INVESTIGATION OF MANDIBULAR CONDYLE SHAPE IN PEDIATRIC POPULATION ACCORDING TO AGE AND GENDER INVESTIGATION OF THE CONDYLE HEAD SHAPE

PEDİATRİK POPULASYONDA MANDİBULAR KONDİL ŞEKLİNİN YAŞ VE CİNSİYETE GÖRE ARAŞTIRILMASI KONDİL BAŞI ŞEKLİNİN İNCELENMESİ

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ARTICLE INFO	ABSTRACT					
Article Information	Objective : The mandibular condyle is a key anatomical landmark involved in facial growth. The temporomandibular joint (TMJ), which plays a grucial relation and speech is of significant interest to depicts, orthodopticts, clinicians, and speech					
Article Type: Research Article	diologists. This study aims to document the normal morphological variations of the condyle using panoramic radiographs in pediatric populations.					
Accepted: 28.02.2025 Published: 30.04.2025	Materials and Methods : The present study involved the radiographic evaluation of 400 condylar heads from 200 patients, comprising 101 females (50.5%) and 99 males (49.5%), aged between 6 and 12 years. Five types of condylar morphology were identified: (a) bird beak, (b) diamond, (c) oval, (d) crooked finger, and (e) smooth-shaped.					
Keywords: Condylar head, Condylar process, Mandibular condyle types, Pediatric populations	Results : A total of 133 patients were classified under the Diamond category. In the Oval category, the measurements of the right and left condyles were found to be similar. The remaining categories, in descending order of frequency, were Smooth, Cooked Finger, and Bird Beak. A statistically significant difference (p < 0.05) was observed between the left and right side measurements in female patients.					
	Conclusions : We believe that increasing the sample size and incorporating three-dimensional evaluations will enhance the understanding of anatomical structures in this region. Future studies utilizing panoramic images reconstructed from three-dimensional data are needed to determine whether they can overcome the limitations associated with conventional and digital panoramic imaging. A comprehensive understanding of the morphological variations in mandibular condyle configuration is essential for distinguishing normal anatomical variants from pathological conditions.					
MAKALE BİLGİLERİ	ÖZET					
Makale Bilgisi	Amaç: Mandibular kondil, yüz büyümesi için önemli bir anatomik dönüm noktasıdır. Temporomandibular eklemin (TME) en önemli fonksiyonları çiğneme ve konuşmadır ve diş hekimleri, ortodontistler, klinisyenler ve radyologlar için büyük ilgi çekicidir. Bu çalışmanın amacı, pediatrik popülasyonlarda panoramik radyografiler aracılığıyla kondilin farklı tipteki normal morfolojik varyasyonlarının belgelenmesidir.					
Makale Türü: Araştırma Makalesi Geliş Tarihi: 28.02.2025 Kabul Tarihi: 19.04.2025 Yayım Tarihi: 30.04.2025						
	Gereç ve Yöntemler: Bu çalışma, 6-12 yaş arası 101'i (%50,5) kız ve 99'u (%49,5) erkek olmak üzere 200 kişinin görüntülen- mesinin ardından 400 kondil başının radyolojik değerlendirmesini içermektedir. Beş tip kondiler morfoloji tanımlanmıştır: a)Kuş gagası, b) Elmas, c) Oval, d) Açılı, e) Düzgün şekilli.					
Anahtar Kelimeler: Kondil başı, Kondiler proses, Mandibular kondil tipleri, Pediatrik popülasyon	Bulgular: Elmas kategorisine toplam 133 kişi tespit edildi. Oval kategorisinde sağ ve sol taraftaki ölçümlerin simetrik (benzer) olduğu görülmüştür. Diğer kategoriler Elmas, Düz, Açılı ve Kuş Gagasıdır. Kızlarda sol ve sağ taraf ölçüm kategorileri arasındaki fark istatistiksel olarak anlamlı bulunmuştur. (p<0,05).					
	Sonuç: Örneklem sayısının arttırılması ve üç boyutlu değerlendirmelerin yapılmasının bu bölgedeki anatomik yapıların tanımı ve değişimini netleştirmeye yardımcı olacağına inanıyoruz. Konvansiyonel ve dijital panoramik görüntülerin kısıtlamalarının üstesinden gelip gelmediklerini belirlemek için 3 boyutlu verilerden oluşturulan panoramik görüntüleri kullanan çalışmalara ihtiyaç vardır. Mandibular kondil şeklindeki morfolojik varyasyonların kapsamlı bir şekilde bilinmesi, standart bir varyant ile anormal bir durumu ayırt etmek için hayati önem taşımaktadır.					

