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Original Research Article

Evaluation of bone dimension and the relation of alveolar crest level with floor of nasal fossa of anterior maxilla and their association with age and gender using cone beam computed tomography: A cross-sectional study

Madhura Barve[1*], Ajay Bhoosreddy[1], Chetan Bhadage[1], Kalyani Khairnar[1]

[1]Dept. of Oral Medicine and Radiology, MGV'S KBH Dental College Nashik, Maharashtra, India

Abstract

Aim and Objective: The aim of the study was to evaluate the bone dimensions in the anterior maxilla, particularly the relationship between the alveolar crest level and the floor of the nasal fossa, and to assess how these factors correlate with age and gender using CBCT.
Materials and Methods: A total of 66 CBCT scans of patients showing anterior maxilla ranging from 18-50 years were reviewed to measure the bone dimensions in anterior maxillary teeth.
Results: In males, the palatal width of the central incisor at the crest and the lateral incisor at both the crest and 6mm from the crest were significantly greater in the 18-28 and 29-39 age groups. In females, the facial and palatal widths of the central incisor at 6mm from the crest were greater in the 29-39 age group. The distance from the crest to the nasal floor for both central and lateral incisors was higher in females aged 40-50 and in males compared to females. Males generally exhibited larger facial and palatal widths for both central and lateral incisors and a greater distance from the crest to the nasal floor.
Conclusion: This study highlights the importance of intact buccal and palatal cortical plates in enhancing implant stability and prognosis. Bone dimensions are influenced by age and gender. Further research with larger sample sizes is necessary to better understand the relationship between bone dimensions, alveolar crest level, and the nasal fossa floor across different age and gender groups.

Keywords: Cone beam computed tomography; Bone Dimensions; Immediate implant placement; Alveolar crest level; Floor of nasal fossa.

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1. Introduction

The replacement of maxillary anterior teeth presents significant challenges due to the aesthetic demands of patients, as changes in this area are often highly noticeable.[1] The increasing patient demand for instant restoration procedures especially in the aesthetic zone requires precise treatment planning. Immediate implant placement (IIP) offers an effective solution by reducing the duration of both the surgical procedure and rehabilitation while optimizing aesthetic outcomes.[2]

Several critical anatomical factors influence the success of immediate implant placement, including bone thickness, height, and the amount of bone beyond the apex. Effective IIP demands careful planning and consideration of these factors to ensure long-term peri-implant tissue stability.[3] The thickness of the facial and palatal alveolar bone plays a crucial role in both the primary and long-term stability of implants.[4]

In the anterior maxilla, evaluating the bone thickness at the extraction site is essential for selecting the most appropriate treatment approach.[5] Additionally, understanding the relationship between the alveolar crest and the floor of the nasal fossa is vital to avoid complications during implant placement.[6]

Age and gender are key factors influencing bone availability, which can affect implant success and stability.[7] Studies show that bone dimensions in the anterior maxilla vary with age and gender, with age-related changes in bone

*Corresponding author: Madhura Barve
Email: barve.madhura90@gmail.com

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structure and gender differences in the thickness of the facial and palatal alveolar bone.[8] These variations are important for implant planning, as they may impact both aesthetic and functional outcomes.[9]

CBCT is the gold standard for evaluating bone dimensions and anatomical relationships, offering detailed 3D imaging for accurate assessment of bone thickness, height, and proximity to structures like the nasal fossa floor.[10,11]

Despite the growing use of CBCT in implant planning, there are limited studies that specifically correlate facial and palatal bone dimensions with age and gender. Therefore, the aim of this cross-sectional study was to evaluate the bone dimensions in the anterior maxilla, particularly the relationship between the alveolar crest level and the floor of the nasal fossa, and to assess how these factors correlate with age and gender using CBCT.

2. Materials and Methods

This cross-sectional study was conducted at the Department of Oral Medicine and Radiology, Dental College in Nashik, Maharashtra, India, after the approval by the Institutional Ethical Clearance with ref.no MGV/KBHDCH/237. The study was conducted by the Declaration of Helsinki.

The objectives of the study were as follows; to measure the facial and palatal width, and the distance from the alveolar crestal bone level to the floor of the nasal fossa in the anterior maxilla using CBCT. And to compare these measurements by age and gender.

