Original Article

Assessment of Articular Eminence Shape and Dental Arch Correlation Using Cone Beam Computed Tomography in Iraqi Residents

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Abstract

Background: Cone beam computed tomography is the most effective device for assessing the link between articular eminence and dental arch shape. It provides accurate information on these variables. **Objectives:** The present investigation utilised cone beam computed tomography imaging to assess the correlation between the morphology of the articular eminence and the form of the dental arch in patients exhibiting class I, II, and III skeletal relationships. Information on the articular eminence and the morphology of the dental arch can be collected using cone beam computed tomography. This imaging technique is regarded the most effective method for evaluating any correlation between these variables. **Materials and Methods:** This prospective study was undertaken at the Baquba teaching hospital in Diyala city from December 2021 to June 2023. A total of 200 patients, comprising an equal number of males and females, participated in this study. The age range of the participants was between 18 and 50 years. These individuals got cone beam computed tomography imaging as a component of their medical care. The data collected in these instances has been utilised to carry out the inquiry continuously. This study obtained approval from both the Iraqi Ministry of Health and the scientific committee of the University of Diyala College of Medicine in Baquba city to use the case in question. **Results:** Comparison of Different Angles (A, B, C) between different arch shapes in right and left Side, no significant differences were found in Angle A, Angle B, or Angle C between different dental arch classes (p-values > .05). Comparison of articular eminence height between different arch shapes, no significant differences were found in articular eminence height between different dental arch classes (p=.872), additionally, our study found no significant difference between the inclination of the articular eminence and the various skeletal relationships of dental arches. Furthermore, our study revealed that the most common shape of dental arches was ovoid, followed by square and tapering arches. Similarly, no significant difference was found between the shape of the articular eminence and the different forms of dental arches (ovoid, square, and tapered). **Conclusion:** A thorough comprehension of the complex connections between the angle of the dental arch and the slope of the articular eminence was achieved by meticulously analysing various angles on both the left and right sides. Despite identifying several associations, the study ultimately determined that none of these relationships achieved statistical significance. The study broadened its focus to encompass the intricate correlation between the width and height of the articular eminence in relation to different arch shapes. The study discovered limited and irregular connections between the maxillary and mandibular arches, which have an oval, tapering, and square shape. The study aimed to detect distinctive patterns in the anatomy of the articular eminence in individuals with class I, II, or III occlusion. The findings indicated that there were negligible differences in the height or angles of AE (alveolar bone crest) among different dental arch types and classes.

Keywords: Articular Eminence, Dental Arch Shape, Class I, II and III Skeletal Relation, Cone Beam Computed Tomography.

Introduction

The temporomandibular joint, also known as the arthrodial ginglymus joint, is composed of the articular tubercle, articular disc, condyle, retro discal tissue, synovial membrane, and joint capsule (TMJ).[1] The phrase "temporal bone" and "mandible," which are its two constituent bones, allude to the most sophisticated and developed joint in humans. The mandible and skull are joined by a pair of articulations, which establish their connection. The temporomandibular joint (TMJ) enables many mandibular activities such as speaking, eating, swallowing, and facial expression. Humans possess the ability to consume both plant and animal-based foods due to their capacity to modify their jaw movements.[2-4]

The convex articular eminence (AE) acts as the front

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boundary of the mandibular fossa.[5] When the jaw is moved, the condylar process glides along the articular eminence (AE), which is a part of the temporal bone. There are variations among individuals in the inclination of AE, which affects the direction of movement of the condyle and the extent of disc rotation over the condyle.[6]

The articular eminence inclination is the angle formed by any horizontal plane, such as the Frankfort Horizontal (FH) plane (AEI).[7] The articular eminence inclination is a crucial factor in the biomechanics of the TMJ. The movements of the condylar disc complex are determined by the articular eminence inclination (AEI).[7] The angle of inclination progressively increases as an individual gets older, while AE remains level at the time of birth.[8] The angle values of arthropod prominence often fall within the range of 30 to 60 degrees.

The articular eminence is considered "flat" when its inclination angle is below 30 degrees, and "steep" when it exceeds 60 degrees.[7,9]

The orientation of the articular eminence (AE) influences the motion of the condyle within the mandibular fossa. The condylar direction is more perpendicular at steep AE slopes and less perpendicular at flat AE slopes.[10] The shape of the mandible is one of the anatomical factors that influences its movement. Furthermore, it is influenced by the absence of teeth,[11] age,[12,13] sex,[12,14] skeletal malocclusion,[15,16] and masticatory loads.[17]

Several scholars have examined the relationship between morphology and dental arch shape (DAS) using cone beam computed tomography (CBCT).[18] The morphologies of DAS and AE were found to be associated. Although the findings do not indicate a direct linkage between the variables, the correlations need to be taken into consideration. A recent study further establishes the association between gender and the morphology of the mandibular fossa and AE.[17] In addition, a 2021 study conducted by Moscagiuri *et al.*[19] used CBCT to evaluate the AEI in Normo-Divergent Subjects with Different Skeletal Classes. The study found no correlation between the AEI and skeletal class.[19] Another study has discovered that male brachycephaly patients exhibit elevated angulations of the AE[18] or in patients with angled condyles.[14]

Cone beam CT (CBCT) has become a feasible alternative to traditional CT scanning in dentistry and maxillofacial diagnostic osseous duties. Although the radiation dose is reduced compared to typical CT scans, CBCT, which was also utilised in this investigation, allows for a shorter scanning duration.[20]

This study utilises Cone Beam Computed Tomography (CBCT) to assess the correlation between the Anterior Aesthetic (AE) morphology and the Dentofacial Aesthetic Scale (DAS) in patients with class I, II, and III skeletal relationships.