Unal M., Turamanlar O. Investigation of Mandibular Condyle Shape in Pediatric Population According to Age and Gender. CJMR 2025; 5(1):12-21 **Correspondence to:** Mehmet UNAL, Afyonkarahisar Health Sciences University, Faculty of Dentistry, Department of Pedodontics Afyonkarahisar, Turkey **Authorship Contributions:** For the preparation of the article all authors have taken equal responsibility. All authors discussed the results and contributed to the final manuscript

Conflict of Interest: The authors declare that they have no conflict of interest.

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Ethics Approval: This retrospective study was approved by the Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (Approval No: 2023/494).

Introduction

The temporomandibular joint (TMJ) is one of the most complex joints in the human body. It connects the mandible to the skull and functions bilaterally and simultaneously. The TMJ comprises several key anatomical components: the mandibular condyle, the mandibular fossa, and the articular eminences of the temporal bone, along with the soft tissue structures including the articular disc, its attachments, and the joint cavity (1).

The temporomandibular joint (TMJ), also known as the mandibular joint, is a bicondylar joint with an ellipsoid shape (2). Compared to other diarthrodial joints, the TMJ is considerably underdeveloped at birth, making it vulnerable to perinatal and postnatal insults. The joint continues to develop during early childhood as the jaw is engaged in sucking motions and, later, in chewing (3). The TMJ plays a critical role in mastication and speech and is of significant interest to dentists, orthodontists, clinicians, and radiologists (4).

The mandibular condyle is a key anatomical landmark essential for facial growth (5). It can exhibit developmental variations as part of its adaptation to pathological conditions, developmental abnormalities, and remodeling processes (6).

Changes in the morphology of the mandibular condyle can arise from various causes, including infections, trauma, tumors, condylar hyperplasia, and ankylosis (7). The shape of the mandibular condyle has been extensively evaluated in previous studies, with considerable variation reported (8). Most morphological changes have been observed in the elderly, primarily due to degenerative alterations in the joint.

The appearance of the mandibular condyle can vary significantly between individuals and across age groups (3). A thorough understanding of the anatomy and morphology of the entire temporomandibular joint (TMJ) is essential for distinguishing normal developmental variations from pathological conditions. The "mixed dentition" period is particularly critical, as any developmental changes during this stage can affect the occlusal relationship of the permanent dentition, which persists throughout life. During this period, various dentocraniofacial anomalies may arise. These anomalies may resolve spontaneously with continued growth and development or, if persistent, may require timely intervention to prevent further complications (9).

Limited data are available on the morphological appearance of the mandibular condyle in pediatric populations. A thorough understanding of its morphological variations is essential for distinguishing normal anatomical variants from pathological conditions. This study aims to document the different types of normal morphological variations of the condyle using panoramic radiographs in pediatric patients.

Materials and Methods

This retrospective study was approved by the Afyonkarahisar Health Sciences University Clinical Research Ethics Committee (Approval No: 2023/494). The cross-sectional study was conducted at the Afyonkarahisar Health Sciences University Faculty of Dentistry, Department of Pediatric Dentistry. A total of 400 condylar heads were radiographically evaluated from 200 digitized orthopantomograms (OPGs). All available OPGs of individuals who visited the department between October 2023 and December 2023 were retrieved from the faculty archive, along with relevant demographic information including age and gender. The inclusion criteria for the study were as follows:

i) panoramic radiographs of patients aged 6–12 years with available demographic information (age and gender);

ii) radiographs displaying a full view of either side of the mandible with optimal density and contrast; and

iii) absence of projection errors that could distort the image.

Panoramic radiographs were excluded from the study if they exhibited any pathology in the maxilla or mandible; evidence of mandibular fractures; developmental anomalies of the jaws; craniofacial syndromes; previous plating for fractures; presence of odontogenic cysts or tumors; complete dentures; or edentulous dental arches.

All radiographs were obtained using the same machine (Planmeca ProMax 2D, Finland) at Afyonkarahisar Health Sciences University, Faculty of Dentistry. The panoramic radiographs were collected in printed format using the Planmeca Romexis software. Five distinct types of condylar morphology were identified: (a) bird beak, (b) diamond, (c) oval, (d) crooked finger, and (e) smooth-shaped (Figure 1).