2.1. Sample size estimation

The formula for calculating the sample size (n):

$n = [(Z\alpha/2 + Z\beta)2 * 2 * \sigma2] / (d)2$

Where,

$Z\alpha/2$ = the critical value of the Normal distribution at $\alpha/2$ (for a confidence level of 95%) = 1.96,

$Z\beta$ = the critical value of the Normal distribution at β (for a power of 80%) = 0.84,

$\sigma2$ = the variance= 1.5746

d = assuming 60% of the difference between two sample means to detect significance

A total of 66 CBCT scans, meeting the study criteria, were selected from the archives of the oral radiology department. The sample included patients aged 18-50 years, grouped by age and gender as follows:

Group A - CBCT scan of male patient (n=33)
- A1. Age 18-28
- A2. Age 29-39
- A3. Age 40-50

Group B - CBCT scan of female patient (n=33)
- B1. Age 18-28
- B2. Age 29-39
- B3. Age 40-50

2.2. Inclusion and exclusion criteria

Inclusion criteria for the study comprised patients aged 18-50 years who underwent high-quality CBCT scans of completely anterior dentulous maxillary arch, including the floor of the nasal fossa.

Furthermore, CBCT scans with radiographic artifacts, impacted teeth, periodontal disease, bony pathology, previous maxillary surgery (e.g., cysts, cleft palate), or a history of trauma in the anterior maxilla were excluded.

2.3. Imaging

The CBCT scans were obtained using the ORTHOPHOS XG 3D imaging system manufactured by SIRONA, Germany, with a field of view measuring 8 cm × 8 cm. Acquired data were seen utilizing SIDEXIS software, specifically a version tube current of 12 mA and a tube voltage of 77 kVp, with an acquisition time of 14 s.

2.4. Methodology

This retrospective study analysed 66 CBCT scans of patients aged 18 to 50 years, referred for various maxillary arch-related purposes, selected from the Department of Oral Medicine and Radiology. Data for measuring the thickness of the facial and palatal cortical bone were reconstructed, with the long axis of the root determining the vertical orientation of the slice.

In the axial plane, the mid-level of the tooth was selected, indicating the location where the cross-sectional views were taken. For the measurements, cross-sectional scans were obtained that showed the entire root, the cementoenamel junction (CEJ) of the examined tooth, as well as the surrounding supporting bone and the floor of the nasal fossa in the corresponding images.

On the selected cross-sectional view, the thickness of the facial and palatal bone wall was measured perpendicular to the long axis of the tooth at two locations:

1. At the crest**:** The facial and palatal bone width was measured. **(Figure 1**)
2. 6mm from the crest: A line was drawn along the root of the anterior tooth, and at this point, the facial and palatal bone width was measured.(**Figure 2**)

To determine the alveolar height, a line was drawn from the facial-palatal alveolar bone at the crestal level. From the midpoint of this line, another line was drawn parallel to the long axis of the alveolar ridge, extending to the floor of the nasal fossa. The distance from the alveolar crest to the floor of the nasal fossa was designated as the alveolar height.(**Figure 3**)