Materials and Methods

This study was conducted in the Baquba Teaching Hospital in Diyala City from December 2021 to June 2023. This study has a total of 200 patients, with an equal number of males and females participating. The age range of the participants is between 18 and 50 years. These individuals received CBCT imaging as a component of their medical care. The data collected in these instances has been utilised to carry out the inquiry continuously. The research proposal was filed to the Research Ethics Committee of the University of Diyala College of Medicine in Baquba city, with the Research Project number 2024AHT821.The participant in our study received and provided their signature on the permission form.

After conducting a comprehensive clinical and radiological evaluation of the group of subjects, information was recorded on an individualised case sheet for each patient. The inclusion criteria were the following:

Adequate contrast and sharpness in the images to make the structures (dental arches and articular eminence) that need to be assessed discernible.

A wide area of viewing that included the skull and showed both TMJs.

(3) All permanent dentition, excluding the wisdom teeth.

No prior fractures or injuries to the craniofacial region.

No symptoms of temporomandibular disorders.

No history of orthognathic surgery or orthodontic therapy.

No evidence of hereditary craniofacial disorder.

No signs of asymmetry in the structure of the face.

No signs of condylar hyperplasia.

(10) No aesthetic restorations involve the first molars' and premolars' buccal cusps, as well as metallic restorations in any aspect, canines, and incisor incisal edges.

Tomographic images were acquired with a CBCT scanner (KaVo OP 3D Pro) as shown in **figure 1**, 10 A 220-240 V 50/60 Hz, voxel size =0.5 mm, field of view(FOV) =8 ×15 cm, Exposure time =24 second, degree of rotation 360.

Figure 1: CBCT Machine (KaVo OP 3D Pro).

During the performing of this study, we detect some imaginary lines and points in order to facilitate the precise detection of angles we needed in these study. The points included the following: HPA (the highest point of articular eminence image in sagittal view) (Figure 2 A); and LPG,(the lowermost point of the glenoid(mandibular) fossa image in sagittal view) (see Figure 2 A). Also 6 imaginary line were used in this study include: line 1, the line that pass through mid of HPA and this line parallel to Frankfurt plane.(see Figure 2A); Line 2, the line that pass through mid of LPG and this line parallel to Frankfurt plane. (see Figure 2A); Line 3, the line in close contact to the most concave surface of the posterior slope of articular eminence (see Figure 2A); Line 4, the line pass in both point HPA and LPG (see Figure 2A); Line 5, line pass through LPG point and its perpendicular to Frankfurt plane (Figure 2B) coronal view; Line 6, line in contact with lateral wall of glenoid (mandibular) fossa. (see Figure 2B) coronal view. In order to detect the exact height of the articular eminence (HAE) in sagittal sections image, a straight line drawing from point HPA perpendicular to line 2, and cross it in point situated on the same level of the point LPG. (Figure 2C), while the anteroposterior inclination was calculated using two methods: method 1, A angle, the angle formed by the crossing of line 1 and line 3 (see Figure 2C); and method 2, B angle, the angle formed by the crossing of line 1 and line 4 (see Figure 2C). The C angle created by the crossing of lines 5 and 6, was used to determine the inclination of the lateral wall of the glenoid (mandibular) fossa. (Figure 2D coronal view).

Measurements of the mandibular and maxillary dental arches, as shown in Figures (3&4). Table 1 show in details the width of measurement of both mandibular and maxillary dental arches, also table (2) show the depth and Perimeter of dental arch measurement of both mandibular and maxillary dental arches. The measurement done in axial section image, all measurement done by using of CBCT machine (KaVo OP 3D Pro).

A total of ten samples were selected at random to evaluate the consistency and dependability of the correlation between the shape of the articular eminence and the dental arch in Iraqi inhabitants. Cone beam computed tomography was utilised to measure these samples and identify the components that impact this correlation.

Inter Examiner Calibration

An experienced senior oral and maxillofacial radiologist compared the researcher's measurement of the randomly chosen 10 CBCT image to ensure calibration. Using a paired t-test, the comparison of the two measurements revealed a difference that was not significant (p>0.05).

Intra Examiner Calibration

The examiner measured the randomly chosen 10 CBCT images two times, allowing two weeks to pass between each test in order to finalize this calibration. Using a paired t-test, the comparison of the two readings revealed no significant difference (p>0.05).

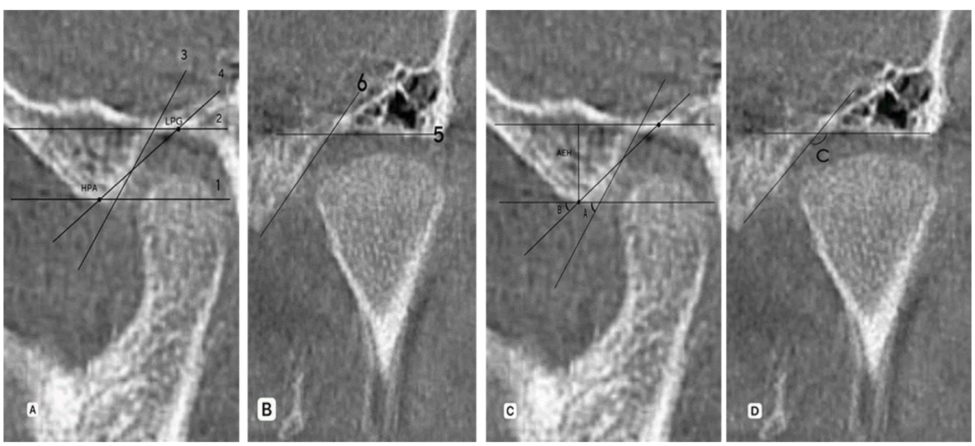

Figure 2 (A,B,C,D): HPA (The Highest Point of Articular Eminence Image in Sagittal View).