Figure 1: Shapes of condyle; a)Bird Beak, b) Diamond, c) Oval, d) Cooked Finger, e) Smooth

The study included 200 patients, comprising 101 females (50.5%) and 99 males (49.5%) between the ages of 6 and 12 years. The mean age of the patients was 8.86 \pm 2.06 years (Tables 1 and 2).

	Statistics
Sex, <i>n</i> (%)	
Female	101 (%50.5)
Male	99 (%49.5)
Age	8.86±2.06
Right, <i>n</i> (%)	
Bird Beak	17 (%8.5)
Diamond	134 (%67)
Oval	28 (%14)
Cooked Finger	5 (%2.5)
Smooth	16 (%8)
Left, <i>n</i> (%)	
Bird Beak	9 (%4.5)
Diamond	133 (%66.5)
Oval	23 (%11.5)
Cooked Finger	17 (%8.5)
Smooth	18 (%9)

Total

200 (%100)

 Table 1: Descriptive Statistics of Patients

			Right						Th	
		Bird Beak	Diamond	Oval	Cooked Finger	Smooth	Total	lest Statistics	р	
	Bird	n	6 _a	1 _b	1 _b	0 _{a, b}	1 _b	9		0.010
	Beak	%	66.7%	11.1%	11.1%	0.0%	11.1%	100.0%	20.091	
		n	9 _{a, b}	96 _b	18 _{a, b}	1 _a	9 _{a, b}	133		
	Diamond	%	6.8%	72.2%	13.5%	0.8%	6.8%	100.0%		
Left	Oval	n	0 _a	18 _a	4 _a	0_a	1 _a	23		
		%	0.0%	78.3%	17.4%	0.0%	4.3%	100.0%		
	Cooked Finger	n	0 _a	12 _a	1 _a	4 _b	0 _a	17		
		%	0.0%	70.6%	5.9%	23.5%	0.0%	100.0%		
	Smooth	n	2 _{a, b}	7 _b	4 _{a, b}	0 _{a, b}	5 _a	18		
		%	11.1%	38.9%	22.2%	0.0%	27.8%	100.0%		
Total %		n	17	134	28	5	16	200		
		8.5%	67.0%	14.0%	2.5%	8.0%	100.0%			

Table 2: Comparison of Right and Left Side Measurement Categories

The application of line based labeling, where different letters in the same line indicate a statistical difference.

Statistics

Data analysis was performed using IBM SPSS Statistics Standard Concurrent User Version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were presented as frequency (n), percentage (%), and mean ± standard deviation. The relationships between dependent categorical variables were assessed using the McNemar test. A p-value of <0.05 was considered statistically significant.

Multiple correspondence analysis is a simple correspondence analysis extended to the case of the categorical variable Q and performed on the indicator matrix of the data. Suppose the variable q has jq categories and the sum of the categories is $J = \sum J_q$. N units, then the indicator matrix Z becomes an nxJ dimensional matrix of zeros and ones.

In the analysis of the indicator matrix Z, the total variation becomes the chi-squared statis-

tic, calculated like a contingency table over Z, and is defined as $\chi_z^2 = n(J - Q)$.

The indicator matrix is denoted as Z = $[Z_1,...,Z_o]$ and shows the categories and the categorical variable $Z_q(nxJ_q), J_q$. Since the Burt matrix B is symmetric, it can be shown that the optimal column parameters during the fitness analysis of the indicator matrix Z are similar to the row or column parameters during the analysis of the Burt matrix B. The principal inertias $(\mu_k^2 \text{ components})$ of matrix B are the squares of those in the indicator matrix Z. In this way, once B is found, the solution for the columns (categories) of Z can be provided within the multiple correspondence analysis. Although the indicator matrix Z covers the multidirectional information contained in the data, it is clear that the multiple correspondence analysis analyses only two-way information. Consequently, it can be said that the multiple correspondence analysis is a weighted least squares approximation of the Burt matrix. The chi-squared statistic can be recalculated like a contingency table for B. It can be simplified as follows:

$$\chi_{B}^{2} = \sum_{q \neq s} \chi_{qs}^{2} + n(J - Q)$$
(1)

Here, χ_{qs}^2 , represents the chi-square statistic for the sub-table $N_{qs}^2 = Z'_q Z_s$ of non-diagonal elements. Total Variation is measured as the sum of the following $\sum_{qs} \chi_{qs}^2$.