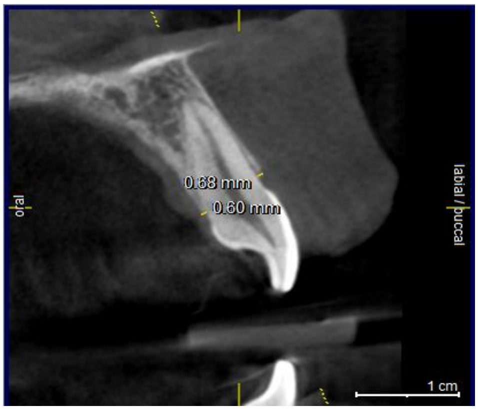

Figure 1: Measurement of facial and palatal bone width at crest

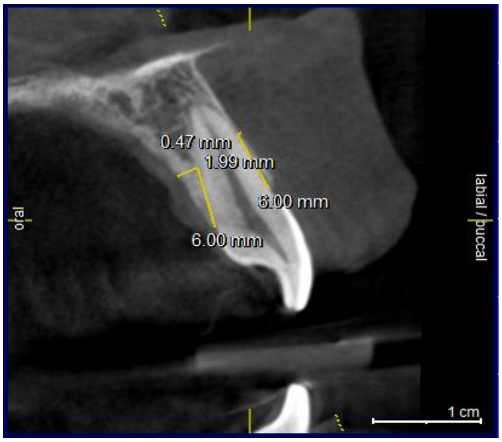

Figure 2: Measurement of facial and palatal bone width at 6mm from crest

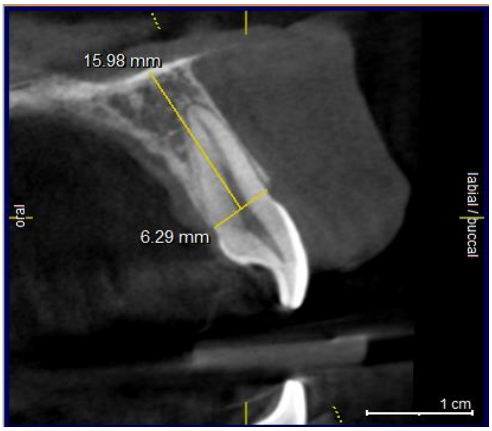

Figure 3: Measurement of distance from crest to nasal floor

2.5. Statistical analysis

Data were collected, tabulated, formulated, and was analysed using SPSS statistical software version 22.0. The level of significance (α) was taken as 5% and hence P value ≤ 0.05 was considered significant for interpretation of results. Bone dimensions were compared across age groups using one-way ANOVA. Gender differences were assessed with an unpaired t-test. For multiple pairwise comparisons within age groups, Tukey HSD post hoc tests were applied separately for males and females.

3. Results

The study population consisted of 66 CBCT scans, selected based on specific inclusion and exclusion criteria. The sample included 33 males and 33 females, aged 18 to 50 years. The facial and palatal bone thickness was measured in different age groups in males and females and was compared.

3.1. Age comparison

In male participants (**Table 1**), it was found that, the mean palatal width of central incisor at crest was more in 18-28 years age group as compared to other age groups in male participants, and this difference found was significant statistically. (p=0.037). It was also found that, the mean palatal width of lateral incisor at crest as well as at 6mm from crest were more in 29-39 years age group as compared to other age groups and this difference found was significant statistically. (p=0.026). However No significant difference was found with respect to comparison of facial and palatal width of canine at crest as well as at 6mm from crest with age.

The comparison of distance from crest to nasal floor of central incisor, lateral incisor and canine with different age groups in males was done and found no significant difference.(**Table 2**)

In females the comparison of facial and palatal width of lateral incisor at crest as well as at 6mm from crest with different age groups was done and found that the mean facial and palatal width of central incisor at 6mm from crest were more in 29-39 years and 18-28 years age groups respectively as compared to other age groups. This difference found was significant statistically. (p=0.031). (p=0.040).(**Table 3**)

In females the comparison of distance from crest to nasal floor of central incisor, lateral incisor and canine with different age groups found that the mean distance from crest to nasal floor for central incisor and lateral incisor were significantly more in 40-50 years age group as compared to other groups.(**Table 4**)

3.2. Gender comparison

In gender comparison of facial and palatal width of central incisor, lateral incisor and canine at crest and at 6mm from crest in 18-28 years it was found that the mean facial width for central incisor at 6mm from crest were more in males as compared to females. It was also found that the mean facial width for lateral incisor at crest as well at 6mm from crest were more in males as compared to females. And these differences found were also significant statistically.(**Table 5**)

In the 29–39-year age group, males demonstrated significantly larger mean palatal widths for both the central and lateral incisors at a 6mm distance from the crest compared to females. The observed differences were statistically significant, suggesting a notable gender-related variation in palatal dimensions.(**Table 6**)

Also, in 40–50-year age group, males had a significantly greater mean palatal width for the central incisor at 6mm from the crest compared to females.(**Table 7**)

The results found that the mean distance from the alveolar crest to the nasal floor was significantly greater in males than in females for both the central and lateral incisors in 18–28-year age group. These differences were statistically significant. **(Table 8)**

Table 1: Comparison of facial and palatal width of central incisor, lateral incisor and canine at crest as well as at 6mm from crest with different age groups in males