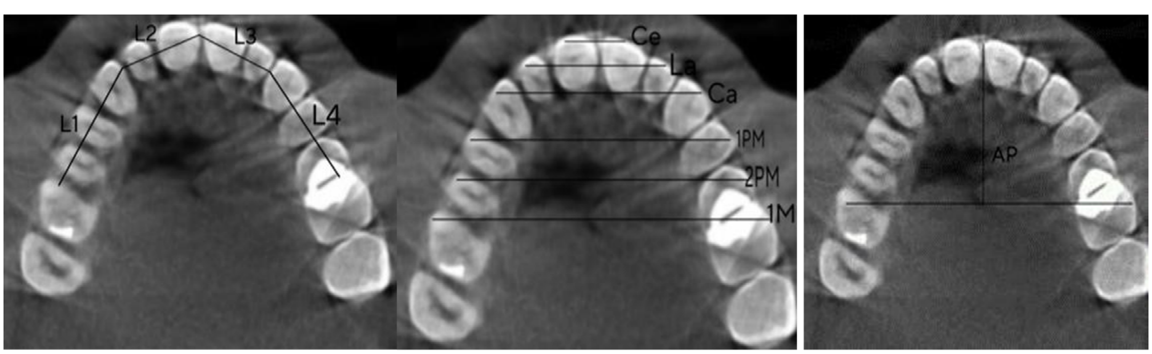

Figure 3: Measurements of the Maxillary Arch.

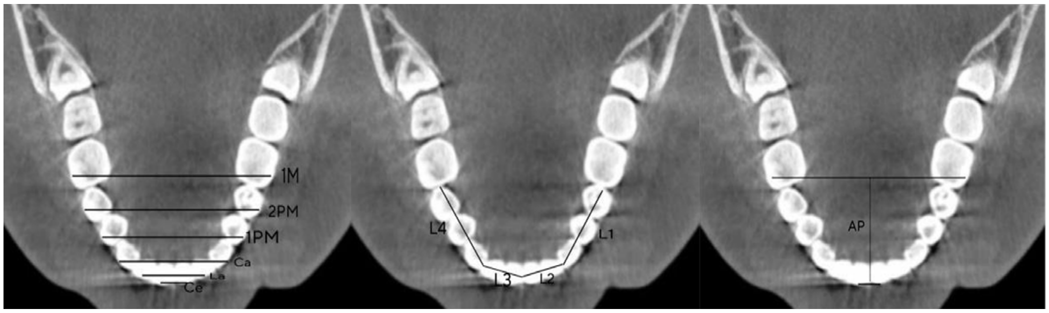

Figure 4: Measurements of the Mandibular Arch.

Table 1: Maxillary and Mandibular Dental Arches Width.

Max. & Mand Arches	Measurement
CE	Distance between the mean incisal points of central incisors
LA	Distance between the mean incisal points of lateral incisors
CA	Distance between the cusp tips of canines
FPM	Distance between the buccal cusp tips of first premolars
SPM	Distance between the buccal cusp tips of second premolars
FM	Distance between the mesiobuccal cusp tips of first molars

Table 2: Maxillary and Mandibular Dental Arches Perimeter.

Max. & mand arches	
AP	Anteroposterior depth of dental arch—distance between mean points of the distance CE and FM
L1	Distance between mesial contact point of the left first molar and distal contact point of the left lateral incisor
L2	Distance between distal contact point of the left lateral incisor and mesial contact point of the left central incisor
L3	Distance between mesial contact point of the left central incisor and distal contact point of the right lateral incisor
L4	Distance between distal contact point of the right lateral incisor and mesial contact point of the right first molar
PM	Perimeter of dental arch—sum of the distances L1+L2+L3+L4

Result

Relation between AE Bone Height and Different Angles On Right and Left Sides

(a) On the Right Side

The relation between AE bone height and different angles on the right side is presented in table 3

There was a negative correlation between AE bone height and Angle A. This means that when angle A increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.015, p=.828)

There was a negative correlation between AE bone height and Angle B. This means that when angle B increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.003, p=.963)

There was a positive correlation between AE bone height and Angle C. This means that when angle C increased, AE bone height increased vise versa. However, the relation was not significant (R=-.056, p=.433)

(b) On the Left Side

The Relation between AE Bone Height and Different Angles On the Left Side is Presented in Table 3

There was a positive correlation between AE bone height and Angle A. this means that when angle A increased, AE bone height increased vise versa. However, not significant relation observed (R=-.003, p=.969)

A positive correlation within AE bone height and Angle B. This means that when angle B increased, AE bone height increased vise versa. However, the relation was not significant (R=.100, p=.159)

There was a negative correlation between AE bone height and Angle C. This means that when angle C increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.045, p=.526)

Table 3: Relation between AE Bone Height and Different Angles On Right and Left Sides.

		Angle A	Angle B	Angle C
Right side	Pearson Correlation	-.015	-.003	.056
	Sig. (2-tailed)	.828	.963	.433
	N	200	200	200
Left side	Pearson Correlation	.003	.100	-.045
	Sig. (2-tailed)	.969	.159	.526
	N	200	200	200

*p is significant at 5% level

Relation between AE Height and Width of Maxillary Dental Arch for Different Arch Forms

(a) Ovoid Maxillary *Arch*

The Relation between AE Bone Height and Width of Maxillary Dental Arch is Presented in Table 4

There was a negative correlation between AE bone height and distance between the mean incisal points of central incisors in maxillary arch (CEMX). This means that when CEMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.053, p=.589)

A positive correlation between AE bone height and LAMX. This means that when distance between the mean incisal points of lateral incisors in maxillary arch (LAMX) increased, AE bone height increased vise versa. However, the relation was not significant (R=.004, p=.964)

There was a negative correlation between AE bone height and distance between the cusp tips of canines in maxillary arch (CAMX). This means that when CAMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.104, p=.283)

