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Morphometric Evaluation of the Maxillary Arch Using Cone Beam Computed Tomography

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ABSTRACT

Objective: Anatomically, a dental arch is a result of natural teeth being positioned on the alveolar bone. The purpose of this study is to assess the morphological characteristics of various maxillary arch types using Cone Beam Computed Tomography (CBCT) and ascertain their prevalence.

Methods: This retrospective study analyzed 200 randomly selected maxillary CBCT images from patients aged 18–65. Measurements were interpreted using various planes, and maxillary arch forms were classified according to the House dental arch classification in the axial region of the CBCT images.

Results: Patients over 45 years old had significantly higher mean canine-palate and first molar-palate measurements compared to younger groups, particularly the 18–25 age group, which showed a higher hard palate–anterior mean than the 25–35 group. Class II cases had a significantly higher mean canine-palate than Class I and III cases. Class II cases also exhibited higher first molar-palate and canine-anterior means compared to Class I and III. In contrast, Class I cases had a higher canine-canine mean than the other classes.

Conclusion: Morphologic measurements are crucial for guiding specialists in diagnosis and treatment, enhancing the ease and accuracy of clinical practice.

Keywords: Maxillary arch dimension, morphometric analysis, CBCT

1. INTRODUCTION

Children's primary dentition should be as close to ideal as achievable for the permanent dentition to function properly and for the children to have normal dental traits in adulthood, such as normal mastication and appearance, space, and occlusion. Human behavior and self-esteem are strongly influenced by one's physical appearance, and dental health issues such as tooth loss, gum disease, malocclusions, and dental caries require early intervention and treatment to ensure a normal permanent dentition in later life (1,2). The maintenance of the canine, incisor, and molar teeth during childhood is important for the formation of the space and occlusion features during permanent dentition. Additionally, emphasizes the significance of the arch dimensions in maintaining a balanced facial profile, stabilizing the form, preventing arch crowding, and correctly aligning teeth. Arch size has been seen to be more important than even teeth size (3,4).

The human dental arch has been mathematically modeled many times, although terminology like elliptic, parabolic, and so forth were initially used to characterize the dental arch. The length, width, and depth of the dental arch were traditionally used to measure the arch's curve. Several specialists have measured angles, linear distances, and ratios using biometry to determine the dental arch's curvature (5,6).

Cone Beam Computed Tomography (CBCT) for measuring the dimensions of the arch and teeth; allows fast, reliable, exact, and remeasurable measurement. Measurements made in CBCT overlap with measurements made on 2D models obtained by digital methods (7). Hand rulers, drawings various scales, etc. in the measurement of tooth and arch length through working models and measurements are used (8).

Technological developments enable the acquisition of 3D images, enabling more accurate analyses along with exact and reliable measurements (8,9). In addition, with 3D models, more models can be stored at less cost and allow analysis with advanced computer programs. 3D models obtained with CBCT are used in many dentistry fields such as orthodontics, prosthesis, implantology, and oral diagnosis (10,11). Although there are studies that evaluated the measurement of the maxillary arch on plaster models obtained from patients, since these measurements may vary according to both the materials used and the patient's soft tissue thickness, evaluation of hard tissue with CBCT images can provide a more thorough examination of the maxillary arch and its morphologies and provides better information (6).

CBCT is frequently used in the evaluation of hard tissues in the head and neck region since it provides 2 and 3-dimensional imaging by minimizing superpositions (9). Jayasinghe et al. published a study in which they evaluated the maxillary arch shapes and measurements in CBCT sections of 106 patients, they found oval shape at a rate of 64% and statistically, the measurements were found to be higher in male individuals (6).

