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Research Article

Analysis of Maxillary and Mandibular Incisors Bony Support in Different Skeletal Pattern-A Cbct Study

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ABSTRACT

Introduction: Achieving the intended dentoalveolar changes is one of the main objectives of orthodontic therapy. The right biomechanics must be considered by the orthodontists based on dentoalveolar anatomy and growth pattern.

Aims and objectives: The aim of this study is to evaluate and compare the bony support of maxillary and mandibular incisors in different skeletal patterns using cone-beam computed tomography (CBCT), and to assess variations in alveolar bone thickness and incisor position across skeletal Class I, Class II, and Class III relationships.

Materials & Methods: This cross-sectional observational study has been done in the Department of Orthodontics and Dentofacial Orthopedics, Guru Nanak Institute of Dental Sciences and Research, Kolkata, India, from March 2023 to January 2025.Total 66 CBCT scan of bengali patients aged between 14yrs to 26yrs is taken randomely from archive of the institution.

Result: In the Maxilla, No significant difference was found in Maxillary Incisor Inclination (118.73 ± 1.13°, 117.33 ± 3.22°, and 118.42 ± 7.05°, respectively; *P* = 0.59) or Maxillary Incisal Angle (118.67 ± 1.24°, 121.21 ± 6.36°, and 117.72 ± 11.35°, respectively; *P* = 0.33). For Maxillary Buccal Cancellous Bone Thickness, Hypodivergent subjects (2.17 ± 0.40 mm) had significantly greater values compared to Normodivergent (1.74 ± 0.24 mm) and Hyperdivergent (1.63 ± 0.78 mm) groups (*P* = 0.0046).

Conclusion: This study used the improved imaging capability of the CBCT to investigate the relationship between vertical facial patterns and upper-lower anterior tooth-alveolar morphology in the Bengali population. Overall, statistically significant differences were found between the facial types for most of the categories measured including buccal cortical bone thickness, lingual cortical bone thickness, and root length, while medullary as well as cortical bone thickness was significantly higher in hypodivergent facial types.

Keywords: CBCT, Maxillary Incisors, Mandibular Incisors, Bony Support, Alveolar Bone Thickness, Skeletal Pattern.

INTRODUCTION

Achieving the intended dentoalveolar changes is one of the main objectives of orthodontic therapy. The right biomechanics must be considered by the orthodontists based on dentoalveolar anatomy and growth pattern. Prior to receiving orthodontic treatment, the anterior and posterior boundaries of the upper and lower incisors should be taken into account. Therefore, one of the key components of aesthetics and the treatment's long-term stability is the incisors' final post-treatment position.

Vertical facial morphology effects the outcome of orthodontic treatment. Biomechanics, treatment plans and outcome is dependent upon amount and direction of facial growth. Some of the past studies involving facial growth and craniofacial morphology have involve use of lateral cephalograms and metallic implants as diagnostic aids. Scientists inserted metallic implants in different stable areas of the maxilla and mandible to utilize a superimposition technique for their conclusions (Bjork, 1955)[1].

The researcher examined mandibular rotation and the positioning of teeth using implants as reference markers. These investigations have shown that individuals with hypodivergent traits tend to have a lower anterior facial height that is shorter relative to their posterior face height, leading to an upward and forward rotation of the mandible as they grow. In individuals with a hypodivergent facial structure, the palatal plane and the angle of the mandibular plane are typically more horizontal. Understanding the morphology of the alveolar bone is crucial for determining the location and installation of temporary anchorage devices to ensure optimal stability. Since its inception, orthodontics has centered around the principle of anchorage and the negative impact that loss of anchorage can have.Temporary skeletal anchorage devices are a recent advancement that has influenced many aspects like ease of treatment mechanics than Conventional anchorage and prevent anchorage loss in three dimensions of spaces.Carefully assessing the quantity of alveolar bone surrounding the tooth root is crucial, particularly when figuring out which way the tooth should migrate. Treatment planning for mini implant placement and final position of the tooth after completion of treatment.