There was a negative correlation between AE bone height and Distance between the buccal cusp tips of first premolars in maxillary arch
(FPMMX). This means that when FPMMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.083, p=.391)

There was a negative correlation between AE bone height and distance between the buccal cusp tips of second premolars in maxillary arch (SPMMX). This means that when SPMMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.068, p=.485)

There was a negative correlation between AE bone height and distance between the mesiobuccal cusp tips of first molars in maxillary arch (FMMX). This means that when FMMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.037, p=.704)

There was a negative correlation between AE bone height and anteroposterior depth of dental arch—distance between mean points of the distance CE and FM in maxillary arch (APMX). This means that when APMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.083, p=.391)

A positive correlation between AE bone height and Perimeter of dental arch—sum of the distances L1+L2+L3+L4 maxillary arch (PMMX). This means that when PMMX increased, AE bone height increased vise versa. However, the relation was not significant (R=.035, p=.722)

(b) Tapered Maxillary Arch

The Relation between AE Bone Height and Width of Maxillary Dental Arch is Presented in Table 4

There was a significant positive correlation between AE bone height and CEMX. This means that when CEMX increased, AE bone height increased vise versa. significant relation observed (R=.307, p=.023*)

A positive correlation between AE bone height and LAMX. This means that when LAMX increased, AE bone height increased vise versa. However, the relation was not significant (R=.000, p=.994)

There was a negative correlation between AE bone height and CAMX. This means that when CAMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.096, p=.486)

There was a negative correlation between AE bone height and FPMMX. This means that when FPMMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.050, p=.751)

There was a negative correlation between AE bone height and SPMMX. This means that when SPMMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.132, p=.336)

A positive correlation between AE bone height and FMMX. This means that when FMMX increased, AE bone height increased vise versa. However, not significant relation observed (R=.23, p=.092)

There was a significant negative correlation between AE bone height and APMX. This means that when APMX increased, AE bone height decreased vise versa. The relation was significant (R=-.268, p=.048*)

There was a negative correlation between AE bone height and PMMX. This means that when PMMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.187, p=.194)

(c) Square Maxillary Arch

The Relation between AE Bone Height and Width of Maxillary Dental Arch is Presented in Table 4

There was a negative correlation between AE bone height and CEMX. This means that when CEMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.124, p=.463)

There was a negative correlation between AE bone height and LAMX. This means that when LAMX increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.001, p=.994)

There was a positive correlation between AE bone height and CAMX. This means that when CAMX increased, AE bone height increased vise versa. However, not significant relation observed (R=.258, p=.123)

A positive correlation between AE bone height and FPMMX. This means that when FPMMX increased, AE bone height increased vise versa. However, the relation was not significant (R=.284, p=.139)

A positive correlation between AE bone height and SPMMX. This means that when SPMMX increased, AE bone height increased vise versa. However, the relation was not significant (R=.302, p=.070)

A positive significant correlation between AE bone height and FMMX. This means that when FMMX increased, AE bone height increased vise versa. The relation was significant (R=.347, p=.036*)

A positive not significant correlation between AE bone height and APMX. This means that when APMX increased, AE bone height increased vise versa. The relation was not significant (R=-.163, p=.334)

There was a negative correlation between AE bone height and PMMX. This means that when PMMX increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.041, p=.810)

Table 4: Relation between AE Height and Width of Maxillary Dental Arch for Different Arch Forms.

		CEMX	LAMX	CAMX	FPMMX	SPMMX	FMMX	APMX	PMMX
Ovoid arch	Pearson Correlation	-.053	.004	-.104	-.083	-.068	-.037	-.083	.035
	Sig. (2tailed)	.589	.964	.283	.391	.485	.704	.391	.722
	N	108	108	108	108	108	108	108	108
Tapered arch	Pearson Correlation	.307	.000	-.096	-.050	-.132	.230	-.268	-.178
	Sig. (2tailed)	.023*	.999	.486	.715	.336	.092	.048*	.194
	N	55	55	55	55	55	55	55	55
Square arch	Pearson Correlation	-.124	-.001	.258	.248	.302	.347	-.163	-.041
	Sig. (2tailed)	.463	.994	.123	.139	.070	.036*	.334	.810
	N	37	37	37	37	37	37	37	37

*p is significant at 5% level

Relation between AE Height and Width of Mandibular Dental Arch for Different Arch Forms

(a) Ovoid Mandibular Arch

The relation between AE bone height and width of mandibular dental arch is presented in table 5

The distance between the mean incisal points of the central incisors in the mandibular arch (CEMD) and AE bone height showed a positive correlation. This means that when

CEMD increased, AE bone height increased vise versa. However, the relation was not significant (R=.033, p=.713)

There was a positive correlation between AE bone height and distance between the mean incisal points of lateral incisors in mandibular arch (LAMD). This means that when

LAMD increased, AE bone height increased vise versa. However, the relation was not significant (R=.097, p=.273)

There was a negative correlation between AE bone height and distance between the cusp tips of canines in mandibular arch CAMD. This means that when

CAMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.006, p=.948)

There was a negative correlation between AE bone height and distance between the buccal cusp tips of first premolars in mandibular arch (FPMMD). This means that when FPMMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.063, p=.473)

There was a negative correlation between AE bone height and distance between the buccal cusp tips of second premolars in mandibular arch (SPMMD). This means that when SPMMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.067, p=.447)

There was a negative correlation between AE bone height and distance between the mesiobuccal cusp tips of first molars in mandibular arch (FMMD). This means that when FMMD increased, AE bone height decreased vise versa. However, not significant relation observed (R=-.057, p=.518)

A negative significant correlation between AE bone height and anteroposterior depth of dental arch—distance between mean points of the distance CE and FM in mandibular arch (APMD). This means that when APMD increased, AE bone height decreased vise versa. The relation was significant (R=-.173, p=.049*)

