ORIGINAL RESEARCH PAPER

Volume-7 | Issue-4 | April-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

MEASUREMENT OF PALATAL BONE THICKNESS IN DIFFERENT ARCH FORMS IN LATE MIXED AND PERMANENT DENTITION – A CONE BEAM COMPUTED TOMOGRAPHY STUDY

Dental Science

Mahalakshmi.K Senior Lecturer, Department of Orthodontics, Tagore Dental College, Chennai.

Sumanth Rangarajan* Reader, Department of Orthodontics, Adhiparasakthi Dental College, Melmaruvathur. *Corresponding Author

ABSTRACT

Introduction: The success of any orthodontic treatment depends on the anchorage control. The palatal area of maxilla with less anatomical structures, serves as an ideal site for the placement of the miniscrew. Aim:The purpose of this study is to compare the palatal bone thickness in different arch forms.

Materials and Methods: CBCT scans of 84 subjects was selected and divided into late mixed(n=42) and permanent dentition(n=42) groups and further into square(n=14),ovoid(n=14) and tapered(n=14) arch forms. The measurements of palatal bone thickness were made at 24 sites using CareStream 3D Imaging software. Results: Bone thickness was higher in the anterior region than in the middle and posterior regions. Square arch forms had thicker bone than ovoid and tapered arch forms.

Conclusion: Thus, determination of palatal bone thickness is considered to be a key factor which helps in the selection of implants and assessment of placement site for the successful orthodontic treatment.

KEYWORDS

Bone analysis, Diagnostic imaging, Dentition

Introduction:

In recent years, miniscrews are used in orthodontics which are temporarily fixed to the bone to enhance orthodontic anchorage either by supporting the teeth of the reactive unit ,or by obviating the need for reactive unit. The design of the miniscrews and the palatal bone thickness determines the success of miniscrew anchorage in maxilla. Many studies has been previously conducted to measure the palatal bone thickness and bone density according to sex, age, and physical conditions. Fulya [1] determined the bone thickness of adults with different facial heights and found that the low angle cases had higher value (2.18mm)than the high angle cases(1.6mm) . Gracco et al[2] compared the bone thickness in different age groups from 10-44 yrs and stated that there was no significant difference between age groups and the thickest bone was found in the anterior sutural region of the palate. King et al[3] concluded that 93% males and 91% females have an adequate bone depth at 3mm lateral to midpalatal suture and 4mm posterior from incisive foramen and there was no correlation between age and the bone depth in paramedian palatal area.

However bone thickness was not assessed in different arch forms, as it is commonly believed that dental arch form, is influenced by supporting bone, musculature, eruption of teeth and intraoral functional forces. The aim of this study is to assess the bone thickness of various palatal areas using CBCT in different arch forms in late mixed and permanent dentition and to guide the clinicians in selecting the most appropriate sites for miniscrews in the palate. especially in adolescent where the incomplete obliteration of the midpalatal suture might increase placement risks. CBCT was used as it produces most accurate reproduction of various biological structures.

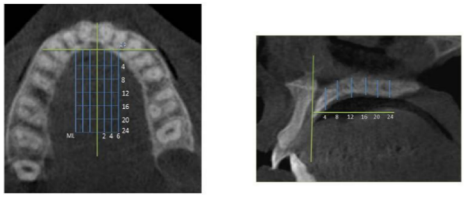
Materials and Methods:

The sample consisted of randomly selected 84 outpatients who visited Department of Orthodontics, Sree Balaji Dental College and Hospital, Chennai in 2014. The subjects were divided into two groups according to dental eruption status of canine. GROUP 1 consisted of 42 late mixed dentition subjects (mean age -12 yrs) where canine eruption has completed with partially erupted posterior teeth and GROUP 2 consisted of 42 permanent dentition subjects (mean age - 18yrs) where all permanent teeth were completely erupted. Patients with missing or grossly decayed teeth; prosthetic crowns or gingival defects, facial and dental asymmetry, diseases affecting quality and quantity of bone were excluded from this study. The institutional ethical committee has approved the proposed project. Informed consents were obtained from all patients or their parents.