Motoyoshi et al investigated to determine relationship between mini screw implant (MSI) failure or success and cortical bone thickness [2**]**. They found that cortical bone thickness was significantly greater in the group that had successful Mini screw implants than in the failure group. Another element that could support the stability of orthodontic treatment is the correlation between the position of the tooth root and the thickness of the cortical and cancellous bone.Several studies have described correlation between alveolar bone thickness, tooth position and facial types. Tsunori et al. examined the relationship between a patient sample's facial type and the buccal-lingual inclination of their lower first and second teeth in 1998. Compared to normal and hyperdivergent facial types, they discovered that these teeth tended to be more lingually inclined in hypodivergent facial types [3**]**. According to Janson et al, people with long face types have much more pronounced buccal inclination in their upper first molars and second premolars than do patients with short face types. Additionally, some authors came to the conclusion that individuals with a thinner alveolar process should have their orthodontic tooth movement restricted since they are more susceptible to potential iatrogenic injury [4**]**.

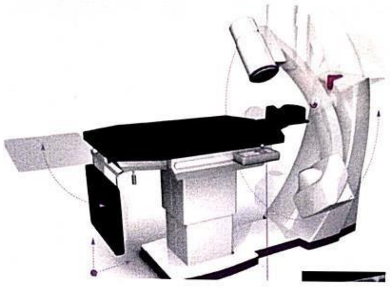
Modern imaging methods like CT (Computerised Tomography) and CBCT (Cone Beam Computed Tomography) can fully assess all of these hard tissue properties. By offering precise, dependable 3D information, which is essential for research purposes. These 3D approaches offer advantages over traditional 2D radiography techniques, such as cephalometric and panoramic radiographs. Compared to traditional imaging methods, a far lower radiation dose is required to provide high-definition images of dentoalveolar structures. Cone Beam Computed Tomography (CBCT) produces images without superimposition or distortion, in contrast to traditional X-rays, which are distorted by the beam's divergence. Cone-beam computed tomography (CBCT) is a novel technique that offers several benefits, including high radiation efficiency, low effective radiation dose, excellent resolution, and quick scan speed [5-6]. In order to accurately observe the fine structure of the oral and maxillofacial region, it decreases the slice thickness of each image by tens of micrometres.CBCT uses scanning to produce volumetric data. Image reconstruction makes it simple to access a variety of flat or curved planes that are used for quantitative measurements [7]. In order to provide original morphological guidelines for proper mini-implant placement as well as a proper outline and road map of movement and position of teeth during and after the treatment, we used CBCT to observe the thickness along the contour of the human alveolar bone in the aesthetic area of the maxillary and mandibular incisors region [8,9,10].

MATERIALS AND METHODS

This cross-sectional observational study has been done in the Department of Orthodontics and Dentofacial Orthopedics, Guru Nanak Institute of Dental Sciences and Research, Kolkata, India, from March 2023 to January 2025.Total 66 CBCT scan of bengali patients aged between 14yrs to 26yrs is taken randomely from archive of the institution. CBCT generated lateral cephalogram was taken from each CBCT image to measure Frankfort Mandibular plane angle (FMA) and the population was subdivided into three group i.e Hypodivergent(FMA less than 21degree), Normodivergent(FMA 22-27 degree) and Hyperdivergent(FMA above 27degree)[9].Presence of any pathology,asymmetry in jaw,any cleft,any radiological sign of alveolar bone resorption,presence of any supernumerary or impacted teeth or missing teeth and history of any previous orthodontic treatment were excluded from our study.

Study Tools: CBCT (Myray Blue sky Machine, Conical, Variable-Field, H.R. Zoom, 90 Kvp, 10 Ma (max), Pulsed Emission).Cone-Beam Computed Tomography (CBCT) Low dosage, high technology Sky View incorporates a modern image-intensifier detector which ensures top image quality at low dosage rates[10-11]. Extra-high resolution acquisition could be achieved by reducing the visual field from 9 to 4 inches. Rotation during the 10/15/20 Second scan cycle was through 190 degrees.

Calibration was performed at the View with 6-foot distance from detector with an 11 cm diameter spherical field of view.SkyView could produce high- resolution images of the entire adult.All reconstructions are Dicom 3.0 compatible Trim and compact design as same image type and file that of same patient. Patient table was 150 cm (width) x 240 cm (length) x 170 cm (height). The X- ray source was an X-ray tube with 90 kV output, comparable to that of a panoramic dental system. The radioprotection requisites were comparable to those of a panoramic dental system.