Given a Burt matrix B, multi-fitness analysis can be defined as a least-squares approximation of B with a lower-rank matrix H that minimises the equation.

$$b^{-1tr} \left\{ D_r^{-1} (B - H) D_r^{-1} (B - H)' \right\}$$
 (2)

This is a suitability analysis of the Burt matrix B. The b here is the grand sum of matrix B. Dr, on the other hand, is the diagonal matrix of row and column category proportions, since matrix B is symmetric. Each sub-table Nqs can be expressed as $b = NQ^2$ the total number of units n of the Burt matrix B as far as n is transformed into a crosstabulation. For variable q, the vector of category proportions Jq is denoted by rq, (1'rq = 1). This is also the set of row category proportions Nqs for any s. The Jq × Jq dimension is denoted by Dq, a diagonal matrix composed of q r elements. In this context, the equation can be rewritten as follows:

$$n^{-1}tr\left\{ \mathcal{D}_{r}^{-1}(B-H)D_{r}^{-1}(B-H)^{'}\right\} = n^{-1}\sum_{q=1}^{Q}\sum_{s=1}^{Q}\left\{ \mathcal{D}_{q}^{-1}(N_{qs}-H_{qs})D_{s}^{-1}(N_{qs}-H_{qs})^{'}\right\}$$
(3)

Here, the supermatrix of Hqs is represented by H.

$$\left\|N_{qs} - H_{qs}\right\|_{qs}^2 = tr$$

In this case, $\{D_q^{-1}(N_{qs} - H_{qs})D_s^{-1}(N_{qs} - H_{qs})'\}$, The equation (3), can be written in a simpler form as follows:

$$n^{-1} \sum_{q} \sum_{s} \left\| N_{qs} - H_{qs} \right)' \|_{qs}^{2}$$
 (4)

The function minimized by this method is:

$$n^{-1} \sum_{q < s} \left\| N_{qs} - H_{qs} \right|^2$$
 (5)

The sum of the term $\frac{1}{2}Q(Q-1)$ corresponds to the sub-table of elements above the diagonal elements of B. The minimisation of the equation (3) is equal to the minimisation of the inconsistency function defined by Healy & Goldstein (10) and the internal consistency criterion defined by Nishisato (11).

Results

A total of 9 patients were classified under the Bird Beak category based on left-side condylar measurements. Within this group, 66.7% remained in the Bird Beak category on the right side, while 11.1% shifted to the Diamond category, 11.1% to the Oval category, and 11.1% to the Smooth category. A statistically significant difference was observed between the Bird Beak category and the Diamond, Oval, and Smooth categories (p < 0.05).

A total of 133 patients were classified under the Diamond category. Among these patients, 6.8% were found in the Bird Beak category, 72.2% remained in the Diamond category, 13.5% in the Oval category, 0.8% in the Cooked Finger category, and 6.8% in the Smooth category on the contralateral side. A statistically significant difference was observed between the Diamond and Cooked Finger categories (p < 0.05).

A total of 17 patients were classified under the Cooked Finger category. A statistically significant difference was observed between the Cooked Finger category and all other condylar morphology categories (p < 0.05). Additionally, 18 patients were included in the Smooth category, and a significant difference was found between the Smooth and Diamond categories.

The differences between left-sided and right-sided condylar morphology categories were analyzed according to gender. A statistically significant difference was observed between the left and right sides in female patients (p<0.05) (Table 3).

Right										
			Bird Beak	Diamond	Oval	Cooked Finger	Smooth	Total	Test statistics	р
	Dird Doold	n	3	0 _b	0 _b	0 _b	1	4		
	BILO BEAK	%	75.0%	0.0%	0.0%	0.0%	25.0%	100.0%		
	Diamond	n	5 _{a, b}	41 _{a,b}	13 ₆	1	2,	62		
		%	8.1%	66.1%	21.0%	1.6%	3.2%	100.0%		
	Qual	n	0_	12,	2	0_	0,	14		
Famala	Ovai	%	0.0%	85.7%	14.3%	0.0%	0.0%	100.0%	11 776	0.023
Female	Cooked	n	0_	9	0_	3,	0,	12	14.726	
	Finger	%	0.0%	75.0%	0.0%	25.0%	0.0%	100.0%		
	Smooth	n	0_	5,	1	0 _{a,b}	3 _b	9		
		%	0.0%	55.6%	11.1%	0.0%	33.3%	100.0%		
	Total %	n	8	67	16	4	6	101		
		%	7.9%	66.3%	15.8%	4.0%	5.9%	100.0%		
	Bird Beak	n	3	1 _b	1 _{a,b}	0 _{a,b}	0 _b	5		0.124
		%	60.0%	20.0%	20.0%	0.0%	0.0%	100.0%		
	Diamond	n	4	55 _b	5	0,	7 _{a, b}	71		
		%	5.6%	77.5%	7.0%	0.0%	9.9%	100.0%		
Male	0	n	0_	6	2	0_	1	9		
	UVal	%	0.0%	66.7%	22.2%	0.0%	11.1%	100.0%	12.669	
	Cooked	n	0_	3	1	1 _b	0	5		
	Finger	%	0.0%	60.0%	20.0%	20.0%	0.0%	100.0%		
	Smooth	n	2_	2 _b	3	0 _{a, b}	2,	9		
		%	22.2%	22.2%	33.3%	0.0%	22.2%	100.0%		
	-	n	9	67	12	1	10	99		
	lotai	%	9.1%	67.7%	12.1%	1.0%	10.1%	100.0%		