A positive correlation between AE bone height and Perimeter of dental arch—sum of the distances L1+L2+L3+L4 in mandibular arch (PMMD). This means that when

PMMD increased, AE bone height increased vise versa. However, the relation was not significant (R=-.086, p=.888)

(b) Tapered Mandibular Arch

The Relation between AE Bone Height and Width of Mandibular Dental Arch is Presented in Table 5

There was a positive correlation between AE bone height and CEMD. This means that when

CEMD increased, AE bone height increased vise versa. However, the not significant relation observed (R=.223, p=.308)

AE bone height and LAMD showed positive correlation. This means that when

LAMD increased, AE bone height increased vise versa. However, not significant relation observed (R=.247, p=.256)

AE bone height and CAMD showed a positive correlation. This means that when

CAMD increased, AE bone height increased vise versa. However, not significant relation observed (R=.367, p=.085)

AE bone height and FPMMD showed positive correlation. This means that when FPMMD increased, AE bone height increased vise versa. However, not significant relation observed (R=.225, p=.302)

AE bone height and SPMMD showed positive correlation. This means that when SPMMD increased, AE bone height increased vise versa. However, not significant relation observed (R=.234, p=.259)

AE bone height and FMMD showed positive correlation. This means that when
FMMD increased, AE bone height increased vise versa. However, not significant relation observed (R=.085, p=.698)
AE bone height and APMD showed significant negative correlation between. This means that when APMD increased, AE bone height decreased vise versa. not significant relation observed (R=-.144, p=.513
AE bone height and PMMD showed positive correlation between. This means that when
PMMD increased, AE bone height increased vise versa. However, the relation was not significant (R=.261, p=.229)

(c) Square Mandibular Arch
The Relation between AE Bone Height and Width of Mandibular Dental Arch is Presented in Table 5

There was a positive correlation between AE bone height and CEMD. This means that when
CEMD increased, AE bone height increased vise versa. However, insignificant relation observed. (R=.017, p=.909)
A positive correlation between AE bone height and LAMD. This means that when
LAMD increased, AE bone height increased vise versa. However, the relation was not significant (R=.041, p=.783)
There was a negative correlation between AE bone height and CAMD. This means that when
CAMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.059, p=.694)
There was a negative correlation between AE bone height and FPMMD. This means that when FPMMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.053, p=.772)
There was a negative correlation between AE bone height and SPMMD. This means that when SPMMD increased, AE bone height decreased vise versa. However, the relation was not significant (R=-.005, p=.973)
There was a negative correlation between AE bone height and FMMD. This means that when FMMD increased, AE bone height decreased vise versa. However, insignificant relation observed. (R=-.025, p=.866)
A significant positive correlation was observed between APMD and AE bone height. This means that when APMD increased, AE bone height increased vise versa. The relation was not significant (R=.022, p=.883)
A positive correlation between AE bone height and PMMD. Means that when PMMD increased, AE bone height increased vise versa. However, the relation was not significant (R=.096, p=.523)

Table 5: Relation between AE Height and Width of Mandibular Dental Arch for Different Arch Forms.

		CEMD	LAMD	CAMD	FPMMD	SPMMD	FMMD	APMD	PMMD
Ovoid arch	Pearson Correlation	.033	.097	-.006	-.063	-.067	-.057	-.173	-.086
	Sig. (2tailed)	.713	.273	.948	.473	.447	.518	.049	.333
	N	130	130	130	130	130	130	130	130
Tapered arch	Pearson Correlation	.223	.247	.367	.225	.259	.085	-.144	.261
	Sig. (2tailed)	.308	.256	.085	.302	.234	.698	.513	.229
	N	23	23	23	23	23	23	23	23
Square arch	Pearson Correlation	.017	.041	-.059	-.053	-.005	-.025	.022	.096
	Sig. (2tailed)	.909	.783	.694	.722	.973	.866	.883	.523
	N	47	47	47	47	47	47	47	47

*p is significant at 5% level

Comparison of Different Angles (A,B, C) between Different Arch Relation
(A) On the Right Side

Comparison of different angles (on the right side) between different classes is presented in table 6 and fig 5
-A one way ANOVA with a P>.05 significance level revealed no discernible variation in Angle A among the classes.
- For (One way ANOVA, P>.05), there was no discernible variation in Angle B between the courses.
- Insignificant relation observed in Angle C between different classes for (One way ANOVA, P>.05)

Table 6: Comparison of Various Angles (Right Side) among Various Classes.

Dental_arch_relation		R_angleA	R_angleB	R_angleC
class I	X	50.48	34.34	136.72
	SD	8.46	6.58	16.08
class II	X	52.71	34.87	137.47
	SD	9.69	5.18	8.44
class III	X	51.60	34.68	137.83
	SD	8.63	6.20	8.09
One- Way ANOVA (p value)		.467	.918	.940

X; mean, SD; standard deviation, *p is significant at 5%.