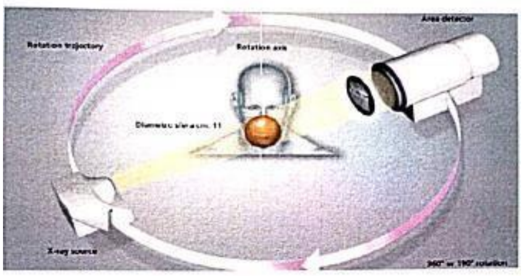
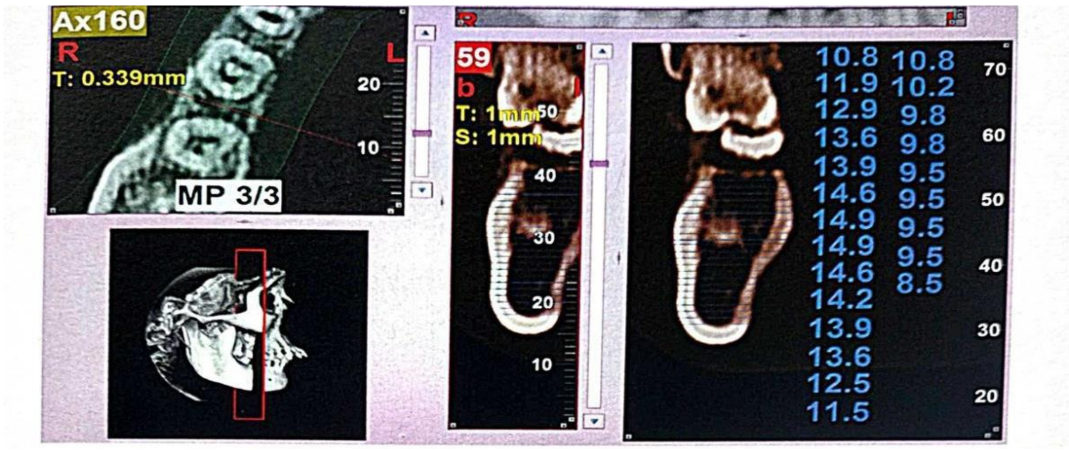


Fig-1: Images Of Cbct (Myray-Skyview) Machine Fig-2: Rotation and Axis of Cbct Tube

0rientation



Parameters Studied

CBCT Images Have Been Analysed Using NNT Viewer Software. Head Orientation- FH Plane Parallel To The Horizontal Plane. Vertical Sections Taken In Each Interproximal Region At The Midpoint Between Two Adjacent Teeth. All Distances Measured Are Perpendicular To The Vertical Plane.

A) Angular-Frankfort Mandibular Plane Angle(Fma) ,Upper Incisor Inclination With Palatal Plane(1_To Pp) ,Lower Incisor To Mandibular Plane Angle(Impa) ,Inter Incisal Angle

B) Linear- Upper Central Incisor-(U)-Buccal Apical Cortical Bone Thickness (Uba-Co), Buccal Apical Cancellous Bone Thickness (Uba-Ca), Total Buccal Apical Bone (Cortical+Cancellous)(Ubat), Palatal Cortical Bone Thickness(Upa-Co). Palatal Cancellous Bone Thickness(Upa-Ca) ,Total Palatal Apical Bone Thickness(Cotical+Cancellous)(Upat) ,Upper Total Apical Bone Thickness(Ubat+Upat)-(Utab) ,Upper Root Length(Url)

C) Linear-Lower Central Incisor-(L)-Buccal Apical Cortical Bone Thickness(Lba-

Co),Buccal Apical Cancellous Bone Thickness(Lba-Ca),Total Buccal Apical Bone (Cortical+Cancellous)(Lbat) ,Lingual Cortical Bone Thickness(Lla-Co),Palatal Cancellous Bone Thickness(Lla-Ca) ,Total Palatal Apical Bone Thickness(Cotical+Cancellous)(Llat) ,Lower Total Apical Bone Thickness(Lbat+Llat)-(Ltab),Lower Root Length(Lrl)