All the 84 subjects were subjected to CBCT scan .Kodak CBCT equipment with 90 kVp; 10 mA; field of view 17*23 cm; exposure time 15 seconds; i-CAT scanner(Imaging Sciences International, Hatfield, Pa) with a spatial resolution of 10 line pairs per centimeter and an isotropic 0.33-mm voxel size was used. The palatal bone thickness was measured at 0, 2, 4, and 6mm mediolateral(ML) to the midpalatal suture on the coronal plane and from 0 to 24mm at 4-mm interval anteroposteriorly(AP) to the level of the posterior margin of the incisive foramen on the sagittal plane. The measurements were made at the intersection points of the reference lines over a set of equally sized grids formed by 24 sites(APML)(Fig 1A).The thickness of the palatal bone was measured perpendicular to the horizontal plane at each designated point(Fig 1B).

FIG 1: REFERENCE LINES FOR MEASURING PALATAL BONE THICKNESS:

A. OCCLUSAL VIEW B. SAGITTAL VIEW: BONE THICKNESS MEASURED EVERY 4 MM FROM THE POSTERIOR MARGIN OF THE INCISIVE FORAMEN



Arch form templates were procured from Orthoform 3M Unitek, Monrovia, CA,USA(Fig2) .The arch form templates were placed over the incisal and buccal cusp tips of the teeth in the study model, for determination of arch forms as square, tapered and ovoid. (Fig 3).

FIG 2: ARCH FORM TEMPLATE

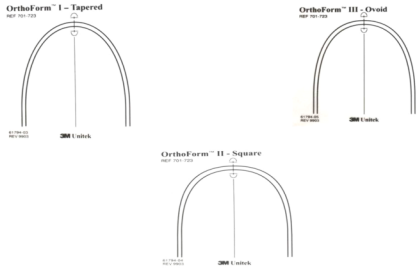


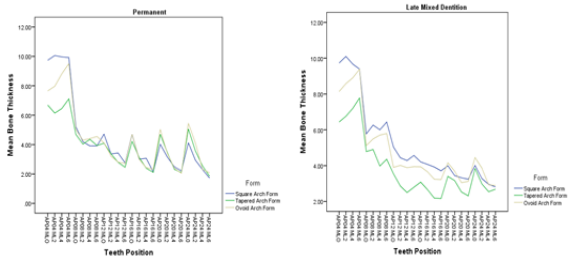
FIG 3: DETERMINATION OF ARCH FORM

Results:
Table 1 shows the mean and standard deviation of the values obtained through CBCT in late mixed and permanent dentition in various arch forms(Graph 1).

TABLE 1: MEAN PALATAL BONE THICKNESS IN LATE MIXED AND PERMANENT DENTITION IN VARIOUS ARCH FORMS.