The purpose of this retrospective study is to assess the morphometric properties of the maxillary arch forms and ascertain the frequency of these forms in individuals whose maxilla have CBCT images in our archive. Previous research using cast models have been published in the literature. Using study casts, Arambawatta et al.'s study evaluated the arch shapes (7). There are issues when study casts are used to estimate the dimensions, even if this is permissible to determine the arch shape. The accuracy and dimensional stability of the resulting cast would depend on the characteristics of both the cast and impression materials. Furthermore, the exact proportions of the underlying skeletal shape may not be shown by the morphology of the gingival tissue. Therefore, it is possible to hypothesize that CBCT measurements, as opposed to those made using study casts, would show the skeleton dimensions with more accuracy. To the best of our knowledge, this is Türkiye's first study on the morphometric assessment of the maxillary arch using CBCT.

2. METHODS

2.1. Patient Selection

In this study, the study group included in the clinical archive, who applied to Marmara University Faculty of Dentistry, Department of Oral, Dental and Maxillofacial Radiology, over 18 years of age, had no developmental anomaly, did not use orthodontic treatment, did not use drugs affecting the bone, did not have tooth loss in the maxilla (except for wisdom teeth). An a priori power analysis was performed using G*Power 3.1 software to determine the necessary sample size for detecting a medium effect size (d = 0.5) with a power of 0.95 and an alpha level of 0.05. The analysis indicated that a minimum of 128 participants (64 per group) would be required. Our study, with a total sample size of 200 participants (100 males and 100 females), exceeds this requirement, ensuring adequate power to detect significant differences between the groups. Ethics committee approval was obtained from the Marmara University School of Medicine Clinical Research Ethics Committee (Approval number: 2023.677 / 05.05.2023).

2.2. Radiographic Examination

Radiographic examination was made using CBCT (Planmeca Promax 3D Mid (Planmeca Oy, Helsinki, Finland, 2012), and images taken from the study group patients evaluated in axial, sagittal, and coronal sections. Maxillary arch shapes were grouped using House dental arch classification in the axial section over CBCT images of the patients participating in the study (Figure 1). Morphometric analyses on the sections performed as shown in the examples (Figure 2). To guarantee a professional and efficient evaluation, clinical images were assessed by clinicians and specialists from the Department of Oral Diagnosis and Radiology. In preparation for the pilot study, these clinicians and radiology specialists received training in tomographic image evaluation from an expert with over 20 years of experience in oral diagnosis and radiology. An agreement on the objective criteria for the qualitative evaluation of the images was forged among the evaluators.During this process, the evaluators collectively established objective criteria for the qualitative assessment of the images. In preparation for the pilot study, these clinicians and radiology specialists received training for image evaluation. Standardization was achieved with these trained individuals, and quality control was overseen by an expert with over 20 years of experience in oral diagnosis and radiology. An agreement on the objective criteria for the qualitative evaluation of the images was forged among the evaluators.

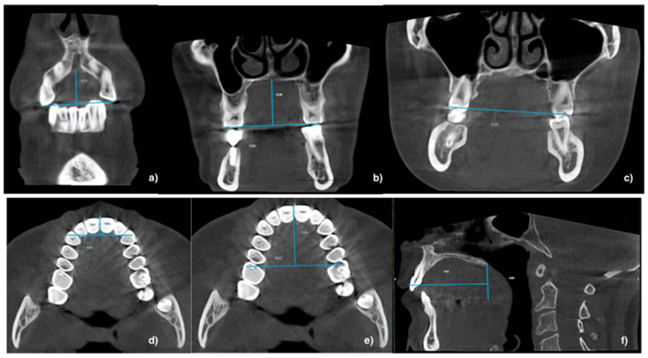

Figure 1. *House dental arch classification (House MM. Full denture technique. Whittier, Calif.: Private printing, 1937).*

2.3. Statistical Analysis

The IBM SPSS Statistics 22 application was utilized for statistical analysis in assessing the study's results. The Kolmogorov-Smirnov test was used to assess the parameters' eligibility for the normal distribution, and the results showed that they were appropriate. In addition to descriptive statistical methods (mean, standard deviation, frequency) for analyzing the study data, Oneway Anova test was used to compare parameters between age groups and maxillary shapes; Tukey HDS test was applied if the group variances were homogeneous; and Tamhane's T2 test was employed to identify the group responsible for the difference in the quantitative data. The parameters were compared between the genders using the student's t-test. The significance level was set at p< .05.