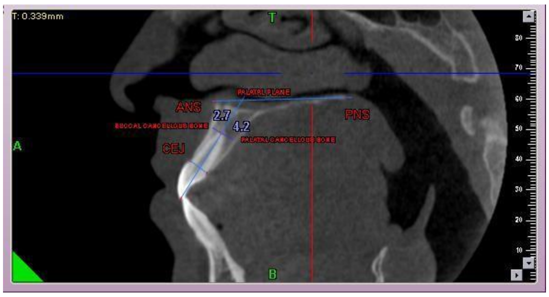


Fig-4 Inter Incisal Angle Bone

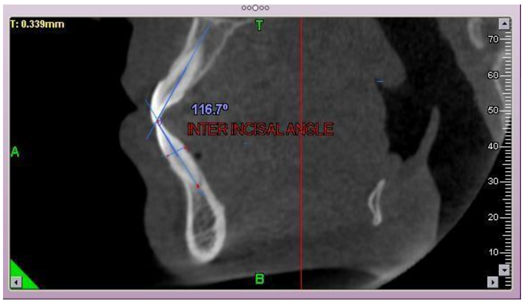


Fig 5: Upper Incisor Buccal and Palatal Cancellous

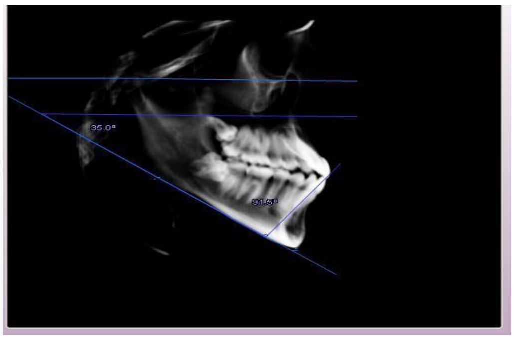


Fig-6 Impa and Fma

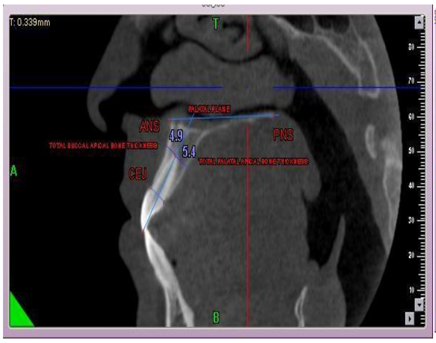


Fig-7-Upper Incisor Buccal and Palatal Cancellous

Fig-8 Lower Incisor Buccal and Lingual Apical Bone Thickness Bone Thickness

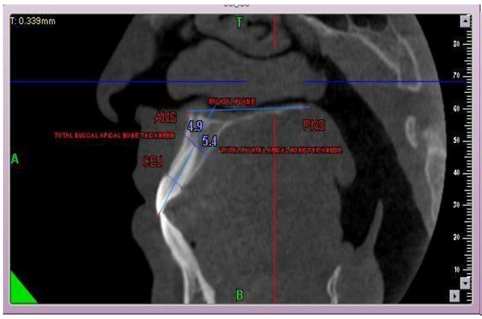


Fig-9-Upper Incisor Buccal and Palatal Total Apical

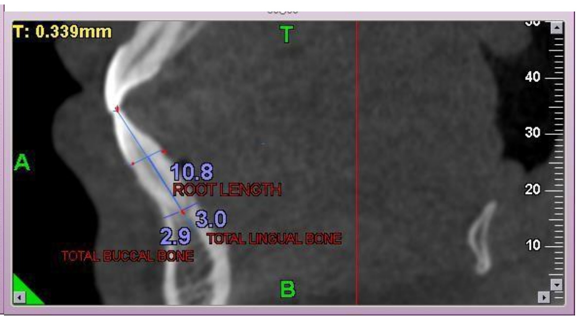


Fig-10 Lower Incisor Root Length and Total Bone Thickness Bone Thickness

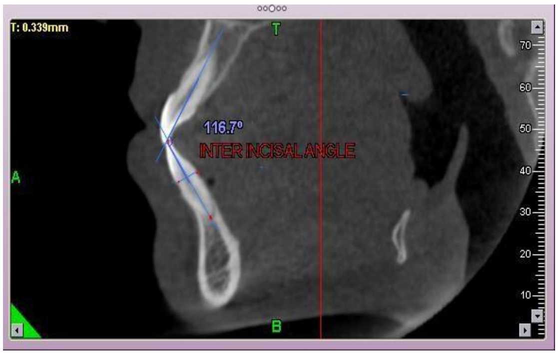


Fig-11-Interincisal Angle

The collected data was tabulated in a spreadsheet using Microsoft Excel 2021 and then statistical analysis was carried out using IBM SPSS Statistics for Windows, Version 27.0. (Armonk, NY: IBM Corp). Graphs, Box plots and Pie diagrams were constructed using the GraphPad Prism for Windows, Version 10.1.2 (GraphPad Software, La Jolla California USA). A Shapiro-Wilk's test and a visual inspection of the histograms, normal Q-Q plots and box plots showed that the collected data were approximately normally distributed for all the groups. Descriptive statistics were used to report quantitative variables in terms of mean(central tendency) and standard deviation(measure of dispersion) along with the range. A One-way Analysis of variance(ANOVA) with a *post-hoc* Tukey test was employed to compare the cephalometric parameters between the three types of growth patterns. The *P*- value of 0.05 was considered as the level of significance.

RESULT

Table 1: Mean Values for the Cephalometric Parameters and Comparisons between the Growth Pattern Types in the Maxilla

Parameter	Hypodivergent (N=20)	Normodivergent (N=20)	Hyperdivergent (N=20)	P Value^{a}
FMA (°)	16.29 ± 2.13^{a}	23.75 ± 1.13^{b}	31.18 ± 2.11^{c}	<0.0001*