Variable		N	Mean	SD	F	df	P value
Central incisor at Crest Facial	A1 (18-28)	11	0.7977	0.14801	0.901	2	0.417; Not significant
	A2 (29-39)	11	0.7164	0.11070			
	A3 (40-50)	11	0.7714	0.17007			
	Total	33	0.7618	0.14457			
Central incisor at Crest Palatal	A1 (18-28)	11	0.9609	0.20417	3.688	2	0.037; Significant
	A2 (29-39)	11	0.8573	0.22926			
	A3 (40-50)	11	0.7445	0.10270			
	Total	33	0.8542	0.20199			
Central incisor 6mm from Crest Facial	A1 (18-28)	11	0.8273	0.22214	1.485	2	0.243; Not significant
	A2 (29-39)	11	0.7895	0.18958			
	A3 (40-50)	11	0.6936	0.14208			
	Total	33	0.7702	0.19033			
Central incisor 6mm from Crest Palatal	A1 (18-28)	11	2.7514	0.84904	1.210	2	0.312; Not significant
	A2 (29-39)	11	3.2509	0.89330			
	A3 (40-50)	11	2.8364	0.65552			
	Total	33	2.9462	0.81120			
Lateral incisor at Crest Facial	A1 (18-28)	11	0.8041	0.10052	0.392	2	0.679; Not significant
	A2 (29-39)	11	0.7464	0.07039			
	A3 (40-50)	11	0.7705	0.23623			
	Total	33	0.7736	0.15074			
Lateral incisor at Crest Palatal	A1 (18-28)	11	0.7577	0.13434	4.156	2	0.026; Significant
	A2 (29-39)	11	0.8727	0.21117			
	A3 (40-50)	11	0.6636	0.15633			
	Total	33	0.7647	0.18642			
Lateral incisor 6mm from Crest Facial	A1 (18-28)	11	0.6259	0.12278	0.415	2	0.664; Not significant
	A2 (29-39)	11	0.5832	0.13650			
	A3 (40-50)	11	0.5750	0.16041			
	Total	33	0.5947	0.13816			
Lateral incisor 6mm from Crest Palatal	A1 (18-28)	11	2.6314	0.76168	4.202	2	0.025; Significant
	A2 (29-39)	11	3.4005	1.34141			
	A3 (40-50)	11	2.2323	0.62396			
	Total	33	2.7547	1.05246			
Canine at Crest Facial	A1 (18-28)	11	0.8186	0.15149	0.093	2	0.912; Not significant
	A2 (29-39)	11	0.7868	0.09608			
	A3 (40-50)	11	0.8077	0.24648			
	Total	33	0.8044	0.17094			
Canine at Crest Palatal	A1 (18-28)	11	0.9114	0.18246	0.737	2	0.487; Not significant
	A2 (29-39)	11	0.8145	0.18634			
	A3 (40-50)	11	0.8400	0.21147			
	Total	33	0.8553	0.19225			
Canine 6mm from Crest Facial	A1 (18-28)	11	0.7082	0.14280	0.041	2	0.960; Not significant
	A2 (29-39)	11	0.7227	0.16351			
	A3 (40-50)	11	0.7014	0.21999			
	Total	33	0.7108	0.17301			
Canine 6mm from Crest Palatal	A1 (18-28)	11	3.0991	1.14372	1.852	2	0.174; Not significant
	A2 (29-39)	11	3.7900	2.11815			
	A3 (40-50)	11	2.6136	0.65660			
	Total	33	3.1676	1.47845			

Table 2: Comparison of distance from crest to nasal floor of central incisor, lateral incisor and canine with different age groups in males

Groups	Central incisor Crest to Nasal floor	Lateral incisor Crest to Nasal floor	Canine Crest to Nasal floor
A1 (18-28)	19.0182	19.2077	19.5023
A2 (29-39)	18.7368	18.8645	20.4777
A3 (40-50)	19.7173	19.5277	21.0214
F	0.391	0.237	1.143
df	2	2	2
P value	0.680; Not significant	0.791; Not significant	0.332; Not significant

Table 3: Comparison of facial and palatal width of lateral incisor at crest as well as at 6mm from crest with different age groups in females

