right -M v/s F P= 0.925, NS
					Left - M v/s F P=0.963, NS
					Males- Lt v/s Rt. P= 0.829, NS
Palatal bone	$1.53 \pm 1.31$	$1.39 \pm 1.14$	$1.37 \pm 1.29$	$1.45 \pm 1.34$	Female- Lt v/s Rt. P= 0.875, NS
					Right -M v/s F P= 0.774, NS
					Left - M v/s F P=0.920, NS
ANOVA-Test,	F = 263.82	F = 238.87	F = 243.49	F = 244.91	
P-value & Sig.	P<0.001, VHS	P<0.001,VHS	P<0.001, VHS	P<0.001, VHS	

Table No.1: Comparison of bone thickness of central incisor at 6mm with male and female and left and right sides of bone

In the present study observed that, there is statistically very highly significant difference of bone thickness of central incisor at 6mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness central incisor at 6mm is more as compare to facial and palatal bone.

There is no statistical significant difference of bone thickness of central incisor at 6mm inFacial and Palatal bone between left and right side of maxilla in males and females (P>0.05).

Table No.2: comparison of bone thickness of central incisorat 9mmwith male and female and left and right sides of bone

	Bo	ne thickness of ce	t-Test, P-value & Significance		
Variables	Group A	(Males)	Group A	(Females)	
	Left	Right	Left Rig	Right	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
					Males- Lt v/s Rt. P= 0.282, NS
Alveolar Bone	7.41±1.61	$7.28 \pm 1.13$	$7.42 \pm 1.68$	$7.27 \pm 1.64$	Female- Lt v/s Rt. P= 0.382, NS
					Right -M v/s F P= 0.981, NS
					Left - M v/s F P=0.919, NS
					Males- Lt v/s Rt. P= 0.567, NS
Facial Bone	$1.45 \pm 0.44$	$1.38 \pm 0.46$	$1.37 \pm 0.39$	$1.35 \pm 0.43$	Female- Lt v/s Rt. P= 0.869, NS
					Right -M v/s F P= 0.642, NS
					Left - M v/s F P=0.873, NS
					Males- Lt v/s Rt. P= 0.095 NS
Palatal bone	$1.88 \pm 1.37$	$1.67 \pm 1.26$	$1.72 \pm 1.32$	$1.75 \pm 1.38$	Female- Lt v/s Rt. P= 0.219, NS
					Right -M v/s F P= 0.592, NS
					Left - M v/s F P=0.855, NS
ANOVA-Test,	F = 223.08	<b>F</b> = 207.57	F = 216.56	F = 204.51	
P-value & Sig.	P<0.001, VHS	P<0.001,VHS	P<0.001, VHS	P<0.001, VHS	

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

very highly significant difference of bone thickness of central incisor at 9mm between Alveolar bone, Facial bone and Palatal bone (P<0.001). The Alveolar bone thickness of central incisor at 9mm is more as compare to facial and palatal bone.

In the present study observed that, there is statistically There is no statistical significant difference of bone thickness of central incisor at 9mm of Facial and Palatal bone between left and right side of maxilla in males and females (P>0.05).

	Bo	ne thickness of la	mm	t-Test, P-value & Significance	
Variables	Group A	(Males)	Group A	(Females)	
	Left	Right	Left	Right	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
					Males- Lt v/s Rt. $P=0.572$ , NS
Alveolar Bone	$6.74 \pm 1.49$	$6.73 \pm 1.48$	$6.80 \pm 1.44$	$6.55 \pm 1.44$	Female- Lt v/s Rt. P= 0.892, NS
					Right -M v/s F P= 0.913, NS
					Left - M v/s F P=0.825, NS
					Males- Lt v/s Rt. P= 0.672, NS
Facial Bone	$0.57 \pm 0.30$	$0.55 \pm 0.32$	$0.54 \pm 0.33$	$0.56 \pm 0.34$	Female- Lt v/s Rt. P= 0.810, NS
					Right -M v/s F P= 0.682, NS
					Left - M v/s F P=0.795, NS
					Males- Lt v/s Rt. P= 0.193, NS
Palatal bone	$0.82 \pm 0.31$	$0.75 \pm 0.30$	$0.73 \pm 0.36$	$0.74 \pm 0.41$	Female- Lt v/s Rt. P= 0.783, NS
					Right -M v/s F P= 0.107, NS
					Left - M v/s F P=0.869, NS
ANOVA-Test,	F = 3963.31	F = 7566.41	F = 4265.63	F = 5518.15	
P-value & Sig.	P<0.001, VHS	P<0.001,VHS	P<0.001, VHS	P<0.001, VHS	

Table No.3: Comparison of bone thickness of lateral incisor at 3mm with male and female and left and right sides of bone

In the present study observed that, there is statistically very highly significant difference of bone thickness of lateral incisor at 3mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness at 3mm is more as compare to facial and palatal.

between left and right in males and females (P>0.05) and there is also no statistical significant difference of bone thickness at 3mm of lateral incisor of Alveolar, Facial and Palatal, left and right between males and females (P>0.05).