Maxillary Incisor Inclination (°)	118.73 ± 1.13	117.33 ± 3.22	118.42 ± 7.05	0.59^{NS}
Inter Incisal Angle (°)	118.67 ± 1.24	121.21 ± 6.36	117.72 ± 11.35	0.33^{NS}
UBA-Ca (Mm)	2.17 ± 0.4^{a}	1.74 ± 0.24^{b}	1.63 ± 0.78^{b}	0.0046*
UBA-Co(Mm)	2.4 ± 0.49^{a}	1.85 ± 0.39^{b}	1.61 ± 0.48^{b}	<0.0001*
UBAT(Mm)	4.58 ± 0.84^{a}	3.59 ± 0.51^{b}	3.23 ± 0.98^{b}	<0.0001*
UPA-Ca(Mm)	2.9 ± 0.17	2.82 ± 0.39	3.09 ± 1.05	0.42^{NS}
UPA-Co(Mm)	2.99 ± 0.41^{a}	2.17 ± 0.52^{b}	2.12 ± 0.54^{b}	<0.0001*
UPAT(Mm)	5.85 ± 0.48^{a}	4.97 ± 0.57^{b}	5.15 ± 1.14^{b}	0.0019*
UTAB (Mm)	10.41 ± 1.16^{a}	8.57 ± 0.56^{b}	8.28 ± 1.67^{b}	<0.0001*
URL (Mm)	11.86 ± 0.9^{a}	12.61 ± 0.59^{b}	12.14 ± 0.7^{a,B}	0.0082*

n:number of subjects per growth pattern
a: analysed by one-way ANOVA test
NS:not significant(P>0.05),*: Significant at P≤0.05
Different superscript letters denote statistically significant differences between the growth pattern types when the main test (one-way ANOVA) is significant. Identical letters indicate

no significant difference.

Table 2: Mean (±Standard Deviation) Values for the Cephalometric Parameters and Comparisons between the Growth Pattern Types in the Mandible

Parameter	Hypodivergent (N=20)	Normodivergent (N=20)	Hyperdivergent (N=20)	P Value[a]
IMPA (°)	100.54 ± 1.4[a]	96.46 ± 2.77[b]	95.02 ± 4.29[b]	<0.0001*
INTER INCISAL ANGLE (°)	119.32 ± 1.35	120.1 ± 6.7	117.02 ± 11.2	0.41[NS]
LBA-Ca (Mm)	2.45 ± 0.39[a]	2.2 ± 0.4[a,B]	1.89 ± 0.85[a]	0.01*
LBA-Co (Mm)	2.57 ± 0.33[a]	1.88 ± 0.42[b]	1.5 ± 0.31[c]	<0.0001*
LBAT (Mm)	5.0 ± 0.71[a]	4.09 ± 0.65[b]	3.39 ± 1.0[c]	<0.0001*
LLA-Ca (Mm)	3.23 ± 0.56[a]	2.28 ± 0.86[b]	2.03 ± 1.09[b]	<0.0001*
LLA-Co (Mm)	3.44 ± 0.38[a]	2.17 ± 0.72[b]	1.54 ± 0.46[c]	<0.0001*
LLAT(Mm)	6.74 ± 0.81[a]	4.45 ± 1.47[b]	3.65 ± 1.25[b]	<0.0001*
LTAB (Mm)	11.75 ± 1.44[a]	8.59 ± 1.92[b]	6.75 ± 1.82[c]	<0.0001*
LRL (Mm)	10.86 ± 0.9[a]	11.61 ± 0.59[b]	11.14 ± 0.7[a,B]	0.0082*