Variable		N	Mean	SD	F	df	P value
Central incisor at Crest Facial	B1 (18-28)	11	0.7209	0.09332	0.652	2	0.528; Not significant
	B2 (29-39)	11	0.7414	0.20710			
	B3 (40-50)	11	0.6691	0.13638			
	Total	33	0.7105	0.15130			
Central incisor at Crest Palatal	B1 (18-28)	11	0.9264	0.40247	1.611	2	0.216; Not significant
	B2 (29-39)	11	0.8100	0.24945			
	B3 (40-50)	11	0.7105	0.12246			
	Total	33	0.8156	0.28771			
Central incisor 6mm from Crest Facial	B1 (18-28)	11	0.5368	0.13335	3.909	2	0.031; Significant
	B2 (29-39)	11	0.7641	0.28396			
	B3 (40-50)	11	0.6559	0.10339			
	Total	33	0.6523	0.20732			
Central incisor 6mm from Crest Palatal	B1 (18-28)	11	3.0882	0.95460	3.594	2	0.040; Significant
	B2 (29-39)	11	2.3832	0.95745			
	B3 (40-50)	11	2.2059	0.41481			
	Total	33	2.5591	0.88020			
Lateral incisor at Crest Facial	B1 (18-28)	11	0.6791	0.08639	0.670	2	0.519; Not significant
	B2 (29-39)	11	0.7509	0.25792			
	B3 (40-50)	11	0.6791	0.10327			
	Total	33	0.7030	0.16624			
Lateral incisor at Crest Palatal	B1 (18-28)	11	0.7873	0.19288	0.744	2	0.484; Not significant
	B2 (29-39)	11	0.7141	0.24917			
	B3 (40-50)	11	0.6941	0.08616			
	Total	33	0.7318	0.18709			
Lateral incisor 6mm from Crest Facial	B1 (18-28)	11	0.5105	0.12672	0.318	2	0.730; Not significant
	B2 (29-39)	11	0.5432	0.12544			
	B3 (40-50)	11	0.5477	0.10548			
	Total	33	0.5338	0.11703			
Lateral incisor 6mm from Crest Palatal	B1 (18-28)	11	2.5800	1.00127	1.516	2	0.236; Not significant
	B2 (29-39)	11	2.1805	0.94130			
	B3 (40-50)	11	1.9609	0.50534			
	Total	33	2.2405	0.85891			
Canine at Crest Facial	B1 (18-28)	11	0.8827	0.33154	0.937	2	0.403; Not significant
	B2 (29-39)	11	0.7764	0.28198			
	B3 (40-50)	11	0.7345	0.12686			
	Total	33	0.7979	0.26123			

Table 3 Continued…							
Canine at Crest Palatal	B1 (18-28)	11	0.7741	0.13459	2.913	2	0.070; Not significant
	B2 (29-39)	11	0.7045	0.16943			
	B3 (40-50)	11	0.8445	0.09321			
	Total	33	0.7744	0.14393			
Canine 6mm from Crest Facial	B1 (18-28)	11	0.5927	0.12271	0.397	2	0.676; Not significant
	B2 (29-39)	11	0.6455	0.14233			
	B3 (40-50)	11	0.6195	0.15011			
	Total	33	0.6192	0.13622			
Canine 6mm from Crest Palatal	B1 (18-28)	11	2.6132	0.62976	1.112	2	0.342; Not significant
	B2 (29-39)	11	2.9032	1.03753			
	B3 (40-50)	11	2.4077	0.60551			
	Total	33	2.6414	0.78582			

Table 4: Comparison of distance from crest to nasal floor of central incisor, lateral incisor and canine with different age groups in females

Groups	**Central incisor Crest to Nasal floor**	**Lateral incisor Crest to Nasal floor**	**Canine Crest to Nasal floor**
B1 (18-28)	15.2145	15.9855	18.6295
B2 (29-39)	18.1423	18.0914	18.8336
B3 (40-50)	19.2073	19.8409	20.0064
F	6.902	6.703	0.886
df	2	2	2
P value	0.003; Significant	0.004; Significant	0.423; Not significant

Table 5: Comparison of facial and palatal width of central incisor, lateral incisor and canine at crest and at 6mm from crest in 18-28 years age group with gender

Age group (18-28 years)	**Gender**	**N**	**Mean**	**SD**	**t**	**df**	**P value**
Central incisor at Crest Facial	Male	11	0.7977	0.14801	1.456	20	0.161
	Female	11	0.7209	0.09332			
Central incisor at Crest Palatal	Male	11	0.9609	0.20417	0.254	20	0.802
	Female	11	0.9264	0.40247			
Central incisor 6mm from Crest Facial	Male	11	0.8273	0.22214	3.718	20	0.001*
	Female	11	0.5368	0.13335			
Central incisor 6mm from Crest Palatal	Male	11	2.7514	0.84904	-0.874	20	0.392
	Female	11	3.0882	0.95460			
Lateral incisor at Crest Facial	Male	11	0.8041	0.10052	3.128	20	0.005*
	Female	11	0.6791	0.08639			
Lateral incisor at Crest Palatal	Male	11	0.7577	0.13434	-0.417	20	0.681
	Female	11	0.7873	0.19288			
Lateral incisor 6mm from Crest Facial	Male	11	0.6259	0.12278	2.170	20	0.042*
	Female	11	0.5105	0.12672			
Lateral incisor 6mm from Crest Palatal	Male	11	2.6314	0.76168	0.135	20	0.894
	Female	11	2.5800	1.00127			
Canine at Crest Facial	Male	11	0.8186	0.15149	-0.583	20	0.566
	Female	11	0.8827	0.33154			
Canine at Crest Palatal	Male	11	0.9114	0.18246	2.008	20	0.058
	Female	11	0.7741	0.13459			
Canine 6mm from Crest Facial	Male	11	0.7082	0.14280	2.034	20	0.055
	Female	11	0.5927	0.12271			
Canine 6mm from Crest Palatal	Male	11	3.0991	1.14372	1.234	20	0.231
	Female	11	2.6132	0.62976			