There is no statistical significant difference of facial and palatal bone thickness at 3mm of lateral incisor

Table No.4: Comparison of bone thickness of lateral incisor at 6mmwith male and female and left and right sides of bone

	Bo	ne thickness of la	t-Test, P-value & Significance		
Variables	Group A	Group A (Males) Group A (Femal		(Females)	
	Left	Right	Left	Right	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
					Males- Lt v/s Rt. P= 0.831, NS
Alveolar Bone	$6.99 \pm 0.24$	$6.78 \pm 0.47$	$6.86 \pm 0.44$	$6.97 \pm 0.25$	Female- Lt v/s Rt. P= 0.921, NS
					Right -M v/s F P= 0.978, NS
					Left - M v/s F P=0.910, NS
					Males- Lt v/s Rt. P= 0.773, NS
Facial Bone	$0.72 \pm 0.23$	$0.74 \pm 0.29$	$0.68 \pm 0.22$	$0.77 \pm 0.31$	Female- Lt v/s Rt. P= 0.824, NS
					Right -M v/s F P= 0.925, NS
					Left - M v/s F P=0.963, NS
					Males- Lt v/s Rt. $P= 0.829$ , NS
Palatal bone	$1.31 \pm 1.21$	$1.18 \pm 1.26$	$1.15 \pm 1.27$	$1.18 \pm 1.39$	Female- Lt v/s Rt. P= 0.875, NS
					Right -M v/s F P= 0.774, NS
					Left - M v/s F P=0.920, NS
ANOVA-Test,	<b>F</b> = 735.12	F = 788.65	F = 728.52	F = 706.32	
P-value & Sig.	P<0.001, VHS	P<0.001,VHS	P<0.001, VHS	P<0.001, VHS	

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

In the present study observed that, there is statistically very highly significant difference of bone thickness of lateral incisor at 6mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness at 6mm is more as compare to facial and palatal.

There is no statistical significant difference of bone thickness of lateral incisor at 6mm of Alveolar bone, Facial, and Palatal between left and right in males and females (P>0.05) and there is also no statistical significant difference of bone thickness of lateral incisor at 6mm of Alveolar, Facial and Palatal, left and right between males and females (P>0.05)

	Bo	ne thickness of la	nm	t-Test, P-value & Significance	
Variables	Group A	(Males)	Group A	(Females)	
	Left	Right	Left	Right	
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
					Males- Lt v/s Rt. P= 0.563, NS
Alveolar Bone	$7.31 \pm 1.01$	$7.13 \pm 0.95$	$7.19 \pm 0.96$	$7.26 \pm 0.97$	Female- Lt v/s Rt. P= 0.468, NS
					Right -M v/s F P= 0.792, NS
					Left - M v/s F P=0.827, NS
					Males- Lt v/s Rt. P= 0.491, NS
Facial Bone	$1.03 \pm 0.27$	$0.97 \pm 0.34$	$0.95 \pm 0.23$	$0.97 \pm 0.25$	Female- Lt v/s Rt. P= 0.913, NS
					Right -M v/s F P= 0.351, NS
					Left - M v/s F P=0.929, NS
					Males- Lt v/s Rt. $P= 0.732$ NS
Palatal bone	$1.33 \pm 1.04$	$1.29 \pm 0.98$	$1.24 \pm 1.02$	$1.34 \pm 1.04$	Female- Lt v/s Rt. P= 0.381, NS
					Right -M v/s F P= 0.419, NS
					Left - M v/s F P=0.463, NS
ANOVA-Test,	F = 853.08	F = 771.76	F = 844.33	F = 820.72	
P-value & Sig.	P<0.001, VHS	P<0.001,VHS	P<0.001, VHS	P<0.001, VHS	

Table No.5: Comparison of bone thickness of lateral incisorat 9mm with male and female and left and right sides of bone

In the present study observed that, there is statistically very highly significant difference of bone thickness of lateral incisor at 9mm between Alveolar, Facial and Palatal (P<0.001). The Alveolar bone thickness at 9mm is more as compare to facial and palatal.