n:number of subjects per growth pattern
a: analysed by one-way ANOVA test
NS:not significant(P>0.05),*: Significant at P≤0.05
Different superscript letters denote statistically significant differences between the growth pattern types when the main test (one-way ANOVA) is significant. Identical letters indicate no significant difference.

In the Maxilla, No significant difference was found in Maxillary Incisor Inclination (118.73 ± 1.13°, 117.33 ± 3.22°, and 118.42 ± 7.05°, respectively; P = 0.59) or Maxillary Incisal Angle (118.67 ± 1.24°, 121.21 ± 6.36°, and 117.72 ± 11.35°, respectively; P = 0.33). For Maxillary Buccal Cancellous Bone Thickness, Hypodivergent subjects (2.17 ± 0.40 mm) had significantly greater values compared to Normodivergent (1.74 ± 0.24 mm) and Hyperdivergent (1.63 ± 0.78 mm) groups (P = 0.0046). Hypodivergent individuals also had significantly higher Maxillary Buccal Cortical Bone Thickness (2.4 ± 0.49 mm) compared to Normodivergent (1.85 ± 0.39 mm) and Hyperdivergent (1.61 ± 0.48 mm) groups (P < 0.0001). Similarly, Maxillary Total Buccal Bone Thickness was significantly greater in Hypodivergent individuals (4.58 ± 0.84 mm) than in Normodivergent (3.59 ± 0.51 mm) and Hyperdivergent (3.23 ± 0.98 mm) groups (P < 0.0001). No significant difference was observed in Maxillary Palatal Apical Cancellous Bone Thickness (2.9 ± 0.17 mm, 2.82 ± 0.39 mm, and 3.09 ± 1.05 mm; P = 0.42). However, Maxillary Palatal Apical Cortical Bone Thickness was significantly higher in Hypodivergent individuals (2.99 ± 0.41 mm) compared to Normodivergent (2.17 ± 0.52 mm) and Hyperdivergent (2.12 ± 0.54 mm) groups (P < 0.0001). A similar pattern was observed in Maxillary Total Palatal Apical Bone Thickness, where Hypodivergent subjects (5.85 ± 0.48 mm) had significantly higher values than Normodivergent (4.97 ± 0.57 mm) and Hyperdivergent (5.15 ± 1.14 mm) groups (P = 0.0019). Maxillary Total Apical Bone Thickness was also highest in Hypodivergent individuals (10.41 ± 1.16 mm) compared to Normodivergent (8.57 ± 0.56 mm) and Hyperdivergent (8.28 ± 1.67 mm) groups (P < 0.0001). In contrast, Maxillary Root Length was significantly greater in Normodivergent individuals (12.61 ± 0.59 mm), followed by Hyperdivergent (12.14 ± 0.70 mm) and Hypodivergent (11.86 ± 0.90 mm) groups (P = 0.0082).