Table 3: Comparison of Right and Lep	t Side Measurement Categories by Gender
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The application of line based labeling, where different letters in the same line indicate a statistical difference.

Among female patients, a total of 4 were classified under the Bird Beak category based on left-side measurements. A statistically significant difference was observed between the Bird Beak category and the Smooth, Diamond, Oval, and Cooked Finger categories (p < 0.05).

A total of 62 patients were classified under the Diamond category in this part of the study. Among these, 8.1% were found in the Bird Beak category, 66.1% remained in the Diamond category, 21% were in the Oval category, 1.6% in the Cooked Finger category, and 3.2% in the Smooth category on the contralateral side. A statistically significant difference was observed between the Oval category and both the Cooked Finger and Smooth categories (p < 0.05).

A total of 12 patients were classified under the Oval category. Among these, 85.7% had right-sided measurements in the Diamond category, while 14.3% had right-sided measurements in the Oval category. This distribution showed a statistically significant difference (p < 0.05).

A total of 12 patients were classified under the Cooked Finger category. Among these, 75% had right-sided measurements in the Diamond category, while 25% had right-sided measurements in the Cooked Finger category. A statistically significant difference was observed between the Cooked Finger category and all other condylar morphology categories (p < 0.05).

A total of 9 patients were classified under the Smooth category. Among them, 55.6% had right-sided measurements in the Diamond category, 11.1% in the Oval category, and 33.3% in the Smooth category. A statistically significant difference was observed between the Smooth category and all other categories, except for the Cooked Finger category (p < 0.05).

Table 4 presents the results of the indicator matrix analysis. Based on this analysis, the rank of the corresponding Burt matrix was determined to be 1. The "Inertia" column in Table 4 indicates the amount of variance (inertia) explained by each dimension, representing the average variation across the levels of the variables. Analysis of these values shows that the contributions of each dimension to the total inertia are relatively similar. The proportion of total variance explained by each dimension was calculated by comparing the inertia of each dimension to the total inertia. The first dimension accounted for the highest explanatory power at 56.2%, followed by the second dimension at 28.9%, yielding a combined explanation rate of 85.1%.

Dimension	Proportion	of Inertia	Confidence Singular Value					
	Accounted for	Cumula- tive	Standard Deviation	Cor- relation				
1	0.562	0.562	0.026	0.571				
2	0.289	0.851	0.029					
3	0.146	0.997						
4	0.003	1.000						
Total	1.000	1.000						

Table 4: Initial Matrix Analysis Results

Although representing the relationships between the levels of these variables in a two-dimensional space is not sufficient to fully explain the overall variance, two dimensions were used for the purpose of visual interpretation. Table 5 presents the correlation coefficients between the dimensions, the contribution of each level to the respective dimensions, and their coordinates within the two-dimensional space.

As shown in Table 5, the Diamond category makes the largest individual contribution to Dimension 1. However, when the Oval and Diamond categories are considered together, they appear to contribute most significantly to both Dimension 1 and Dimension 2, depending on how they are grouped or ordered in the analysis.

 Table 5: Central Coordinates of Categories of Variables

 According to Dimensions

		-		
	Mass	Score in D		
Right		1	2	Inertia
Bird Beak	0.083	-1.977	0.977	0.196
Diamond	0.673	0.293	-0.100	0.041
Oval	0.139	-0.223	-0.324	0.014
Cooked Finger	0.029	1.660	2.787	0.135
Smooth	0.076	-0.676	-0.668	0.068
Active Total	1.000			0.453

According to Figure 2, based on the distanc-

es from the center—representing the overall mean configuration—the greatest symmetry between right and left condylar morphology is observed in the Oval category. In other words, when the condyle is classified as Oval, there is a high probability that the right and left measurements are similar, indicating strong bilateral agreement. This is followed by the Diamond and Smooth categories, with lower levels of agreement observed in the Cooked Finger and Bird Beak categories.