Facial and Palatal between left and right in males and females (P>0.05) and there is also no statistical significant difference of bone thickness of lateral incisor at 9mm of Alveolar, Facial and Palatal, left and right between males and females (P>0.05)

There is no statistical significant difference of bone thickness of lateral incisor at 6mm of Alveolar, Facial,

Size	Gender	Side	Canine	Central	Lateral	Overall	ANOVA-Test, P-value
				incisor	incisor	average	& Significance
			Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
At 3mm	Males	Left	$7.07 \pm 0.87$	$7.01 \pm 0.24$	6.88 ±0.24	$7.06 \pm 0.43$	F = 0.85, P=0.761, NS
		Right	$6.98 \pm 0.88$	$7.02 \pm 0.24$	$6.55 \pm 0.47$	$6.89 \pm 0.52$	F = 0.63, P=0.803, NS
	Females	Left	$7.02 \pm 1.51$	$6.77 \pm 0.41$	$6.74 \pm 0.44$	$7.00 \pm 0.58$	F = 1.53, P=0.167, NS
		Right	6.97±1.53	6.91±0.25	$6.73 \pm 0.25$	$7.05 \pm 0.47$	F = 1.18, P=0.231, NS
At 6mm	Males	Left	$7.16 \pm 0.87$	7.14±1.56	6.99± 1.44	$6.99 \pm 1.28$	F = 1.32, P=0.287, NS
		Right	$7.02 \pm 1.50$	$7.01 \pm 1.60$	6.78±1.44	$6.79 \pm 1.51$	F = 1.67, P=0.117, NS
	Females	Left	$7.05 \pm 0.95$	$7.03 \pm 1.64$	6.97±1.49	$6.90 \pm 1.53$	F = 0.53, P=0.821, NS
		Right	$7.16 \pm 0.87$	7.13±1.55	$6.86 \pm 1.48$	$6.73 \pm 1.51$	F = 0.93, P=0.743, NS
At 9mm	Males	Left	$7.91 \pm 0.30$	7.41±1.61	7.31±1.01	$7.54 \pm 0.87$	F = 1.39, P=0.276, NS
		Right	$7.85 \pm 0.43$	$7.28 \pm 1.13$	7.31±1.01	$7.48 \pm 0.74$	F = 1.73, P=0.109, NS
	Females	Left	$7.87 \pm 0.37$	$7.42 \pm 1.68$	$7.19 \pm 0.96$	$7.49 \pm 0.98$	F = 1.78, P=0.097, NS
		Right	$7.86 \pm 0.31$	$7.27 \pm 1.64$	$7.26 \pm 0.97$	$7.46 \pm 0.87$	F = 1.16, P=0.226, NS
Over	all Mean ± S	SD	$7.30 \pm 0.87$	$7.11 \pm 1.02$	$6.95 \pm 0.95$		

NS= not significant, S=significant, HS=highly significant, VHS=very highly significant

Study observed that, the overall mean of alveolar bone thickness of canine is **7.30**, the overall mean of central incisor bone thickness is **7.11** and the overall mean of lateral incisor bone thickness is **6.95**. In alveolar bone thickness of canine is more as compare to central incisor and lateral incisor and central incisor bone thickness is more as compare to lateral bone thickness but statistically not significant (P>0.05)

There is no statistical significant difference of alveolar bone thickness between canine, central incisor and lateral incisor at 3mm in males and female at left and right sides (P>0.05)

There is no statistical significant difference of alveolar bone thickness of canine, central incisor and lateral incisor between at 3mm, 6mm and 9mmof all measurements of male, female with left and right (P>0.05)



Diagram 1: Multiple bar diagram represents comparison of alveolar bone thickness between canine, central incisor and lateral incisor