In the Mandible, No significant difference was observed in the Mandibular Incisal Angle across the groups (119.32 ± 1.35°, 120.1 ± 6.7°, and 117.02 ± 11.2°, respectively; $P = 0.41$). Mandibular Buccal Cancellous Bone Thickness was significantly higher in Hypodivergent individuals (2.45 ± 0.39 mm) compared to Normodivergent (2.2 ± 0.4 mm) and Hyperdivergent (1.89 ± 0.85 mm) groups ($P = 0.01$). Hypodivergent individuals also showed significantly higher Mandibular Buccal Cortical Bone Thickness (2.57 ± 0.33 mm) compared to Normodivergent (1.88 ± 0.42 mm) and Hyperdivergent (1.5 ± 0.31 mm) groups ($P < 0.0001$). Similarly, Mandibular Total Buccal Bone Thickness was greatest in Hypodivergent subjects (5.0 ± 0.71 mm) versus Normodivergent (4.09 ± 0.65 mm) and Hyperdivergent (3.39 ± 1.0 mm) individuals ($P < 0.0001$). Mandibular Lingual Apical Cancellous Bone Thickness was also significantly higher in Hypodivergent subjects (3.23 ± 0.56 mm) than in Normodivergent (2.28 ± 0.86 mm) and Hyperdivergent (2.03 ± 1.09 mm) groups ($P < 0.0001$). Likewise, Hypodivergent individuals exhibited the greatest Mandibular Lingual Apical Cortical Bone Thickness (3.44 ± 0.38 mm) compared to Normodivergent (2.17 ± 0.72 mm) and Hyperdivergent (1.54 ± 0.46 mm) groups ($P < 0.0001$). The same trend was seen for Mandibular Total Lingual Apical Bone Thickness, which was highest in Hypodivergent individuals (6.74 ± 0.81 mm), followed by Normodivergent (4.45 ± 1.47 mm) and Hyperdivergent (3.65 ± 1.25 mm) groups ($P < 0.0001$). Similarly, Mandibular Total Apical Bone Thickness was greatest in Hypodivergent individuals (11.75 ± 1.44 mm), significantly exceeding Normodivergent (8.59 ± 1.92 mm) and Hyperdivergent (6.75 ± 1.82 mm) values ($P < 0.0001$). Finally, Mandibular Root Length was significantly greater in Hyperdivergent individuals (11.01 ± 0.66 mm) compared to Normodivergent (10.79 ± 0.38 mm) and Hypodivergent (10.26 ± 0.55 mm) groups ($P = 0.0002$).

DISCUSSION

Due to the intrinsic precision of CBCT and its clipping function, which allows it to see thin alveolar bone among complicated overlapping craniofacial tissues, three-dimensional imaging such as CBCT has made it possible to see the bony architecture. With relatively low radiation compared with conventional helical computed tomography has enabled alveolar bony measurement with good to excellent repeatability[12-13].Furthermore, it is acknowledged that traditional standard orthodontic radiographs, including lateral cephalograms, can significantly introduce bias and mistakes when determining the position of the lower incisors. One possibility to accurately assess the position of the tooth structures is to use a CBCT scan: the incisor centerline can be accurately evaluated in all planes [14].

CBCT, a high-resolution imaging technique, has become an established method for depicting the morphology of mandibular incisors and the surrounding alveolar bone. However, CBCT has the disadvantage of higher exposure to radiation dosage compared to conventional radiographs [15]. Higher costs might at present also a drawback for the routine use of CBCT. Recent studies using CBCT have revealed differences in density and thickness of the maxillary buccal and palatal bones in patients with different facial heights .The cortex thickness was reported to decrease from anterior to posterior in the maxillary buccal region. Kasai and Kawamura assessed the relationship between the buccolingual tilt and wear score of the mandibular teeth among Japanese individuals, concluding that those with strong masticat-ory capability have mandibular molars that are oriented more buccally [16]. Masumoto et al. and Tsunori et al. found that the gonial angle and mandibular plane angle significantly influenced the inclination of molars. Since form follows function, various chewing traits might influence the inclinations of alveolar bone and teeth [17]. Tsunori, M Mashita, & Kasai et al discovered notable positive correlations between the inclination of the lower central incisors and the morphological shape of the alveolar bone.The root apex of the lower central incisor was nearer to the lingual alveolar crest when it was inclined buccally[18].

No studies have been published on the quantitative relationship between the maxillary and mandibular incisors bone support with inclination and its co-relation with different skeletal pattern. Thus, this study, of 66 untreated adult patients with different vertical facial pattern is taken to evaluate the correlation between maxillary and mandibular central incisor in bone tissue amount of buccal and lingual surfaces, inclinations and root length. In this study, the labial and lingual inclination of the upper and lower central incisors was correlated with the adjacent apical bone thickness of both cortical and and cancellous bone. Total amount of apical bone was also measured in relation to upper and lower central incisors. Both inclination and root length were also analysed.