Figure 2: Multiple Correspondence Analysis Graph

Discussion

The American Academy of Oral and Maxillofacial Radiology recommends routine use of panoramic radiographs to evaluate the structural components of the temporomandibular joint (TMJ), due to their relatively low radiation exposure and cost compared to computed tomography (3).

Panoramic radiographs are the most commonly used diagnostic tool among dental clinicians, providing valuable information about the teeth, mandible, and associated jaw structures (3). Dentists and orthodontists widely regard panoramic radiography as the current standard of care for dental diagnosis and treatment planning, and it can also aid in the early detection of temporomandibular joint disorders (TMDs) (3, 12, 13). The mandibular condyle serves as a critical anatomical reference point in relation to facial growth, exhibiting considerable variation in shape and size across different age groups and individuals (3). Furthermore, the condylar process is a key anatomical component of the mandible, directing mandibular bone growth in both vertical and sagittal dimensions (14).

A comparative analysis of condylar head shape distributions across different dentition stages has shown that round-shaped condyles are most commonly observed during the primary dentition phase, while convex-shaped condyles are most prevalent during the permanent dentition phase. A transitional pattern from round to convex shapes is typically observed during the mixed dentition period (15). In comparison, the age group analyzed in our study falls within the mixed dentition phase; however, the Diamond-shaped condyle was the most frequently observed morphology in our dataset.

Shaikh et al. reported that oval-shaped condylar morphology was more frequently observed in males, whereas diamond-shaped morphology was more prevalent in females (3). In contrast, our study found that diamond-shaped condylar morphology was the most common in both male and female groups.

In a study by Al Saedi, the oval shape was reported as the most common form of the mandibular condyle in a young adult population, accounting for 56% of the total sample (8). Conversely, Ozbilen found that various non-oval condylar shapes became more prevalent with increasing age, likely due to heightened occlusal forces (16). In our study, which focused on a younger age group, the Diamond-shaped condyle was the most frequently observed morphology. Singh et al. conducted a study on the normal morphology of mandibular condyles within a defined population and reported that the round-shaped morphology was the most prevalent, observed in 62% of the study population (1). He emphasized that the shape of the mandibular condyle can vary considerably and categorized it into four primary types: flat, pointed, angled, and round. Although a different classification system was employed in our study, we found that diamond-shaped condylar heads were more common than oval-shaped ones.

According to Khanai, the most common condylar shape observed in younger individuals was oval, whereas diamond-shaped condyles were more frequently seen in the older age group (17). This finding suggests that condylar morphology may change with age and can be influenced by various factors, including age, sex, occlusal forces, malocclusion, and skeletal classification. However, in the present study despite the relatively young age of the participants—the Diamond-shaped condyle was identified as the most prevalent morphology.

The findings from the study by Tanu et al. demonstrate that the morphology of the condylar head undergoes notable changes during the mixed dentition period, with round-shaped condyles being more common in younger children and convex-shaped condyles becoming more prevalent as children approach the establishment of fully functional dentition (18). In our study, the Diamond-shaped condylar head interpreted as a form of convex morphology was the most frequently observed in the mixed dentition population. This discrepancy may be attributed to racial or ethnic differences, as the study by Tanu et al. was conducted in a Far Eastern population.

To our knowledge, there is a lack of suf-

ficient studies examining the morphology of the mandibular condyle in a young and healthy Turkish pediatric population. Therefore, further research using cone beam computed tomography (CBCT), which allows for more detailed and accurate evaluation of condylar morphology, is recommended. The absence of CBCT imaging in our study may be considered a limitation.

Conclusions

In this study, the most common shapes of the mandibular condyle were examined using panoramic radiographs of patients in their developmental period. The diamond-shaped condyle was the most frequently observed in both sexes, accounting for approximately two-thirds of the sample. The Diamond-Diamond combination was the most common bilateral pattern. Further studies on Turkish pediatric populations-particularly those employing Cone Beam Computed Tomography (CBCT)—are warranted. Increasing the sample size and incorporating three-dimensional evaluations will aid in better defining and understanding the morphological variations and developmental changes in this anatomical region.

Limitations

One of the main limitations of our study is the inability to utilize cone-beam computed tomography (CBCT), which provides high-resolution three-dimensional imaging of anatomical structures. Additionally, the sample size was relatively limited, and future studies should include a larger population to enhance the generalizability of the findings.

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