*Indicates that P value is significant

Table 6: Comparison of facial and palatal width of central incisor, lateral incisor and canine at crest and at 6mm from crest in 29-39 years age group with gender

Age group (29-39 years)	Gender	N	Mean	SD	t	df	P value
Central incisor at Crest Facial	Male	11	0.7164	0.11070	-0.353	20	0.728
	Female	11	0.7414	0.20710			
Central incisor at Crest Palatal	Male	11	0.8573	0.22926	0.463	20	0.649
	Female	11	0.8100	0.24945			
Central incisor 6mm from Crest Facial	Male	11	0.7895	0.18958	0.247	20	0.807
	Female	11	0.7641	0.28396			
Central incisor 6mm from Crest Palatal	Male	11	3.2509	0.89330	2.198	20	0.040*
	Female	11	2.3832	0.95745			
Lateral incisor at Crest Facial	Male	11	0.7464	0.07039	-0.056	20	0.956
	Female	11	0.7509	0.25792			
Lateral incisor at Crest Palatal	Male	11	0.8727	0.21117	1.611	20	0.123
	Female	11	0.7141	0.24917			
Lateral incisor 6mm from Crest Facial	Male	11	0.5832	0.13650	0.716	20	0.482
	Female	11	0.5432	0.12544			
Lateral incisor 6mm from Crest Palatal	Male	11	3.4005	1.34141	2.469	20	0.023*
	Female	11	2.1805	.94130			
Canine at Crest Facial	Male	11	0.7868	0.09608	0.116	20	0.909
	Female	11	0.7764	0.28198			
Canine at Crest Palatal	Male	11	0.8145	0.18634	1.449	20	0.163
	Female	11	0.7045	0.16943			
Canine 6mm from Crest Facial	Male	11	0.7227	0.16351	1.182	20	0.251
	Female	11	0.6455	0.14233			
Canine 6mm from Crest Palatal	Male	11	3.7900	2.11815	1.247	20	0.227
	Female	11	2.9032	1.03753			

*Indicates that P value is significant

Table 7: Comparison of facial and palatal width of central incisor, lateral incisor and canine at crest and at 6mm from crest in 40-50 years age group with gender

Age group (40-50 years)	Gender	N	Mean	SD	t	df	P value
Central incisor at Crest Facial	Male	11	0.7714	0.17007	1.556	20	0.135
	Female	11	0.6691	0.13638			
Central incisor at Crest Palatal	Male	11	0.7445	0.10270	0.707	20	0.487
	Female	11	0.7105	0.12246			
Central incisor 6mm from Crest Facial	Male	11	0.6936	0.14208	0.712	20	0.485
	Female	11	0.6559	0.10339			
Central incisor 6mm from Crest Palatal	Male	11	2.8364	0.65552	2.695	20	0.014*
	Female	11	2.2059	0.41481			
Lateral incisor at Crest Facial	Male	11	0.7705	0.23623	1.175	20	0.254
	Female	11	0.6791	0.10327			
Lateral incisor at Crest Palatal	Male	11	0.6636	0.15633	-0.566	20	0.578
	Female	11	0.6941	0.08616			
Lateral incisor 6mm from Crest Facial	Male	11	0.5750	0.16041	0.471	20	0.643
	Female	11	0.5477	0.10548			
Lateral incisor 6mm from Crest Palatal	Male	11	2.2323	0.62396	1.121	20	0.276
	Female	11	1.9609	0.50534			
Canine at Crest Facial	Male	11	0.8077	0.24648	0.876	20	0.392
	Female	11	0.7345	0.12686			
Canine at Crest Palatal	Male	11	0.8400	0.21147	-0.065	20	0.949
	Female	11	0.8445	0.09321			
Canine 6mm from Crest Facial	Male	11	0.7014	0.21999	1.019	20	0.320
	Female	11	0.6195	0.15011			
Canine 6mm from Crest Palatal	Male	11	2.6136	0.65660	0.765	20	0.453
	Female	11	2.4077	0.60551			