Maxillary Central incisors apical area buccal cortical bone, lingual(palatal) cortical bone & Significantly thicker in hypodivergents and palatal cancellous bone is greater in hyperdivegent individuals than normo and hypodivergents. For the Maxillary Incisor Inclination .For the Maxillary Buccal Cancellous and cortical Bone thikness (mm), Hypodivergent subjects exhibited the highest value followed by Normodivergent and Hyperdivergent. For the Maxillary Total Buccal Bone Thickness (mm), Hypodivergent subjects exhibited the highest value followed by Normodivergent and Hyperdivergent.). However, Maxillary Palatal Apical Cortical Bone Thickness was significantly higher in Hypodivergent individuals and Maxillary Total Apical Bone Thickness was also highest in Hypodivergent individuals (10.41 ± 1.16 mm) compared to Normodivergent (8.57 ± 0.56 mm) and Hyperdivergent (8.28 ± 1.67 mm) groups (P < 0.0001) In the Mandible, Mandibular Buccal Cancellous Bone Thickness was significantly higher in Hypodivergent individuals. Hypodivergent individuals also showed significantly higher Mandibular Buccal Cortical Bone Thickness (2.57 ± 0.33 mm) compared to Normodivergent (1.88 ± 0.42 mm) and Hyperdivergent (1.5 ± 0.31 mm) groups (P < 0.0001). Similarly, Mandibular Total Buccal Bone Thickness was greatest in Hypodivergent subjects (5.0 ± 0.71 mm) versus Normodivergent (4.09 ± 0.65 mm) and Hyperdivergent (3.39 ± 1.0 mm) individuals (P < 0.0001). Mandibular Lingual Apical Cancellous Bone Thickness was also significantly higher in Hypodivergent subjects (3.23 ± 0.56 mm). Overall all measurements suggested that in hyperdivergent individuals there are thinner bone support both in lingual and labial site along with longer slender root than other facial types.site by site, hypodivergent individuals represents thicker cortical and cancellous bone in both labial and lingual site along with shorter root length as compared to others. So, all the statistical analyses suggested that there is a significant positive correlation in root length and bone tissue amount especially apical bone thickness of both cortical and cancellous bone around the apex of the upper and lower central incisor in different facial types [19-22]. Since cortical thickness is reported to be a major factor in the success of mini- implants. moreover, thickness of marrow cancellous bone also help to determine the limit of root movement during orthodontic treatment in three dimension of spaces.so, it is important to use an accurate and reproducible method to measure it to plan final incisors position with maximum stability. Cortical bone density as well as thickness along with length of root and inclination is changed with each facial type. As per this study, we found hyper divergent individuals have thinner cortices and longer root lengths. So, There is more chance of implant failure due to the thinner cortex side by side high chance of dehiscence is there during retraction and space closure mainly in the mandibular incisor region. That is why, we have to consider and co-relate both upper and lower incisors in their position and apical bone support as well as inclination before and during orthodontic treatment, especially in high-angle cases.

CONCLUSION

This study used the improved imaging capability of the CBCT to investigate the relationship between vertical facial patterns and upper-lower anterior tooth-alveolar morphology in the Bengali population. Overall, Statistically significant differences were found between the facial types for most of the categories measured including buccal cortical bone thickness, lingual cortical bone thickness, and root length, while medullary as well as cortical bone thickness was significantly higher in hypodivergent facial types. The present study confirms that cortical bone thickness at in high-angle patients is minimum and this would bring a higher risk of orthodontic mini-implant failure due to lack of primary stability in these patients. So, it is an orthodontist's responsibility to take precautions in patients with less cortical bone thickness (i.e. hyper-divergents) so that they do not lose their mini-screws if they are an important part of our treatment plan. These precautions could be to use thicker mini-screws, to emphasize and monitor oral hygiene more strictly, possibly to place the mini-screws in a more angulated position to take advantage of the longer diagonal bone surface or to use the orthodontic mini- implant. Moreover, precaution for incisors movement during retraction and torquing should be taken to make a road map for final positisiton of roots at end of treatment along with to reduce iatrogenic damage of periodontal tissues with thinner bone support. Therefore,a through preplanning should be done with detailed and meticulous examination of tooth supporting structure like alveolar bone.so,we have to " Begin with end in mind".

Limitations:

1) This study involved the limited sample size -Subjects were limited to the patients in the dental records archive from Guru Nanak Institute of Dental Science & Research.
2) Sex differences were not studied.
3) Measurements taken from right side only.

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