Teeth Position	Dentition											
	Permanent						Late Mixed Dentition					
	Square Arch Form		Tapered Arch Form		Ovoid Arch Form		Square Arch Form		Tapered Arch Form		Ovoid Arch Form	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
AP4 MLO	9.74	.46	6.69	.63	7.65	.93	9.73	.32	6.44	.43	8.14	.65
AP4 ML2	10.06	.35	6.14	.72	7.96	1.01	10.10	.61	6.76	.62	8.58	.67
AP4 ML4	9.96	.35	6.45	1.25	8.81	.90	9.67	.47	7.19	.77	8.90	.77
AP4 ML6	9.92	.50	7.11	1.28	9.51	.98	9.39	.51	7.77	1.02	9.38	.74
AP8 MLO	5.21	.16	4.69	.79	5.01	.48	5.78	.71	4.79	.88	5.12	.50
AP8 ML2	4.19	.17	4.03	.92	4.30	.87	6.26	.73	4.90	.56	5.49	.50
AP8 ML4	3.91	.24	4.36	.67	4.41	.93	6.00	.59	3.98	.61	5.71	.45
AP8 ML6	3.91	.17	3.94	.56	4.55	.82	6.44	.60	4.36	1.03	5.79	1.42
AP12 MLO	4.71	.40	4.09	.69	4.11	.82	5.04	.80	3.54	.58	3.90	.92
Ap12 ML2	3.36	.60	3.37	.61	3.21	.85	4.44	.46	2.86	.59	4.01	.66
AP12 ML4	3.43	.27	2.79	.60	2.81	.76	4.29	.28	2.50	.23	3.89	.79
Ap12 ML6	2.75	.57	2.46	.47	2.71	.65	4.57	.27	2.79	.59	3.94	1.27
AP16 MLO	4.69	.38	4.22	.58	4.69	.92	4.21	.32	3.08	.38	3.94	1.01
AP16 ML2	3.01	.57	3.12	.52	2.99	.85	4.07	.44	2.66	.81	3.66	1.07
AP16 ML4	3.07	.19	2.39	.38	2.43	.62	3.92	.23	2.19	.37	3.24	1.13
Ap16 ML6	2.14	.28	2.11	.37	2.34	.68	3.71	.38	2.16	.14	3.22	1.19
AP20 ML0	4.01	.53	4.70	.66	5.03	1.21	3.99	.39	3.40	.47	4.16	1.50
AP20 ML2	3.16	.46	3.46	.66	3.41	1.08	3.44	.47	3.16	.74	3.69	1.11
AP20 ML4	2.49	.25	2.32	.47	2.39	.57	3.32	.43	2.53	.38	3.05	1.12
AP20 ML6	2.21	.46	2.10	.38	2.05	.48	3.24	.47	2.31	.11	3.12	1.32
AP24 ML0	4.12	.72	5.06	.53	5.44	1.00	4.01	.39	3.84	.61	4.45	1.49
AP24 ML2	2.94	.26	3.57	.80	4.10	1.11	3.28	.59	2.98	.58	3.86	1.07
AP24 ML4	2.31	.13	2.55	.62	2.32	.59	2.96	.34	2.54	.24	2.93	1.10
AP24 ML6	1.71	.27	1.84	.41	2.09	.54	2.81	.48	2.69	.29	2.90	1.44

GRAPH 1: PALATAL BONE THICKNESS IN VARIOUS ARCH FORMS IN LATE MIXED AND PERMANENT DENTITION



Independent sample t test was done to find the statistical difference($P< 0.05$) in palatal bone thickness between late mixed and permanent dentition in various arch forms(table 2). In square arch form , significant difference between late mixed and permanent dentition was found in many region with the highest statistical significance seen in AP8ML2,AP8ML4,AP8ML6,AP12ML2,AP12ML4,AP12ML6,AP16ML2,AP16ML4,AP16ML6,AP20ML2,AP20ML4,AL20ML6, AP24ML4, AL24ML6 (P=0.00). Tapered arch form showed significant difference in AP16ML0, AP20ML0, AP24ML0, AP24ML6 (P=0.000).In ovoid arch forms, statistically significant difference was seen in AP8ML2,AP8ML4 (P=0.000) followed by AP12ML4 (P=0.001).

TABLE 2:COMPARISON OF PALATAL BONE THICKNESS BETWEEN LATE MIXED AND PERMAMNET DENTITION IN VARIOUS ARCH FORMS (P<0.05)