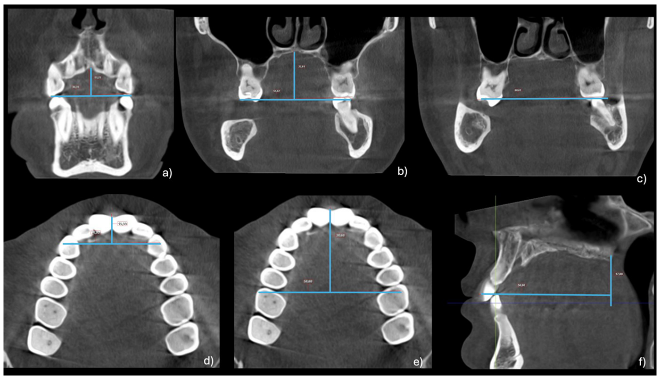

Figure 2. *a)The distance between the incisal edges of the canines and the distance between the incisal edges of the canines to the hard palate (coronal); b)The distance between the mesiobuccal cusp crests of the 1st molars and the distance between the mesiobuccal cusp crests of the 1st molars and the distance to the hard palate (coronal); c)The distance between the mesiobuccal cusp crests of the 2nd molars (coronal); d)The distance from the incisal edges of the canines to the vestibule of the central teeth (axial); e)The distance between the mesiobuccal cusp crests of the 1st molars to the vestibule of the central teeth (axial), f) Distance of posterior nasal spine from line of occlusion and the distance from the most vestibule point of the centrals perpendicular to the line connecting the posterior nasal spina and the occlusion line (sagittal).*

3. RESULTS

The study group consists of a total of 200 cases, 100 female and 100 male between the ages of 18-65. The mean age is 30.02±11.01 years. According to the arch classification of the study group, 37% is class I, 12.5% is class II, 50.5% is class III. (Table1).

The age ranges of 18-25, 25-35, 35-45, and 45-65 for our study to analyze differences between young adulthood and subsequent decades. Additionally, we combined the 45-65 age range into a single category due to the more minimal changes typically observed in this period compared to the more distinct variations seen in younger decades.

Table 1. *Demographic characteristics*

		n	%
Age	18-25	86	43
	25-35	52	26
	35-45	41	20.5
	45-65	21	10.5
Gender	Female	100	50
	Male	100	50
Arch Type	Class I	74	37
	Class II	25	12.5
	Class III	101	50.5

The minimum, maximum and average values of the morphometric measurements obtained, as well as their standard deviations, were found as follows (Table 2).

Table 2. *Morphometric measurements of all patients*

Localization	N	Minimum	Maximum	Mean	Sd
Canine-Canine	200	26.8	44.0	35.73	2.95
Canine-palatinal	200	5.8	16.8	10.54	2.23
1. molar	200	42.0	67.2	54.32	3.54
1. molar-palatinal	200	16.2	56.6	21.95	4.31
2. molar	200	45.2	72.4	59.37	3.74
Canine-anterior	200	6.0	13.4	9.63	1.45
1. molar – anterior	200	24.0	36.2	28.88	2.21
Occlusion-palatinal	200	13.4	34.0	21.35	3.61
Hard palate-anterior	200	45.8	66.2	55.89	4.01

Sd, Standard deviation

It was observed that cases over the age of 45 had a statistically significant difference from the 25-45 age group when evaluated in terms of canine-palatal distance (p<0.05), and from all age groups when evaluated in terms of 1st molar and 2nd molar distances, respectively (p<0.05) (Table 3). The 1st molar-anterior and the hard palate-anterior among 18-25 years, canine-palatal among cases over the age of 45 are significantly higher than the other age groups (p< .05). There is no statistically significant difference between the age groups in terms of canine-canine, first molar-palatinal, canine-anterior and occlusion-palatinal averages (Table 3).