Table No.11: Comparison of facial bone thick	ness between canine, central incisor and lateral incison
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Size	Gender	Side	Canine	Central	Lateral	Overall	ANOVA-Test, P-value
				incisor	incisor	average	& Significance
			Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
At 3mm	Males	Left	$1.17 \pm 0.87$	$0.93 \pm 0.39$	$0.57 \pm 0.30$	$0.89 \pm 0.52$	F = 2.52, P=0.021, S
		Right	$1.18 \pm 0.88$	$0.90 \pm 0.37$	$0.55 \pm 0.32$	$0.88 \pm 0.45$	F = 2.67, P=0.018, S
	Females	Left	$1.17 \pm 0.86$	$0.93 \pm 0.25$	$0.54 \pm 0.33$	$0.88 \pm 0.41$	F = 2.48, P=0.029, S
		Right	$1.15 \pm 0.88$	$0.93 \pm 0.40$	$0.56 \pm 0.34$	$0.88 \pm 0.43$	F = 2.51, P=0.023, S
At 6mm	Males	Left	$1.39 \pm 1.22$	$1.17 \pm 0.33$	$0.72 \pm 0.23$	$1.11 \pm 0.59$	F = 2.71, P=0.013, S
		Right	$1.37 \pm 1.29$	$1.09 \pm 0.35$	$0.74 \pm 0.29$	$1.09 \pm 0.53$	F = 2.54, P=0.017, S
	Females	Left	$1.36 \pm 1.27$	$1.06 \pm 0.30$	$0.68 \pm 0.22$	$1.07 \pm 0.48$	F = 2.87, P=0.008, HS
		Right	$1.39 \pm 1.28$	$1.07 \pm 0.32$	$0.77 \pm 0.31$	$1.08 \pm 0.51$	F = 2.59 , P=0.014, S
At 9mm	Males	Left	$1.43 \pm 0.43$	$1.45 \pm 0.44$	$1.03 \pm 0.27$	$1.32 \pm 0.68$	F = 2.32, P=0.041, S
		Right	$1.45 \pm 0.49$	$1.38 \pm 0.46$	$0.97 \pm 0.34$	$1.27 \pm 0.73$	F = 2.41, P=0.039, S
	Females	Left	$1.45 \pm 0.45$	$1.37 \pm 0.39$	$0.95 \pm 0.23$	$1.25 \pm 0.36$	F = 2.46, P=0.035, S
		Right	$1.47 \pm 0.81$	$1.35 \pm 0.43$	$0.97 \pm 0.25$	$1.27 \pm 0.47$	F = 2.61, P=0.019, S
Over	all Mean ± S	SD	$1.36 \pm 0.72$	$1.13 \pm 0.37$	$0.75 \pm 0.28$		

Study observed that, the overall mean of facial bone thickness of canine is **1.36**, the overall mean of central incisor bone thickness is **1.13** and the overall mean of lateral incisor bone thickness is **0.75**.

There is statistical significant difference of facial bone thickness between canine, central incisor and lateral incisor at 3mm in males and female at left and right sides (P<0.05). The facial bone thickness of canine is significantly more as compare to central incisor and lateral incisor and the mean central incisor bone

thickness is significantly more as compare to lateral incisor.

There is statistical significant difference of mean facial bone thickness of canine, central incisor and lateral incisor between at 3mm, 6mm and 9mmof all measurements male, female with left and right Side. (P<0.05). The mean facial bone thickness of canine, central incisor and lateral incisor at 3mm is significantly less as compare to at 6mm and 9mm



Diagram 2: Multiple bar diagram represents comparison of facial bone thickness between canine, central incisor and lateral incisor

Table No.12: Comparison of palatal bone thickness between canine, central incisor and lateral incisor

Size	Gender	Side	Canine	Central	Lateral	Overall	ANOVA-Test, P-value
				incisor	incisor	average	& Significance
			Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
At 3mm	Males	Left	$1.32 \pm 0.86$	$1.15 \pm 0.91$	$0.82 \pm 0.31$	$1.09 \pm 0.69$	F = 2.61, P=0.019, S
		Right	$1.19 \pm 0.92$	$1.13 \pm 0.78$	$0.75 \pm 0.30$	$1.02 \pm 0.67$	F = 2.93, P=0.010, HS
	Females	Left	$1.27 \pm 0.91$	$1.03 \pm 0.92$	$0.73 \pm 0.36$	$1.01 \pm 0.72$	F = 2.36, P=0.044, S
		Right	$1.29 \pm 0.93$	$1.01 \pm 0.94$	$0.74 \pm 0.41$	$1.02 \pm 0.75$	F = 2.51, P=0.025, S
At 6mm	Males	Left	$1.41 \pm 0.92$	$1.27 \pm 1.31$	$1.21 \pm 1.21$	$1.41 \pm 1.14$	F = 2.29, P=0.046, S
		Right	$1.44 \pm 0.92$	$1.29 \pm 1.14$	$1.18 \pm 1.26$	$1.23 \pm 1.01$	F = 2.42, P=0.029, S
	Females	Left	$1.42 \pm 0.92$	$1.28 \pm 1.29$	$1.15 \pm 1.27$	$1.28 \pm 1.15$	F = 2.44, P=0.037, S
		Right	$1.40 \pm 0.93$	$1.33 \pm 1.34$	$1.18 \pm 1.39$	$1.33 \pm 1.22$	F = 2.35, P=0.041, S
At 9mm	Males	Left	$1.49 \pm 0.47$	$1.37 \pm 1.37$	$1.33 \pm 1.04$	$1.56 \pm 0.96$	F = 2.89, P=0.008, HS
		Right	$1.47 \pm 0.45$	$1.35 \pm 1.26$	$1.29 \pm 0.98$	$1.44 \pm 0.89$	F = 2.43, P=0.034, S
	Females	Left	$1.48 \pm 0.43$	$1.39 \pm 1.32$	$1.24 \pm 1.02$	$1.46 \pm 0.92$	F = 2.67, P=0.013, S
		Right	$1.49 \pm 0.46$	$1.34 \pm 1.38$	$1.34 \pm 1.04$	$1.51 \pm 0.96$	F = 2.84, P = 0.009, HS
Over	all Mean ± S	D	$1.42 \pm 0.81$	$1.38 \pm 1.12$	1.08± 0.89		

Study observed that, the overall mean of palatal bone thickness of canine is **1.42**, the overall mean of central incisor bone thickness is **1.38** and the overall mean of lateral incisor bone thickness is **1.08**.