Form		Dentition				Independent Samples Test	
		Permanent		Late Mixed Dentition			
		Mean	SD	Mean	SD	t-value	P- value
Square Arch Form	AP4 MLO	9.74	.46	9.73	.32	.048	.962
	AP4 ML2	10.06	.35	10.10	.61	-.227	.822
	AP4 ML4	9.96	.35	9.67	.47	1.871	.073
	AP4 ML6	9.92	.50	9.39	.51	2.756	**.011**
	AP8 MLO	5.21	.16	5.78	.71	-2.945	**.007**
	AP8 ML2	4.19	.17	6.26	.73	-10.356	**.000**
	AP8 ML4	3.91	.24	6.00	.59	-12.277	**.000**
	AP8 ML6	3.91	.17	6.44	.60	-15.078	**.000**
	AP12 MLO	4.71	.40	5.04	.80	-1.384	.178
	AP12 ML2	3.36	.60	4.44	.46	-5.332	**.000**
	AP12 ML4	3.43	.27	4.29	.28	-8.248	**.000**
	AP12 ML6	2.75	.57	4.57	.27	-10.793	**.000**
	AP16 MLO	4.69	.38	4.21	.32	3.687	**.001**
	AP16 ML2	3.01	.57	4.07	.44	-5.515	**.000**
	AP16 ML4	3.07	.19	3.92	.23	-10.874	**.000**
	AP16 ML6	2.14	.28	3.71	.38	-12.342	**.000**
	AP20 ML0	4.01	.53	3.99	.39	.123	.903
	AP20 ML2	3.16	.46	3.44	.47	-1.636	.114
	AP20 ML4	2.49	.25	3.32	.43	-6.302	**.000**

Tapered Arch Form	AP20 ML6	2.21	.46	3.24	.47	-5.861	**.000**
	AP24 ML0	4.12	.72	4.01	.39	.521	.607
	AP24 ML2	2.94	.26	3.28	.59	-1.980	.058
	AP24 ML4	2.31	.13	2.96	.34	-6.718	**.000**
	AP24 ML6	1.71	.27	2.81	.48	-7.539	**.000**
	AP4 MLO	6.69	.63	6.44	.43	1.228	.231
	AP4 ML2	6.14	.72	6.76	.62	-2.426	**.023**
	AP4 ML4	6.45	1.25	7.19	.77	-1.895	.069
	AP4 ML6	7.11	1.28	7.77	1.02	-1.522	.140
	AP8 MLO	4.69	.79	4.79	.88	-.293	.772
	AP8 ML2	4.03	.92	4.90	.56	-3.033	**.005**
	AP8 ML4	4.36	.67	3.98	.61	1.570	.128
	AP8 ML6	3.94	.56	4.36	1.03	-1.343	.191
	AP12 MLO	4.09	.69	3.54	.58	2.279	**.031**
	AP12 ML2	3.37	.61	2.86	.59	2.241	**.034**
	AP12 ML4	2.79	.60	2.50	.23	1.721	.097
	AP12 ML6	2.46	.47	2.79	.59	-1.660	.109
	AP16 MLO	4.22	.58	3.08	.38	6.179	**.000**
	AP16 ML2	3.12	.52	2.66	.81	1.785	.086
	AP16 ML4	2.39	.38	2.19	.37	1.467	.154
	AP16 ML6	2.11	.37	2.16	.14	-.476	.638
	AP20 ML0	4.70	.66	3.40	.47	5.980	**.000**
	AP20 ML2	3.46	.66	3.16	.74	1.128	.269
	AP20 ML4	2.32	.47	2.53	.38	-1.282	.211
	AP20 ML6	2.10	.38	2.31	.11	-2.035	.052
	AP24 ML0	5.06	.53	3.84	.61	5.670	**.000**
	AP24 ML2	3.57	.80	2.98	.58	2.236	**.034**
	AP24 ML4	2.55	.62	2.54	.24	.040	.968
	AP24 ML6	1.84	.41	2.69	.29	-6.211	**.000**
Ovoid Arch Form	AP4 MLO	7.65	.93	8.14	.65	-1.602	.121
	AP4 ML2	7.96	1.01	8.58	.67	-1.900	.069
	AP4 ML4	8.81	.90	8.90	.77	-.292	.772
	AP4 ML6	9.51	.98	9.38	.74	.393	.698
	AP8 MLO	5.01	.48	5.12	.50	-.578	.568
	AP8 ML2	4.30	.87	5.49	.50	-4.428	**.000**
	AP8 ML4	4.41	.93	5.71	.45	-4.725	**.000**
	AP8 ML6	4.55	.82	5.79	1.42	-2.834	**.009**
	AP12 MLO	4.11	.82	3.90	.92	.650	.521
	AP12 ML2	3.21	.85	4.01	.66	-2.817	**.009**
	AP12 ML4	2.81	.76	3.89	.79	-3.686	**.001**
	AP12 ML6	2.71	.65	3.94	1.27	-3.239	**.003**
	AP16 MLO	4.69	.92	3.94	1.01	2.070	**.048**
	AP16 ML2	2.99	.85	3.66	1.07	-1.824	.080
	AP16 ML4	2.43	.62	3.24	1.13	-2.368	**.026**
	AP16 ML6	2.34	.68	3.22	1.19	-2.427	**.022**
	AP20 ML0	5.03	1.21	4.16	1.50	1.694	.102
	AP20 ML2	3.41	1.08	3.69	1.11	-.673	.507
	AP20 ML4	2.39	.57	3.05	1.12	-1.979	.059
	AP20 ML6	2.05	.48	3.12	1.32	-2.867	**.008**
	AP24 ML0	5.44	1.00	4.45	1.49	2.074	**.048**
	AP24 ML2	4.10	1.11	3.86	1.07	.572	.572
	AP24 ML4	2.32	.59	2.93	1.10	-1.811	.082
	AP24 ML6	2.09	.54	2.90	1.44	-1.981	.058