Table 3. *Evaluation of morphometric measurements by age groups*

	18-25 (n=86)	25-35 (n=52)	35-45 (n=41)	45-65 (n=21)	
	Med±Sd	Med±Sd	Med±Sd	Med±Sd	p
Canine – canine	35.88±3.2	35.7±2.59	35.04±2.93	36.54±2.69	.252
Canine-palatinal	10.05±2.16	10.55±2.21	11.03±2.34	11.56±1.95	.014*
1. molar	54.01±3.45	54.25±3.4	53.91±3.19	56.58±4.22	.020*
1. molar-palatinal	21.23±2.46	22±5.46	23.07±5.71	22.56±3.59	.132
2. molar	59.1±3.93	59.14±3.4	59.07±3.43	61.66±3.8	.031*
Canine-anterior	9.84±1.52	9.29±1.4	9.66±1.55	9.57±1.05	.205
1. molar – anterior	29.55±2.43	28.37±2.03	28.24±2.03	28.68±1.14	.002*
Occlusion-palatinal	21.01±3.55	22.1±3.34	21.14±3.67	21.26±4.38	.375
Hard palate-anterior	56.71±4.21	54.88±3.69	55.31±4.18	56.14±301	.049*

Oneway ANOVA Test **p< .05*
Med, Median; Sd, Standard deviation

The canine-canine averages of Class I cases are significantly higher than those of Class II (p<.01) and Class III (p<.05) groups. (p< .05) (Table 4) First molar-Palatal and Canine-Anterior values' averages of Class II cases are significantly higher than those of Class I (p= .005; p= .001) and Class III (p= .016; p= .001) respectively.

The canine-palatal mean values of Class II cases are significantly higher than those of Class I (p<.01) and Class III (p<.05) groups (p< .05). The canine-palatal mean values of Class III cases are significantly higher than those of the Class I group (p= .003; p< .05).

There is no statistically significant difference between the maxilla shapes in terms of the averages of 1st molar, 2nd molar, 1st molar-anterior, occlusion-palatinal and hard palate-anterior. There is no statistically significant difference between the maxilla shapes in terms of 1.molar, 2.molar, 1.molar-anterior, occlusion-palatinal and hard palate-anterior averages (Table 4).

Table 4. *Evaluation of morphometric measurements according to the shape of the maxilla*

	Class I (n=37)	Class II (n=25)	Class III (n=101)	
	Med±Sd	Med±Sd	Med±Sd	p
Canine-Canine	36.63±2.33	34.31±3.21	35.43±3.12	.001*
Canine-palatinal	9.71±2.00	12.00±2.16	10.78±2.19	.001*
1. molar	54.55±3.51	52.82±3.52	54.53±3.50	.075
1. molar-palatinal	21.32±4.89	24.43±6.4	21.79±2.80	.006*
2. molar	58.96±3.57	59.44±4.76	59.66±3.59	.470
Canine-anterior	9.36±1.36	10.77±1.35	9.55±1.43	.001*
1. molar – anterior	28.93±1.98	29.73±2.11	28.64±2.36	.088
Occlusion-palatinal	20.77±3.14	21.44±3.58	21.75±3.92	.205
Hard palate-anterior	56.53±3.99	55.15±3.4	55.60±4.14	.194

*Oneway ANOVA Test *p< .0*
Med, Median; Sd, Standard deviation

All measured distances are significantly greater in males compared to females. For example, measurements such as the distance between canine teeth, the 1st molar distance, and the hard palate to anterior distance are consistently higher in males. This pattern suggests that males generally have larger dental structures compared to females across all examined parameters.All morphometric measurements of male were statistically significantly higher than female (p< .05) (Table 5).