There is statistical significant difference of palatal bone thickness between canine, central incisor and lateral incisor at 3mm in males and female at left and right sides (P<0.05). The palatal bone thickness of canine is significantly more as compare to central

incisor and lateral incisor and the mean central incisor bone thickness is significantly more as compare to lateral incisor at 3mm.

There is statistical significant difference of palatal bone thickness between canine, central incisor and lateral incisor at 3mm,6mm, 9mm in males and female at left and right sides (P<0.05). The palatal bone thickness of canine is significantly more as compare to central incisor and lateral incisor.

There is statistical significant difference of mean Facial bone and palatal bone thickness of canine, central incisor and lateral incisor between at 3mm, 6mm and 9mmof all measurements male, female with left and right (P<0.05). The mean palatal bone thickness of canine, central incisor and lateral incisor is more as compared to facial bone thickness And facial and palatal bone thickness of canine is more as compared to central incisor.

Diagram 3: Multiple bar diagram represents comparison of palatal bone thickness between canine, central incisor and lateral incisor



#### DISCUSSION

Primary stability of implant is achieved by engaging the palatal wall and bone approximately 4 mm to 5 mm beyond the apex of the extraction socket. And it can be achieved by pressing the drills bodily against the palatal wall of the socket during the sequential osteotomy. Although thick labial bone plate is generally resistant to resorption and grafting is unnecessary, bone grafting is frequently done in case of thin labial bone to prevent collapse and minimize resorption regardless of the gap size.<sup>11</sup>

Dental implant placement following extraction is a common dental procedure. Satisfactory results and

long-term stability with implant treatment depend on the presence of a facial plate of sufficient height and thickness.

Furthermore, the maxillary anterior region presents considerable challenges becausechanges in it are often aesthetically notable to patients. Simultaneously, several local risk factors can compromise the quality of implant outcomes.Examining facial plate thickness at the location of each tooth to be extracted and replaced with an implant is thus crucial for selection of the appropriate treatment for the anterior maxillary region.<sup>13</sup>

Ideally, the facial bone wall should be at least 1.5-2 mm thick to avoid facial plate resorption immediately following dental implantation and to ensure proper soft tissue support. If this requirement is not met and an excessively thin facial bone is used, fenestration, dehiscence, and recession are possible, which may further result in poor aesthetics.<sup>14</sup>

Moreover, there is a bidirectional relationship between buccal bone thickness and crestal labial soft tissue. As a soft tissue profile is highly influenced by bone thickness, a role of thick soft tissue in protecting against crestal bone loss. Given this, thick tissue biotypes are associated with higher crestal bone levels, less gingival recession, and better aesthetic results than are thinner biotypes Le and Borzabadi-Farahani.<sup>1</sup>

In total, 100 CBCT scans measured and evaluated. The facial bone thickness of central incisor in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left central incisors are,  $0.93 \pm$ 0.39 mm,  $1.17 \pm 0.33$  mm, and  $1.45 \pm 0.44$  mm, respectively; for the maxillary right central incisors are  $0.90 \pm 0.37$  mm,  $1.09 \pm 0.35$  mm, and  $1.38 \pm 0.46$  mm, respectively. In females, coronal, mid-root, and apical third of left central incisor are  $0.93 \pm 0.25$  mm,  $1.06 \pm$ 0.30 mm, and  $1.37 \pm 0.39$  mm. In females, in the right maxillary central incisor region, at the coronal, mid-root, and apical third are  $0.93 \pm 0.40$  mm,  $1.07 \pm$ 0.32 mm, and 1.35  $\pm$  0.43 mm, respectively. The overall mean of facial bone thickness of central incisor is  $1.13 \pm 0.37$  (P<0.05). The between-gender differences were statistically significant for all regions except the coronal region of the right central incisor. The facial bone thickness in males is more than in females in all regions measured(P<0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) and there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