Table 3 shows statistically significant difference between the three arch forms (square, tapered , ovoid) in late mixed and permanent dentition groups using one way ANOVA test. Significant difference was seen between the various arch forms in anterior as well as posterior palatal region in late mixed and permanent dentition groups. In permanent dentition, AP4ML0, AP4ML2, AP4ML4, AP4ML6, AP16ML4, AP24ML2 showed significant difference between different arch forms(P=0.000).In late mixed dentition ,significant difference was seen in AP4ML0, AP4ML2, AP4ML4,AP4ML6, AP8ML2 (P=0.000) etc.

TABLE 3:COMPARISON OF PALATAL BONE THICKNESS BETWEEN SQUARE,TAPERED AND OVOID ARCH FORMS IN LATE MIXED AND PERMANANT DENTITION (P<0.05).

Teeth		Arch Form						One way ANOVA	
		Square Arch Form		Tapered Arch Form		Ovoid Arch Form			
		Mean	SD	Mean	SD	Mean	SD	F-value	P-value
Permanent	AP4 MLO	9.74	.46	6.69	.63	7.65	.93	69.100	**.000**
	AP4 ML2	10.06	.35	6.14	.72	7.96	1.01	97.700	**.000**
	AP4 ML4	9.96	.35	6.45	1.25	8.81	.90	54.059	**.000**
	AP4 ML6	9.92	.50	7.11	1.28	9.51	.98	34.177	**.000**
	AP8 MLO	5.21	.16	4.69	.79	5.01	.48	3.251	**.049**
	AP8 ML2	4.19	.17	4.03	.92	4.30	.87	.479	.623
	AP8 ML4	3.91	.24	4.36	.67	4.41	.93	2.343	.109
	AP8 ML6	3.91	.17	3.94	.56	4.55	.82	5.405	**.008**