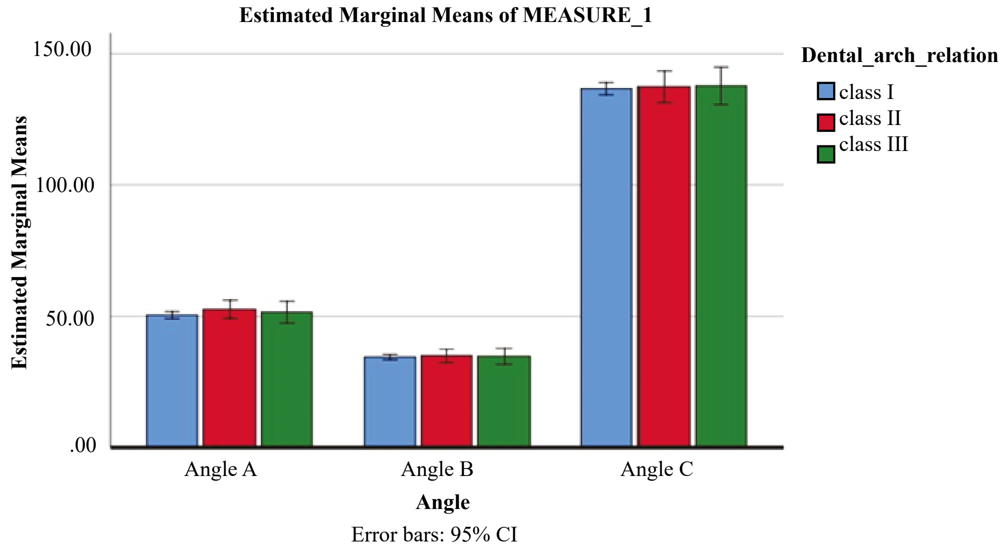

Figure 5: Comparison of Various Angles (Right Side) between Various Classes.

(B) On the Left Side

A comparison of various angles (on the left) between various class is presented in table 7 and fig 6

Insignificant relation observed in Angle A in various classes for (One way ANOVA, P>.05)

-For (One way ANOVA, P>.05), there was no discernible variation in Angle B between the courses.

-For (One way ANOVA, P>.05), there was no discernible variation in Angle C between the courses.

Table 7: Comparison of Different Angles (on the Left Side) between Different Classes.

Dental_arch_relation		R_angleA	R_angleB	R_angleC
class I	X	50.48	34.34	136.72
	SD	8.46	6.58	16.08
class II	X	52.71	34.87	137.47
	SD	9.69	5.18	8.44
class III	X	51.60	34.68	137.83
	SD	8.63	6.20	8.09
One- Way ANOVA (p value)		.763	.536	.056

X; mean, SD; standard deviation, *p is significant at 5%.

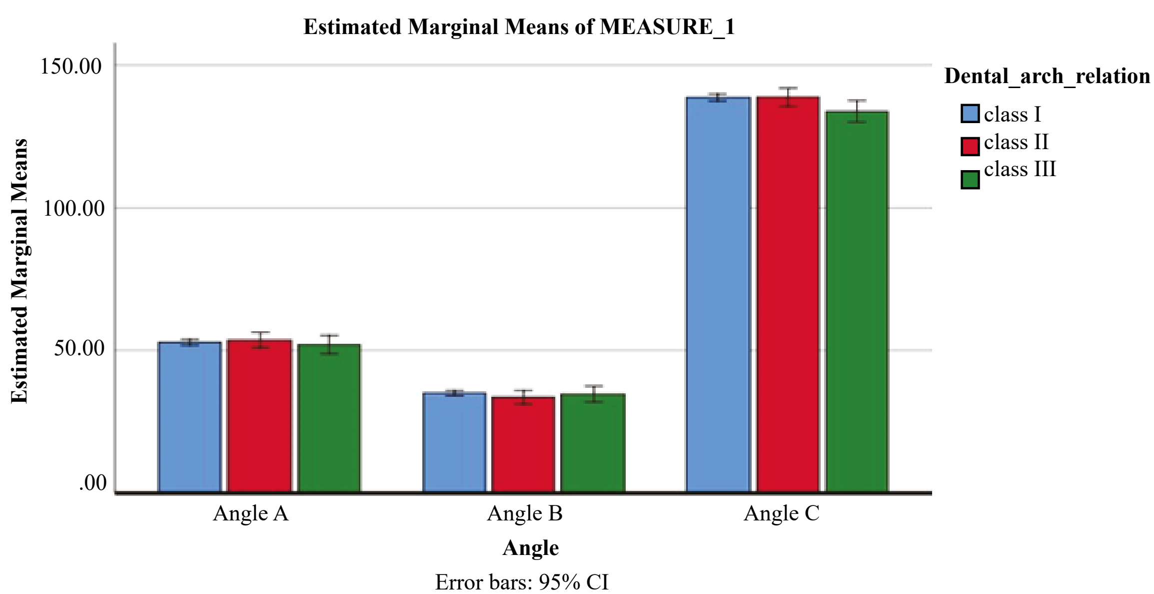

Figure 6: Comparison of Different Angles (On the Left Side) between Different Classes.

Comparison of AE_height between Different Arch Relation

Comparison of AE_height between different classes is presented in table 8 and figure 7.

Insignificant relation observed in AE_height between different classes for (One way ANOVA, P=.872)

Table 8: Comparison of AE_Height between Different Classes.

AE_height		
Dental_arch_relation	Mean	Std. Deviation
class I	7.2094	.83331
class II	7.2333	.87609
class III	7.1059	.70575
One Way ANOVA (p value)	.872	

X; mean, SD; standard deviation, *p is significant at 5%.

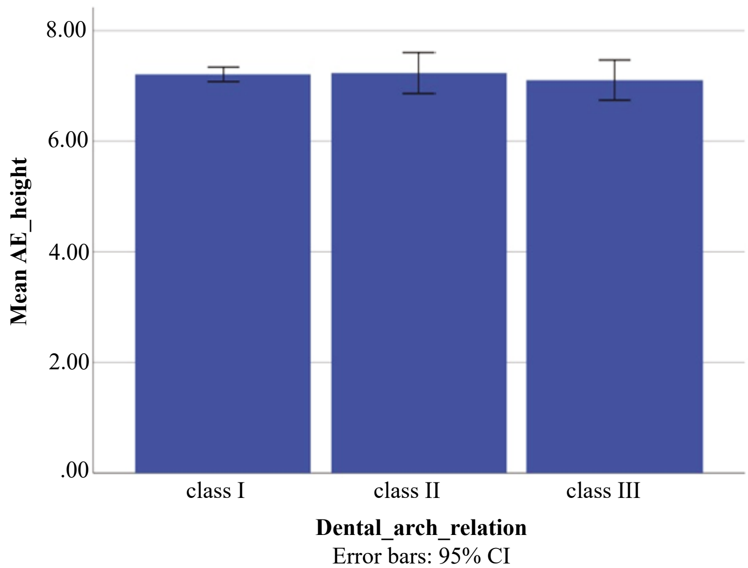

Figure 7: Comparison of AE_height between Different Classes.