Table 5. *Evaluation of morphometric measurements by gender*

	Male (n=100)	Female (n=100)	
	Med±Sd	Med±Sd	p
Canine-Canine	36.44±2.64	35.02±3.09	.001*
Canine-palatinal	11.18±2.01	9.90±2.27	.001*
1. molar	55.31±3.66	53.34±3.13	.001*
1. molar-palatinal	22.66±3.01	21.23±5.22	.018*
2. molar	60.51±3.70	58.24±3.44	.001*
Canine-anterior	9.91±1.42	9.35±1.45	.006*
1. molar – anterior	29.23±2.32	28.54±2.05	.026*
Occlusion-palatinal	22.89±3.87	19.81±2.56	.001*
Hard Palate-anterior	57.25±3.92	54.53±3.65	.001*

*Student t Test *p<.05*
Med, Median; Sd, Standard deviation

4. DISCUSSION

Numerous dental disciplines, including prosthodontics, orthodontics, the design of sports-related protective oral devices, forensic dentistry, and implant dentistry, depend on an accurate assessment of maxillary arch proportions (6,11).

The ability to provide an effective complete denture in prosthodontics significantly depends on the proportions of the maxillary arch before tooth loss. This is crucial in order for the denture to complement the patient's face structure and look, from the choice of impression trays to its construction. The maxillary arch dimension, which may vary depending on the population and other circumstances, is very important when choosing imprint trays and keeping track of the inventory of trays (10,12).

Stock trays can be difficult to adapt and modify frequently, and if they were, especially the metal trays, they would become useless (10).

The average arch length and width in a study of young Korean adults were 44.13 mm and 64.12 mm, respectively. The ovoid morphology was determined to be the dominating form. The arch length in the current study, however, was 62.71 mm for male and 45.88 mm for female, which is significantly different from the Korean population (13). The Sri Lankan study revealed that the width is greater compared to the Korean population even when the width at the 2nd molar region is compared (7). The recent research showed bigger dimensions, even when contrasted with a study conducted on Saudi Arabian individuals. According to the current study, there are clear disparities between the genders in arch length and width at all locations of measurement (15). This would indicate that these gender and ethnic disparities should be taken into account when producing or ordering stock imprint trays in order to choose the proper sizes.

Additionally, arch dimensions are crucial for establishing orthodontic tooth movement and determining the durability of the aligned dentition after treatment. When evaluating the arch type, the most common shape was ovoid, which was typical of the populations in Korea and Saudi Arabia. Orthodontic planning and final results are greatly influenced by arch size. Arch wires are made with the width, length, and form of the arch in mind (16).

Therefore, orthodontic components like arch wires and other inter maxillary devices need to be modified depending on the study population and the changes in the maxillary arch's proportions. The gender differences in arch length and intermolar width were found to be substantial in this study, indicating the need for careful selection of these devices. Additionally, these findings would be helpful in deciding the upper and lower bounds of the therapy outcomes as well as the viability of such techniques when arch growth is envisaged (17,18).

Mouthguards and other sports-related protective equipment are frequently suggested. In sports stores, the majority of these items are readily available off the shelf. The prevalence of the various arch forms, including oval, U, and V shapes, as well as the length and width, must be carefully considered while planning the inventory of these goods. Additionally, as was already said, consideration needs to be given to the significant gender variances of these factors (19,20).

The results of this study will assist define the norms of the Turkish population in terms of maxillary dimensions, and such information will also be extremely helpful in forensic dentistry for estimating the approximate race of forensic material in unidentified remains. Due to the fact that there are gender variations, this would help identify the gender and facilitate forensic reproduction (21,22).

The preferred approach to restoring missing teeth is implant dentistry. When choosing the size and length of implants, consideration should be given to the height and width of the arch. Therefore, it is important to choose and plan for the proper implant lengths when placing teeth, especially when performing immediate implants, to achieve the best results. When planning implant stock inventories, this can also be a relevant factor (23).