	AP12 MLO	4.71	.40	4.09	.69	4.11	.82	3.909	**.028**
	AP12 ML2	3.36	.60	3.37	.61	3.21	.85	.250	.780
	AP12 ML4	3.43	.27	2.79	.60	2.81	.76	5.522	**.008**
	AP12 ML6	2.75	.57	2.46	.47	2.71	.65	1.084	.348
	AP16 MLO	4.69	.38	4.22	.58	4.69	.92	2.351	.109
	AP16 ML2	3.01	.57	3.12	.52	2.99	.85	.159	.854
	AP16 ML4	3.07	.19	2.39	.38	2.43	.62	10.988	**.000**
	AP16 ML6	2.14	.28	2.11	.37	2.34	.68	.904	.413
	AP20 ML0	4.01	.53	4.70	.66	5.03	1.21	5.148	**.010**
	AP20 ML2	3.16	.46	3.46	.66	3.41	1.08	.621	.543
	AP20 ML4	2.49	.25	2.32	.47	2.39	.57	.477	.624
	AP20 ML6	2.21	.46	2.10	.38	2.05	.48	.463	.633
	AP24 ML0	4.12	.72	5.06	.53	5.44	1.00	10.819	**.000**
	AP24 ML2	2.94	.26	3.57	.80	4.10	1.11	7.369	**.002**
	AP24 ML4	2.31	.13	2.55	.62	2.32	.59	1.030	.367
	AP24 ML6	1.71	.27	1.84	.41	2.09	.54	2.780	.074
Late Mixed Dentition	AP4 MLO	9.73	.32	6.44	.43	8.14	.65	161.761	**.000**
	AP4 ML2	10.10	.61	6.76	.62	8.58	.67	97.306	**.000**
	AP4 ML4	9.67	.47	7.19	.77	8.90	.77	47.797	**.000**
	AP4 ML6	9.39	.51	7.77	1.02	9.38	.74	19.778	**.000**
	AP8 MLO	5.78	.71	4.79	.88	5.12	.50	6.961	**.003**
	AP8 ML2	6.26	.73	4.90	.56	5.49	.50	17.992	**.000**
	AP8 ML4	6.00	.59	3.98	.61	5.71	.45	54.419	**.000**
	AP8 ML6	6.44	.60	4.36	1.03	5.79	1.42	13.785	**.000**
	AP12 MLO	5.04	.80	3.54	.58	3.90	.92	14.019	**.000**
	AP12 ML2	4.44	.46	2.86	.59	4.01	.66	28.283	**.000**
	AP12 ML4	4.29	.28	2.50	.23	3.89	.79	48.955	**.000**
	AP12 ML6	4.57	.27	2.79	.59	3.94	1.27	16.753	**.000**
	AP16 MLO	4.21	.32	3.08	.38	3.94	1.01	11.465	**.000**
	AP16 ML2	4.07	.44	2.66	.81	3.66	1.07	11.068	**.000**
	AP16 ML4	3.92	.23	2.19	.37	3.24	1.13	21.970	**.000**
	AP16 ML6	3.71	.38	2.16	.14	3.22	1.19	16.652	**.000**
	AP20 ML0	3.99	.39	3.40	.47	4.16	1.50	2.555	.091
	AP20 ML2	3.44	.47	3.16	.74	3.69	1.11	1.425	.253
	AP20 ML4	3.32	.43	2.53	.38	3.05	1.12	4.298	**.021**
	AP20 ML6	3.24	.47	2.31	.11	3.12	1.32	5.451	**.008**
	AP24 ML0	4.01	.39	3.84	.61	4.45	1.49	1.515	.232
	AP24 ML2	3.28	.59	2.98	.58	3.86	1.07	4.624	**.016**
	AP24 ML4	2.96	.34	2.54	.24	2.93	1.10	1.613	.212
	AP24 ML6	2.81	.48	2.69	.29	2.90	1.44	.205	.816

Post hoc analysis using TUKEY HSD (alpha =0.05) was done to find the reliability of the results obtained in One way ANOVA test. In permanent dentition , significant difference was seen between ovoid and square arch form in AP12 MLO (alpha =0.057) whereas in late mixed dentition group ,significant difference was seen in AP08 MLO region (alpha=0.05) between ovoid and square arch forms**.**

Discussion:

CBCT with a radiation dose of 36.9-50.3 microsievert[4], produces 3D information with high-resolution imaging, diagnostic reliability, and risk-benefit assessment. Primary stability of miniscrew is determined by the bone properties[5,6], surgical technique, and implant size and design[7]. Mechanical interlocking of miniscrews in cortical bone can be achieved by increasing the length and diameter of the miniscrew, thereby decreasing the load at the bone . Mid palatal area with dense cortical bone has been determined as the best anchorage site in the maxilla and hence the present study was done in the different palatal regions to assess the bone thickness. Even though the palate is a reliable and stable placement site for TADs, the cortical and cancellous bone densities in adults were higher than those in adolescents and hence this study was conducted on adults and adolescents. Miniscrews have been placed in the midpalatal suture area of adults, and the parapalatal area in adolescents to prevent possible developmental disturbances of the midpalatal sutures. In adults, increased bone density with decreased pore volume and diameter in lacunar canalicular region leads to longer hyalinization period and increased treatment duration. This is because the transverse growth of the midpalatal suture continues up to the late teen and is not fused completely even in adults.

In this study, the palatal bone thickness was higher in the anterior region than the posterior regions in both late mixed and permanent dentition which correlated with the study conducted by Moon[8], Kang[9] and King[3].The study, also correlated with the study conducted by Lombardo[2] and Moon[10] who concluded that the palatal bone thickness decreased laterally and posteriorly but Lai et al[11] stated that the bone density tends to decrease laterally and anteriorly. The results also indicates that the area 2mm lateral to mid palatal suture and 4mm posterior to incisive papilla provides better implant stabilization due to the presence of good quality and quantity of bone. Significant difference in bone densities in late mixed and permanent dentition was seen anteroposteriorly from 8mm of incisive papilla and mediolateraly from 2mm from midpalatal suture.The study conducted by Farnsworth[12] and Park[13] also confirms that there is a significant difference between late mixed and permanent dentition groups due to the incomplete obliteration of the mid palatal suture in adolescents. But Ryu [14] found no significant difference between the two groups. In adults, factors such as dense bone, decreased pore volume and the periodontium determines the changes occurring during the orthodontic treatment [15].

The present study on arch forms was first of its kind to assess the palatal bone thickness in relation to different arch forms. The size and shape of the dental arches have considerable implications in orthodontic diagnosis and treatment planning affecting the space available, dental aesthetics and stability of the dentition. The square arch forms has the maximum bone thickness compared to the tapered and ovoid arch forms. Statistical analysis showed significant difference in the anterior region than the posterior region in both late mixed and permanent dentition (P=0.00).According to the study done by Milo Hellmen on Class II patients, the increase in bone thickness in anterior area in Class II division II patients was due to the abnormal muscular and atmospheric pressure on the mandibular molars leading to distal position of the teeth. The upper and lower lips have forced the maxillary anterior teeth back against the mandibular anterior teeth and with the tongue held in the upper part of the mouth, the upper arch has developed to nearly the proper width. The upper teeth are bunched and retruding, the upper arch nearly the normal width, the mandible nearly normal in development, and the chin normal or well developed and the maxillary alveolar process appears to have drifted anteriorly resulting in increased bone thickness in the anterior region. Therefore, the maximum bone thickness in the square arch form found in the present study may be attributed to the study done by Milo Hellmen. [16].

***Future studies*:** In the present study we have only evaluated the quality of bone in the palate, in relation to different arch forms in late mixed and permanent dentition. Further research with increased sample size and additional simulated studies can be done to evaluate the bone density in different types of palatal shape and in different types of malocclusion.

Conclusion: The present study was conducted to assess the bone thickness in various regions of the palate in late mixed and permanent dentition. The samples were further divided into three groups, in relation to their arch forms as square, tapered and ovoid with the help of orthoform arch form template. The palatal area was further divided into 24 areas mediolaterally and anteroposteriorly. The palatal bone thickness was measured at the point of intersection of these areas.

The CBCT study findings regarding palatal bone thickness of late mixed and permanent dentition in different arch forms can be summarized as follows: a) The late mixed dentition group showed significantly thinner bone compared with permanent dentition group b)Bone thickness decreased laterally and posteriorly in all three arch forms c)The square arch form showed thicker bone compared to tapered and ovoid arch forms d) Significant difference in bone density between late mixed and permanent dentition was seen anteropos teriorly from 4mm and mediolaterally from 2mm .