Discussion

The aim of this study is to assess the correlation between the dental arch (DA) and alveolar bone (AE) structure in patients diagnosed with occlusion class I, II, or III Kennedy, using cone beam computed tomography (CBCT). The inclination of the articular eminence, which can be assessed using radiographic or clinical methods such as occlusal wax registration or intraoral registration equipment, serves as an indicator of condylar guidance.[21] According to the research, radiography techniques are more easily standardised and have greater reproducibility compared to clinical procedures. By utilising radiographic procedures, one can identify specific reference points on radiograms, resulting in data that is both replicable and standardised. However, a disadvantage of radiography procedures is that they rely on the patient being exposed to potentially harmful X-ray radiation. The morphology of the temporomandibular joint (TMJ) was traditionally evaluated using conventional radiographic methods, such as cephalometry[9], and panoramic[22]. Nevertheless, Conventional radiography does possess various drawbacks. These radiographs are unable to investigate the morphology of the central and medial regions of the TMJ due to superimpositions. Only the angle of the eminence's furthest lateral posterior slope is apparent on conventional radiography. Conventional radiographs are unable to create slices, hence the anatomy of the articular eminence is not accurately depicted in these examinations.[23]

This work utilised the sagittal, axial, and coronal sections of the temporomandibular joint (TMJ) obtained from a cone beam computed tomography (CBCT) scan. These sections were employed to calculate the articular eminence inclination (AEI) utilising radiographic methods.

In Relation between AE Bone Height and different angles on right Side, Angle A showed a negative correlation with AE bone height, but it was not significant (p=.828). Angle B also had a negative correlation with AE bone height, but it was not significant (p=.963). Angle C exhibited a positive correlation with AE bone height, but it was not significant (p=.433). In left Side, Angle A demonstrated a positive correlation with AE bone height, but it was not significant (p=.969). Angle B also showed a positive correlation with AE bone height, and it was not significant (p=.159). Angle C had a negative correlation with AE bone height, but it was not significant (p=.526). So on both sides, there are varied correlations between angles and AE bone height, but none are statistically significant.

The relationship between the height and width of the maxillary dental arch for different arch shapes was examined. In the case of an ovoid maxillary arch, the height of the AE bone showed diverse relationships with various measurements (CEMX, LAMX, CAMX, etc.), but none of these correlations were found to be significant. The connections exhibited variability across various architectural forms. In the tapering maxillary arch, which is comparable to the ovoid arch, several correlations were identified, but most of them were not statistically significant. However, there were some substantial negative correlations that were observed with CEMX and APMX (p-values .023). In the square maxillary arch, there were various associations, but only a few reached borderline significance. Notable significant positive correlations were discovered with FMMX and APMX (p-values .036), the correlations between AE bone height and maxillary arch dimensions were generally feeble and variable across different arch shapes. The correlations observed were not substantial.

Positive connections were identified between the height and width of the mandibular dental arch for different arch types, specifically in the case of ovoid mandibular arch with CEMD, LAMD, and APMD, however, none of them were noteworthy or substantial. An evident inverse correlation was detected with APMD (p=.049), Positive associations were frequently seen in the Tapered Mandibular Arch, although none attained statistical significance. Additionally, a non-significant negative correlation was observed with APMD (p=.144), In the Square Mandibular Arch, there were generally positive connections, but no significant relationships were found. The link between AE bone height and mandibular arch dimensions was generally modest, similar to the maxillary arch. Only a few meaningful correlations were observed. When comparing the angles (A, B, C) between different arch shapes on the right side, no significant differences were observed in Angle A, Angle B, or Angle C among different dental arch classes (p-values > .05). No significant variations were seen in Angle A or Angle B between different dental arch classes on the left side (p-values > .05), There was a borderline significance (p=.056) observed in Angle C between different classes, There were no significant differences observed in the angles A, B, and C among different dental arch classes on either side. The marginal relevance of Angle C on the left side may necessitate additional examination with a more extensive sample.

When comparing the height of the alveolar bone crest (AE) in different arch relations, no statistically significant differences were seen between dental arch classes (p=.872), several studies have utilised CBCT to explore the relationship between the dental arch and the form of the alveolar bone. Verner *et al.*[18] discovered the relationship between the two is mostly influenced by the height of the AE, which shows the most significant correlation with dimensions of the DA.[18] A study conducted by Costa *et al.*[17] emphasised the importance of considering anatomical factors, particularly the lateral slope of the mandibular fossa and the posterior slope of the AE.[17] Ikai conducted another study which indicates that a more inclined middle angle of the eminence is associated with a posteriorly positioned upper jaw or an anteriorly positioned lower jaw.[24] Another study utilised CBCT to measure tooth size and arch dimensions and discovered no significant differences in sexual comparison for all parameters. However, significant differences were observed in the arch perimeter groups and the overall ratio of arch length.[25] These data demonstrate that CBCT has the ability to enhance our understanding of the relationship between the DA and AE shape, and provide crucial anatomical information for various dental procedures.