The palatal bone thickness of central incisor in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left central incisors are,  $1.15 \pm$ 0.91 mm,  $1.53 \pm 1.31$  mm, and  $1.88 \pm 1.37$  mm, respectively; for the maxillary right central incisors are  $1.13 \pm 0.78$  mm,  $1.39 \pm 1.14$  mm, and  $1.67 \pm 1.26$  mm, respectively. In females, cervical, mid-root, and apical third of left central incisor are ,  $1.03 \pm 0.92$  mm,  $1.37 \pm$ 1.29 mm, and  $1.72 \pm 1.32$  mm. In females, in the right maxillary central incisor region, at the cervical, mid-root, and apical third are  $1.01 \pm 0.94$  mm,  $1.45 \pm$ 1.34 mm, and  $1.75 \pm 1.38$  mm, respectively. The overall mean of palatal bone thickness of central 1.42 incisor is ± 1.12mm (P<0.05). The between-gender differences were statistically significant for all regions except the cervical region of the central incisor. The palatal bone thickness in males than in females in all regions is more

measured(P<0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) .and there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05). There is a statistical significant difference between facial bone thickness and palatal bone the palatal bone thickness is more as compared to facial bone (P>0.05).

The facial bone thickness of lateral incisor in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left lateral incisors are  $0.57 \pm$ 0.30 mm, 0.72  $\pm$  0.23 mm and 1.03  $\pm$  0.27 mm. respectively; for the maxillary right lateral incisors are  $0.55 \pm 0.32$  mm, 0.74  $\pm$  0.29 mm, and 0.97  $\pm$  0.34 mm, respectively. In females, cervical, mid-root, and apical third of left lateral incisor are  $0.54 \pm 0.33$  mm,  $0.68 \pm 0.22$  mm and  $0.95 \pm 0.23$  mm. In females, in the right maxillary lateral incisor region, at the coronal, mid-root, and apical third are  $0.56 \pm 0.34$  mm,  $0.77 \pm 0.31$  mm, and  $0.97 \pm 0.25$  mm, respectively. The overall mean of facial bone thickness of lateral incisor is  $0.75 \pm 0.28$  (P<0.05). The between-gender differences were statistically significant for all regions except the cervical region of the lateral incisor. The facial bone thickness in males is more than in females in all regions measured(P<0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) and there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

The palatal bone thickness of lateral incisor in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left lateral incisors are mm, mm and mm, respectively; for the maxillary right lateral incisors are mm, mm, and mm, respectively. In females, cervical, mid-root, and apical third of left lateral incisor are mm, mm and mm. In females, in the right maxillary lateral incisor region, at the coronal, mid-root, and apical third are mm, mm, and mm, respectively. The overall mean of facial bone thickness of lateral incisor is (P<0.05). The statistically between-gender differences were significant for all regions except the cervical region of the lateral incisor. The facial bone thickness in males more than in females in all is regions measured(P<0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) and there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

The facial bone thickness of canine in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left canine are,  $1.17 \pm 0.87$  mm,  $1.46 \pm$ 1.22 mm, and  $1.49 \pm 0.43$  mm, respectively; for the maxillary right canine are  $1.18 \pm 0.88$  mm,  $1.44 \pm$ 1.29 mm, and 1.45  $\pm$  0.49 mm, respectively. In females, cervical, mid-root, and apical third of left canine are ,  $1.17 \pm 0.86$  mm, and  $1.48 \pm 1.27$  mm,  $1.45 \pm 0.45$  mm . In females, in the right maxillary canine region, at the cervical, mid-root, and apical third are  $1.15 \pm 0.88$  mm,  $1.42 \pm 1.28$  mm, and 1.49 $\pm$  0.81 mm, respectively. The overall mean of facial bone thickness of canine is  $1.36 \pm 0.72$ mm (P<0.05). The between-gender differences were statistically significant for all regions except the coronal region of the right central incisor. The facial bone thickness in males is more than in females in all regions measured(P<0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) and there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

The palatal bone thickness of canine in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left canine are,  $1.32 \pm 0.86$  mm,  $1.39 \pm$ 0.92 mm, and  $1.47 \pm 0.47$  mm, respectively; for the maxillary right canine are  $1.19 \pm 0.92$  mm,  $1.14 \pm$ 0.92 mm, and  $1.42 \pm 0.45$  mm, respectively. In females, cervical, mid-root, and apical third of left canine are ,  $1.27 \pm 0.91$  mm, and  $1.34 \pm 0.92$  mm,  $1.43 \pm 0.43$  mm . In females, in the right maxillary canine region, at the cervical, mid-root, and apical third are  $1.29 \pm 0.93$  mm,  $1.38 \pm 0.93$  mm, and 1.45 $\pm 0.46$  mm, respectively. The overall mean of palatal bone thickness of canine is  $1.34 \pm 0.81$ mm (P<0.05). The between-gender differences were statistically significant for all regions except the cervical region of the canine. The facial bone thickness in males is more than in females in all regions measured (P < 0.001). The facial bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of facial bone thickness at 3mm of central incisor between left and right in males and females (P>0.05). And there is also no statistical significant difference of facial bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