*Indicates that P value is significant

Table 8: Comparison of distance from crest to nasal floor of central incisor, lateral incisor and canine in 18-28 years, 29-39 years and 40-50 years age group with gender

Variable	Age group	Gender	N	Mean	SD	t	df	P value
Central incisor Crest to Nasal Floor	Age group (18-28 years)	Male	11	19.0182	2.59941	4	20	< 0.001*
		Female	11	15.2145	1.78543			
	Age group (29-39 years)	Male	11	18.7368	2.96292	0.447	20	0.659
		Female	11	18.1423	3.26259			
	Age group (40-50 years)	Male	11	19.7173	2.44889	0.476	20	0.639
		Female	11	19.2073	2.57031			
Lateral incisor Crest to Nasal Floor	Age group (18-28 years)	Male	11	19.2077	2.82625	3.286	20	0.004*
		Female	11	15.9855	1.60834			
	Age group (29-39 years)	Male	11	18.8645	2.19035	0.714	20	0.483
		Female	11	18.0914	2.84639			
	Age group (40-50 years)	Male	11	19.5277	1.59713	-0.325	20	0.748
		Female	11	19.8409	2.76747			
Canine Crest to Nasal Floor	Age group (18-28 years)	Male	11	19.5023	2.76024	0.847	20	0.407
		Female	11	18.6295	2.0132			
	Age group (29-39 years)	Male	11	19.5023	2.76024	0.847	20	0.407
		Female	11	18.6295	2.0132			
	Age group (40-50 years)	Male	11	21.0214	2.46044	0.915	20	0.371
		Female	11	20.0064	2.73517			

* Indicates that P value is significant

4. Discussion

The anterior maxilla, or "esthetic zone," is critical for supporting the upper teeth and shaping the facial skeleton, making it essential for dental implant placement and aesthetic outcomes.[12,13] Accurate bone dimensions around natural teeth are crucial for planning immediate implants.[14] A study by Farahmand et al. used Cone Beam CT to measure facial bone thickness in the anterior maxilla, highlighting the need for careful planning at the extraction site.[15]

In addition to facial bone thickness, the palatal bone is crucial for guiding implant placement, as highlighted by Gluckman et al, influencing both the initial osteotomy and the long-term success of the implant. Alveolar bone height also directly impacts implant stability and aesthetics, making precise measurements crucial for treatment planning.[16]

Present study was carried out to evaluate the bone dimension and the relation of alveolar crest level with floor of nasal fossa of anterior maxilla and their association with age and gender using cone beam computed tomography. A total; 66 patients were included in the study, divided into two groups: males (n=33) and females (n=33) which were sub grouped in to different age groups as 18-28, 29-39, 40-50 years.

Our results showed that the mean facial width at the crest was 0.73 ± 0.14 mm for the central incisor, 0.73 ± 0.16 mm for the lateral incisor, and 0.80 ± 0.21 mm for the canine, similar to findings by Al Tarawneh et al.[17] and Zekry et al.[18] At 6mm from the crest, the mean facial width was 0.71 ± 0.20 mm for the central incisor, 0.56 ± 0.13 mm for the lateral incisor, and 0.66 ± 0.16 mm for the canine, which aligns with Al Tarawneh et al[17] study.

For palatal width at the crest, we found 0.83 ± 0.24 mm for the central incisor, 0.74 ± 0.18 mm for the lateral incisor, and 0.81 ± 0.17 mm for the canine, similar to the results of Gluckman et al.[3] At 6mm from the crest, the mean palatal width was 2.75 ± 0.86 mm for the central incisor, 2.49 ± 0.98 mm for the lateral incisor, and 2.90 ± 1.20 mm for the canine, in agreement with Albandar et al.[19]

The mean distance from the alveolar crest to the nasal floor was 18.33 ± 2.94 mm for the central incisor, 18.58 ± 2.61 mm for the lateral incisor, and 19.74 ± 2.50 mm for the canine, consistent with findings from Zhang et al.[5] These results confirm the reliability of CBCT in assessing the bone dimensions of the anterior maxilla.