According to Kook et al., the average number of intercanine distances was 30 mm for White people and 32 mm for Korean people. The mean intercanine distance was determined to be 35 mm in our study. Following molar distance evaluation, the mean measures for White individuals were 52.2 mm, the mean for Korean individuals was 52.6 mm, and the mean for Turkish individuals was 54.3 mm (24). The literature on morphometric analyses using CBCT is relatively limited. Our study on a group of the Turkish population could serve as a foundational reference for future research in this area. However, to draw more comprehensive and generalizable conclusions, it is essential to include a broader and more diverse patient population in subsequent studies. Future research should consider including different demographic and ethnic groups, which would help expand the literature on CBCT morphometric analyses and lead to more robust findings.

5. CONCLUSION

Morphologic measures are critical for directing professionals through diagnosis and therapy, making clinical practice more efficient and accurate.There are notable variations in the maxillary arch based on gender and age. We found that in our study there were statistically significant difference between three classes among age groups and gender. With the data acquired, the Turkish population should review and reexamine the criteria that can be created based on patient needs in areas like forensic medicine, prosthetics, and orthodontics.

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Author Contributions:

Research idea: FNP

Design of the study: FNP. SYÜ,HY

Acquisition of data for the study: SYÜ,HY

Analysis of data for the study: FNP,SYÜ,HY

Interpretation of data for the study: SYÜ,HY

Drafting the manuscript: FNP,SYÜ

Revising it critically for important intellectual content: FNP

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REFERENCES

[1] Enlow DH, McNamara JA Jr. The neurocranial basis for facial form and pattern. Br Med J. 1973;43(3):256-270. DOI: 10.1043/0003-3219(1973)043<0256.

[2] Nakatsuka M, Iwai Y, Jue SS, Oh SH, Guo L, Tominaga Y, Kumabe S. A morphological study on the classification of maxillary dental arches. Br Med J. 2004;81(1):5-13. DOI: 10.2535/ofaj.81.5.

[3] Tarigan T, Nasution ID. Alveolar arch shapes and its relation to complete denture retention. Br Med J. 2020;5(1):30-36. DOI: 10.24815/jds.v5i1.18426.

[4] Facal-García M, de Nova-García, Suárez-Quintanilla D. The diastemas in deciduous dentition: the relationship to the tooth size and the dental arches dimensions. Br Med J. 2001;26(1):65-69. DOI: 10.17796/jcpd.26.1.d316.842.14173564k.

[5] Islam R, Alam MK, Shahid F, Khamis MF. Global dental arch dimension norms and sexual disparities: An overview. Br Med J. 2019;18(1):30. DOI: 10.3329/bjms.v18i1.39543.

[6] Jayasinghe RM, Thilakumara IP, Hettiarachchi PVKS, Fonseka MCN, Nanayakkara CD, Jayasinghe RD. Morphometric analysis of maxillary arch dimensions using Cone Beam Computer Tomography (CBCT). Br Med J. 2022;12(5):500-504. DOI: 10.1016/j.jobcr.2022.06.001.

[7] Arambawatta AKS, Nandasena BGT, Peiris HRD. Dental arch morphology in normal occlusion of the Sri Lankan population. Br Med J. 2020;20(5):48-56. DOI: 10.20396/bjos.v10i1.8641705.

[8] Tarazona B, Llamas JM, Cibrian R, Gandia JL, Paredes V. A comparison between dental measurements taken from CBCT models and those taken from a digital method. Br Med J. 2013;35(1):1-6. DOI: 10.1093/ejo/cjr005.

[9] Zilberman O, Huggare JA, Parikakis KA. Evaluation of the validity of tooth size and arch width measurements using conventional and three-dimensional virtual orthodontic models. Br Med J. 2003;73(3):301-306. DOI: 10.1043/0003-3219(2003)073<0301.