The Alveolar bone width of central incisor in males at 3mm in cervical, 6 mm in mid-root, and 9mm apical third of the maxillary left central incisorare, 7.13  $\pm$  0.24 mm, 7.01  $\pm$  1.56 mm, and 7.41  $\pm$  1.61 mm, respectively; for the maxillary right central incisors are 6.91  $\pm$  0.24 mm, 6.86  $\pm$  1.60 mm, and 7.28  $\pm$  1.13 mm, respectively. In females, coronal, mid-root, and apical third of left central incisor are 7.12  $\pm$  0.41 mm, 6.98  $\pm$  1.64 mm, and 7.42  $\pm$  1.68 mm. In females, in the right maxillary central incisor region, at the coronal,

mid-root, and apical third are  $7.13 \pm 0.25$  mm,  $6.91 \pm 1.55$  mm, and  $7.27 \pm 1.64$  mm, respectively. The overall mean of alveolar bone width of central incisor is  $7.11 \pm 1.02$ mm (P<0.05). The between-gender differences were statistically significant for all regions except the coronal region of the right central incisor. The facial bone thickness in males is more than in females in all regions measured(P<0.001). The alveolar bone thickness at 9mm is more as compare to at 3mm and 6mm.

There is no statistical significant difference of alveolar bone thickness at 3mm of central incisor between left and right in males and females (P>0.05) and there is also no statistical significant difference of alveolar bone thickness at 6mm of central incisor of left and right side between males and females (P>0.05).

In this study according to the measurement and evaluation of the teeth observed that the facial bone and palatal bone thickness of canine (Mean FB = 1.36  $\pm$  0.72, PB = 1.42  $\pm$  0.81) is more as compared to central incisor (Mean FB = 1.13  $\pm$  0.37 PB = 1.38  $\pm$  1.12) and lateral incisor (Mean FB =0.75  $\pm$  0.28 PB = 1.08  $\pm$  0.89) and In males left side of the maxillary canine has more thickness as compared to females group.

Generally, buccal alveolar bone crest of maxillary anterior teeth existed within 3 mm from CEJ. These results support the theory that implant head should be at least 3 mm apical to an imaginary line connecting the cementoenamel junctions (CEJs) of the adjacent teeth<sup>15</sup>.

With respect to the reference lines A, B, C and D, the thickness of facial bone in central incisor, lateral incisor and canine is less than 2 mm. It is important to place the axis of the implant corresponding to the incisal edges of the adjacent teeth or slightly palatal to this landmark<sup>10</sup>. Otherwise implant can perforate the buccal alveolar plate. Kan and Rungcharassaeng<sup>11</sup> stated that primary stability of implant is achieved by engaging the palatal wall and bone approximately 4 mm to 5 mm beyond the apex of the extraction socket. And it can be achieved by pressing the drills bodily against the palatal wall of the socket during the sequential osteotomy. Although thick facial bone plate is generally resistant to resorption and grafting is unnecessary, bone grafting is frequently done in case of thin facial bone to prevent collapse and minimize resorption regardless of the gap size.

The level of alveolar crest with respect to CEJ is an important parameter to consider while placing an implant; many studies suggested that the head of the implant should be located within 2-3 mm from the CEJ of adjacent teeth<sup>10</sup>.

In the present study distance between CEJ to the bone crest was found to be 2-3mm for incisors, whereas canines had greater CEJ to crest distance (>3 mm). This is in accordance with Vera et al<sup>10</sup>, who found CEJ to crest distance was 2.79 mm for maxillary anteriors. Similarly Wang et al<sup>16</sup> reported a distance of 0.1 mm to 4 mm.

The present radiographic study evaluated the thickness of alveolar bone labially and palatally in maxillary anteriors and found occurrence of very thin labial plate anteriorly. This study found less than 2 mm alveolar bone at all five points (crest, 3 mm from crest, midroot level, apical third, ) in all the maxillary anteriors and further supports the fact that implant should be inclined palatally.