Prior research focused solely on analysing the anteroposterior direction to determine the inclination of the AE. The present study assessed the lateral inclination of the mandibular fossa at its highest point. It considered that the lateral area is where the first alterations in the temporomandibular joint (TMJ) occur, and that the condyle-disk complex moves both laterally and in anteroposterior rotational and translational motions. Upon comparing the square arch to the ovoid arch, it was seen that the angle A exhibited a greater magnitude on the left side. Elevated values of this angle are believed to indicate heightened pressures exerted on the condyle-disk complex, potentially altering the lateral wall of the mandibular fossa and so promoting sideways movements. On the other hand, minor slopes can serve as a physical obstacle to prevent bigger sideways movements. A sagittal tomographic segment is exclusively utilised in specific examinations to assess the morphology of AE. Consistent with previous research, the current study aimed to thoroughly investigate adverse effects (AE) and recognise that abnormalities in the temporomandibular joint (TMJ) do not occur exclusively in one particular aspect. Therefore, the central, lateral, and medial regions were all assessed in this study. Studies relating DAs with accurate occlusion and AE morphology are vital because the DAs' unique features are essential to the stomatognathic system's appropriate operation and because occlusion is directly linked to the AE's morphology.

DA shapes have been classified using diverse methods, including as polynomial functions, geometric and mathematical curves, and pre-made templates like OrthoForm and pentamorphic arches. Advocates of mathematical techniques argue that the distinctive nature of DA forms renders the deployment of an ideal model unnecessary. Preserving the DA form is crucial in preventing relapses after treatment, making the observations of these experts highly relevant to orthodontic methods. Templates have been proven to be an excellent alternative when the objective is to classify the morphology of the dental arch in different populations and link it to occlusal changes, such as horizontal overlap. Upon study of the DA form, it was determined that the ovoid shape had the most prevalence, followed by the square and tapering arches,[18,26] Comparable outcome was seen in the current investigation. Tapering arches exhibit a significantly greater degree of intrusion compared to other forms of DA,[27] Contrarily, Lee and his colleagues found that square arches were more prevalent compared to ovoid and tapering shapes.[28] The variances can be attributed to the ethnic composition of the individuals being studied. Granados[29] compared the inclination of the articular eminence (AE) in people with and without articular disc displacement by measuring the angle formed between the Frankfurt plane and the posterior wall of the AE. Patients with articular disc displacement exhibited significantly higher mean values in the central, medial, and lateral regions compared to those without symptoms.[29] The condyle trajectory's inclination is more pronounced in the anterior, inferior, and medial directions during lateral motions. This could explain the steeper anterior eminence (AE) and disc displacement. This discovery is further reinforced by the fact that the inclination in the lateral portion was less than in the central and medial sections. Based on the present investigation, which validated the results published by Sülün *et al.*[30], When applying the same method (angle A), the central and medial parts of all types of DAs showed higher inclination rates compared to the lateral regions. Denture arches with tapered and square shapes on the left side exhibited asymmetry in the lateral trajectory of the condyle on the AE due to higher inclination values in the lateral and central regions. The mean values of the AE inclination showed symmetry between the right and left sides only in ovoid arches located in the central, medial, and lateral parts.[31]

The outcome may be influenced by the length of the facial vertical pattern and the degree of the skeletal link. According to the paper, the condyle is positioned at a higher level or in closer proximity to the roof of the fossa in the class III group. Additionally, the inclination and height of the eminence are connected to alterations in the morphology of the fossa. In line with the results of this study, Jasinevicius *et al.*[32] observed no notable disparities in the height of the mandibular fossa between the class I and class II groups.[32] In addition, Cohlmia *et al.*[33] did not find any correlation between different dental malocclusions, the inclination of the eminence, and the depth of the mandibular fossa.[33]

Only a limited number of studies have examined the relationship between the sagittal class of the skeleton and the AEI, and none of these studies specifically focused on the vertical pattern variable. The study conducted by Lobo *et al.*[34] revealed that there was no statistically significant distinction between Classes I and II, which aligns with the findings of our own investigation. Regarding Class III, they noted significantly lower values. However, even in our situation, these differences did not achieve statistical significance. The user's text is incomplete.[34] A study conducted by Moscagiuri *et al.*[19] found no correlation between articular eminence inclination and skeletal class.[19] These two findings are consistent with the outcomes of our investigation.

Conclusion

A thorough comprehension of the complex connections between the angle of the dental arch and the inclination of the articular eminence (AEI) was achieved by meticulously analysing various angles on both the left and right sides. Despite identifying several associations, the study ultimately determined that none of the relationships achieved statistical significance. The study broadened its focus to encompass the intricate correlation between AE width and height in relation to different arch designs. The study discovered that there were limited and inconsistent connections between the maxillary and mandibular arches, which have an oval, tapered, and square shape. Additionally, it was disclosed that the oval shape was the most widespread. The study aimed to detect distinctive patterns in the anatomy of the articular eminence in individuals with class I, II, or III occlusion. The findings indicated that there were little differences in AE height or angles among different dental arch types and classes.

Limitations

It is crucial to acknowledge the constraints of this investigation. The main disadvantage is that the centre slice of the condyle, which is the most important section for analysing the position and shape of the condyle, is difficult to find. Indeed, even in a three-dimensional radiograph, the discernment of the structures becomes more challenging due to changes in the morphology of the different components of the joint. Another constraint was the lack of consideration for the patient's dietary preferences, namely whether they preferred a soft, mixed, or hard diet. Finally, future research should use magnetic resonance imaging (MRI) to assess the correlation between the DA and the AEI, particularly in cases where there is anterior displacement of the articular disc. This is important because the current study did not involve an evaluation of symptomatic patients.

Recommendation

Assessing the same variable using a sample size bigger than that used in this study, as well as comparing the variable used in this study across other races.

Conflicts of Interest

There is no conflict of interest amongst the authors.

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Ethical Approval

College of Medicine, University of Diyala approved this work. Each participant signed a written permission form before the treatment began.

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