[10] Bell A, Ayoub AF, Siebert P. Assessment of the accuracy of a three-dimensional imaging system for archiving dental study models. Br Med J. 2003;30(3):219-223. DOI: 10.1093/ortho/30.3.219.

[11] Leifert MF, Leifert MM, Efstratiadis SS, Cangialosi TJ. Comparison of space analysis evaluations with digital models and plaster dental casts. Br Med J. 2009;136(1):16.e1-16. DOI: 10.1016/j.ajodo.2008.11.019.

[12] Stevens DR, Flores-Mir C, Nebbe B, Raboud DW, Heo G, Major PW. Validity, reliability, and reproducibility of plaster vs digital study models: Comparison of peer assessment rating and Bolton analysis and their constituent measurements. Br Med J. 2006;129(6):794-803. DOI: 10.1016/j.ajodo.2004.08.023.

[13] Banerjee R, Chahande J, Radke U, Jaiswal P. Evaluation of the role of skull anthropometry for complete denture teeth selection: A cross-sectional study. Br Med J. 2018;18(1):42-46. DOI: 10.4103/jips.jips_211_17.

[14] Park SJ, Leesungbok R, Song JW, Chang SH, Lee SW, Ahn SJ. Analysis of dimensions and shapes of maxillary and mandibular dental arch in Korean young adults. Br Med J. 2017;9(5):321-327. DOI: 10.4047/jap.2017.9.5.321.

[15] Al-Zubair NM. Determinant factors of Yemeni maxillary arch dimensions. Br Med J. 2015;27(1):50-54. DOI: 10.1016/j.sdentj.2014.08.005.

[16] Alkadhi OH, Almahfouz SF, Tokhtah HA, Binhuwaishel LA. Dental Arch Dimensions in Saudi Adults. Br Med J. 2018;2018:2190250. DOI: 10.1155/2018/2190250.

[17] Barghan S, Tetradis S, Mallya S. Application of cone beam computed tomography for assessment of the temporomandibular joints. Br Med J. 2012;57 Suppl 1:109-118. DOI: 10.1111/j.1834-7819.2011.01663.x.

[18] Al-Khatib AR, Rajion ZA, Masudi SM, Hassan R, Anderson PJ, Townsend GC. Tooth size and dental arch dimensions: A stereophotogrammetric study in Southeast Asian Malays. Br Med J. 2011;14(4):243-253. DOI: 10.1111/j.1601-6343.2011.01529.x.

[19] Geary JL, Clifford TJ, Kinirons MJ. Occlusal accommodation and mouthguards for prevention of orofacial trauma. Br Med J. 2009;7(1):55-59. DOI: 10.3290/j.ohpd.a15268.

[20] Kannampurath A, Leela Srikantannair S, Mathew P, SivaPrasad T. Maxillary sinus in gender determination: A morphometric analysis using cone beam computed tomography. Br Med J. 2023. DOI: 10.1007/s12024.023.00749-5.

[21] Grewal DS, Khangura RK, Sircar K, Tyagi KK, Kaur G, David S. Morphometric analysis of odontometric parameters for gender determination. Br Med J. 2017;11(8) . DOI: 10.7860/JCDR/2017/26680.10341.

[22] Okori H, Apolot PS, Mwaka E, Tumusiime G, Buwembo W, Munabi IG. A secondary analysis to determine variations of dental arch measurements with age and gender among Ugandans. Br Med J. 2015;8:428. DOI: 10.1186/s13104.015.1411-6.

[23] Zhang W, Skrypczak A, Weltman R. Anterior maxilla alveolar ridge dimension and morphology measurement by cone beam computerized tomography (CBCT) for immediate implant treatment planning. Br Med J. 2015;15:65. DOI: 10.1186/s12903.015.0055-1

[24] Kook YA, Nojima K, Moon HB, McLaughlin RP, Sinclair PM. Comparison of arch forms between Korean and North American white populations. Br Med J. 2004;126(6):680-686. DOI: 10.1016/j.ajodo.2003.10.038.

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