The findings of the present study are in accordance with Nowzari et al<sup>12</sup>who measured thickness of aveloar bone at five different points and found occurrence of thin labial plate. Zekry et al<sup>17</sup>. reported mean width of 0.9 mm in maxillary anteriors. In a similar study, Feuntes et al<sup>18</sup>. reported less than 10% sites with more than 2 mm thickness. Recently Farahamnd et al<sup>19</sup>. found similar findings in maxillary anteriors. When centrals, laterals and canines were compared canine found to have a thicker labial plate when compared to central incisors and lateral incisor, this was in accordance with Ghassemian et al<sup>6</sup>. When the influence of gender on thickness of facial and palatal alveolar bone thickness was analysed a statistically significant difference was found with respect to the palatal alveolar bone. This finding was in contrast to the findings of Nowzari et al<sup>12</sup>.

In case of immediate implant placement, the labio-palatal width of the bone at the root apex is an important parameter to consider as extension of implant beyond the apex is indicated for increased primary stability and proper initial alignment<sup>10</sup>. In case of thin bone width at apex there are chances of labial wall perforation, therefore prior analysis of width of bone at apex is needed in immediate implant cases.

Cone beam computed tomography (CBCT) images (Planmeca ProMax 3D) of 403 teeth (208 upper teeth and 195 lower teeth) were obtained from 49 patients referred to the Dental School of Seville from January to December 2014. The height difference between the palatal and buccal walls was measured on the most coronal point of both walls. The thickness of the palatal wall was measured 2 mm from the most coronal point of the palatal wall.

There was significant difference in buccal bone thickness by gender (p<0.05). The thinnest point of the maxillary buccal bone was measured in women as 2.11 mm and in men as 2.02 mm in the first premolar teeth. The thickest point of maxillary buccal bone was measured in women as 9.87 mm and in men 10.71 mm palatinal root of the first molar. A comparison of buccal bone thickness between age showed a statistically significant difference at the distobuccal and palatinal roots of the first molar, at the mesiobuccal root of the second molar (p<0.05).

The measurements of maxillar buccal bone thickness using CBCT for various dental procedures especially in endodontic surgery, orthodontic mini implant treatment, dental implant procedures, and healing after tooth extraction that are important knowledge.

In our study, the labio palatal width at the apex was found to be ranging from 3-12 mm. In the present

study central incisors and canines were found to be in close proximity to the nasal floor compared to the lateral incisors. Distance from apex to nasal floor ranged from 1-10 mm. These findings suggest greater chances of perforating nasal floor during immediate implant placement in maxillary anterior region.

The present study supports the finding of presence of facial bone thickness within the range of 2-3mm over the maxillary anteriors and frequent presence of fenestrations and dehiscence. Maxillary anteriors were seen in close proximity to the nasal cavity, therefore 3-dimensional pre-radiographic assessment using CBCT is important to assess the anatomical parameters which may hamper implant placement.

The initial thickness of maxillary facial bone overlying maxillary anterior teeth has significant impact on the responding level of facial bone and soft tissues after extraction and that may interfere with the osseointegration of an immediately placed implant, especially in the absence of bone grafting procedures at the time of immediate implant placement.

The dimensions of the maxillary anterior buccal bone wall have gained importance in the past few years with the use of immediate implants. The most frequently used methods to measure buccal bone thickness are the use of caliper and CBCT scans and Cone-beam computed tomography (CBCT) scans that have been widely used in the dental field due to advantages that include low radiation dose, low cost, and the ability to view a detailed three-dimensional image of the regions of interest.

CBCT scans may help in giving the guidelines for treatment planning in the maxillary anterior aesthetic region specifically for the implant placement, it can contribute to the evaluation of some possible pre- or post-surgical soft or hard tissue complications.

Hence the purpose of this study is to measure and evaluate the thickness of facial and palatal alveolar bone and buccal bony curvature of maxillary anterior teeth in north to provide valuable guidelines for choosing proper implant fixture with regards to diameter, length and axis of surgical drilling procedure and anatomical dimensions of the buccal bone wall of the aesthetic maxillary anterior region for immediate implant placement, based on CBCT images.

#### CONCLUSION

The results of this study may provide insight on the usefulness of CBCT in providing a base line data for selecting the appropriate site for implant placement in terms of alveolar height. CBCT enables accurate measurement of bone quality and quantity along with measuring the distance from anatomic structures, due to its three-dimensional nature. CBCT proves to be a valuable diagnostic aid in pre implant radiological assessment.

Within the limitations of this study, the following conclusions may be drawn as the facial alveolar bone walls on the anterior maxillary teeth is generally thin (< 2 mm), with the thickness decreasing with an

increase in age. Which are not be ideal for flapless immediate implant placement due to a missing buccal bone wall after extraction of the teeth. For the inevitable dimensional loss following tooth extraction and to provide a convex contour of the facial tissues for a successful esthetic outcome would require bone augmentation, Bone expansion , Bone graft . CBCT analysis is informative to clinicians about the presence or absence and quantity of the buccal bone wall for appropriate treatment selection.

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