There has been a great demand for minimal patient compliance and maximum control of anchorage units for efficient orthodontic mechanics. The above results and findings which we have achieved represent a guide for the clinicians for the successful placement of the implant anchorage system in the palate between the age group of 10-20 years. The study done on different patient arch form has given enough evidence that the square shaped arch form has more thicker bone than the tapered and ovoid arch forms. Thus, these findings will be useful for the clinician for the placement of temporary anchorage devices in cases where they require rapid palatal expansion, molar distalization and will be a key element for the successful selection of optimal site for placement of temporary anchorage devices.

References:

1. F.Ozdemir, M Tozlu, and D.G Cakan, Cortical bone thickness of the alveolar process measured with CBCT in patients with different facial types. Am J Orthod Dentofacial Orthop 2013;143:190-6.
2. Gracco A, Lombardo L, Cozzani M, Siciliani G. Quantitative cone-beam computed tomography evaluation of palatal bone thickness for orthodontic miniscrew placement. Am J Orthod Dentofacial Orthop. 2008;134:361–369. 6.
3. KS. King, EW. Lam, M.G Faulkner,et al, Vertical bone volume in the paramedian palate of adolescents: A CT study. Am J Orthod Dentofacial Orthop 2007;132:783-8.
4. O H Karatas, E.Toy, Three-dimensional imaging techniques: A literature review, European Journal of Dentistry, Vol 8 , Issue 1 , Jan-Mar 2014: 132-140
5. Gracco A, Boccaccio A, Cirignaco A, Cozzani M, Pappalettere C, Vitale G. Numerical/experimental analysis of the stress field around miniscrews for the orthodontic anchorage. Eur J Orthod. 2009 Feb;31: 12–20.
6. JS Lee, H Kim, YC Park, SH Kyung, TK Kim, The Efficient Use of Midpalatal Miniscrew Implants. Angle Orthod 2004;74:711–714.
7. M Tozlu, D Nalbantgil, F Ozdemir ,Effects of a newly designed apparatus on orthodontic skeletal anchorage, European Journal of Dentistry, Vol 7 ,Supplement 1 ,Sept 2013 :S 83-88
8. SH Moon, SH Park, WH Lim, YS Chun, Palatal Bone Density in Adult Subjects:Implications for Mini-Implant Placement, Angle Orthod. 2010; 80:137–144.
9. Kang S, Lee SJ, Ahn SJ, Heo MS, Kim TW. Bone thickness of the palate for orthodontic mini-implant anchorage in adults. Am J Orthod Dentofacial Orthop 2007;131(Suppl 4):S74-8.
10. Moon SH, Park SH, Lim WH, Chun YS. Palatal bone density in adult subjects: implications for mini-implant placement. Angle Orthod. 2010;80:
11. Lai RF, Zou H, Kong WD, Lin W. Applied anatomic site study of palatal anchorage implants using CBCT. Int J Oral Sci. 2010;2:98–104
12. D Farnsworth, P.E Rossouw, R.F. Ceen, and PH. Buschang, Cortical bone thickness at common miniscrew implant placement sites. Am J Orthod Dentofacial Orthop 2011;139:495-503.
13. Park HS, Jeong SH, Kwon OW. Factors affecting the clinical success of screw implants used as orthodontic anchorage. Am J Orthod Dentofacial Orthop 2006;130:18-25.
14. JH Ryu, JH Park, TV Thi Thu, M Bayome, YJ Kim et al, Palatal bone thickness compared with CBCT in adolescents and adults for mini-implant placement. Am J Orthod Dentofacial Orthop 2012;142:207-12.
15. G.S. Dyer, E.F. Harris and J.L. Vaden, Age effects contrasted on orthodontic with adults treatment: Adolescents contrasted on orthodontic with adults. Am J Orthod Dentofac Orthop 1991;100:523-30.
16. Milo Hellman, Studies on the etiology of Angle's ClassII Malocclusal manifestations, "Read at the annual meeting of the American Society of Orthodontist, at Atlantic city, N. J., April. 1921