This study found significant age-related differences in the facial and palatal widths of the central and lateral incisors, with little change observed in the canine region. In males, the 18-28 years age group had the largest mean palatal width at the crest of the central incisor, which was statistically significant compared to older groups. This aligns with Rai et al., who also reported greater palatal thickness in younger individuals, suggesting a decline with age.[1]

For the lateral incisor, the 29-39 years age group exhibited significantly greater palatal width both at the crest and 6mm from the crest, consistent with Rai et al.[1] In contrast, Albandar et al. found no significant age-related changes in the anterior maxilla, which may reflect differences in study design or methodology.[19]

No significant differences were observed in the facial and palatal widths of the canine across age groups, supporting findings by Sheerah et al.[9] and Abdulmajeed et al.[20] that canine bone thickness remains stable with age.

In females, the 29-39 years age group showed significantly greater facial width at 6mm from the crest of the central incisor ($p = 0.031$), in line with Xuewei Wang et al.,[8] who observed reduced facial plate thickness with age. For palatal width, the 18-28 years age group had significantly greater width at 6mm from the crest ($p = 0.040$), reflecting similar trends in males. However, Albandar et al.[19] found no significant changes in palatal bone thickness at the crest, highlighting variability across studies.

These findings highlight the importance of considering age in clinical assessments of dental and maxillofacial anatomy, as age-related changes could impact implant planning and placement strategies.

The mean distance from the crest to the nasal floor for the central incisor, lateral incisor, and canine was greatest in the 40-50 years age group, with significant differences observed for the central and lateral incisors. These results are consistent with Rai et al. [1], who found a significant difference in alveolar height across age groups for the lateral incisor and reported greater alveolar height in the 41-50 years age group for the central incisor. In our study, the maxillary canine exhibited the greatest alveolar height, followed by the lateral incisor and central incisor, which aligns with Dina F. Ahmed et al.[21] However, Zhang et al.[5] found no significant differences in alveolar height among teeth. These findings highlight the significance of age-related changes in alveolar height, particularly in the central and lateral incisors, which is crucial for accurate implant planning in older patients.

Gender comparison of bone thickness in our study showed that, in the 18-28 years age group, males had significantly greater facial width at 6mm from the crest for both the central and lateral incisors compared to females. These findings are consistent with Nuhad A. Hassan et al.[22] and El Nahass et al.,[23] who also reported greater buccal bone thickness in males. Additionally, the mean palatal width at 6mm from the crest was greater in males for both incisors in 29-39 years age group, with statistically significant differences, consistent with Xuewei Wang et al.[8] In the 40-50 years age group, males again showed greater palatal width at 6mm from the crest for the central incisor, supporting findings by Xuewei Wang et al.[8] and Rai et al.[1] However, Albandar et al.[19] found no significant gender effect on palatal bone thickness in anterior teeth, indicating variability across studies. These findings highlight the significant impact of gender on facial and palatal bone dimensions, especially in the central and lateral incisors.

In our study, gender-wise comparison of alveolar height revealed that males had greater alveolar height compared to females. Specifically, in the 18–28-year age group, males exhibited significantly greater alveolar height for both the central and lateral incisors, with these differences being statistically significant. This finding aligns with the study by Rim et al.,[23] who also reported that males tend to have greater alveolar bone heights than females.

This radiographic study evaluated the alveolar bone thickness both labially and palatally in the maxillary anterior region, identifying a notably thin facial bone in the anterior area. At all measurement points (At crest and 6 mm from crest), the facial bone thickness was consistently less than 2 mm across all maxillary anterior teeth. These results reinforce the suggestion that implant placement in this region should be angled palatally for improved outcomes. Also, our study reveals significant age-related and gender differences in maxillary bone dimensions, with males showing greater facial and palatal widths, as well as alveolar height, particularly in the 18-28-year age group. These age-related changes in the central and lateral incisors emphasize the need to consider age and gender in implant treatment planning for optimal outcomes.

5. Limitations and Future Scope of Study

The limitation of the study was the small sample size.

Thus, for further evaluation and future scope, more studies with a larger sample size are needed to correlate the bone dimension and the relation of alveolar crest level with floor of nasal fossa of anterior maxilla with all the two parameters namely age and gender of participants.

6. Conclusion

The presence of intact buccal and palatal cortical plates enhances implant stability and improves prognosis. There is association of age and gender with bone dimension.

The results of this study may provide an insight on the usefulness of CBCT in providing a base line data for selecting the appropriate site for implant placement in terms of alveolar width and height.

7. Source of Funding

Nil.

8. Conflicts of Interest

There are no conflicts of interest.

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