BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 6

DOI: 10.58240/1829006X-2025.21.6-207

ORIGINAL RESEARCH

EVALUATION OF DIFFERENT MORPHOLOGICAL VARIATIONS OF THE CONDYLE USING ORTHOPANTOMOGRAM – A RETROSPECTIVE STUDY

Sabitha Gokulraj, MDS[1], Durgadevi Pancharethinam, MDS[2] , Ipsita Bhattacharyya, BDS[3], Karthik A. MDS[4]
Divya Krishnamoorthi MDS, Ph.D[5], Kumar A.MDS[6]

1. Associate professor, Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation-Deemed to be university Salem, TN, India
2. Assistant professor, Department of Oral Medicine and Radiology, Sree Balaji Dental College and hospital, BIHER, Chennai, TN, India
3. Dentist , Orthosquare Dental Clinic Pune, India
4. Assistant professor, Department of Oral Medicine and Radiology, Coorg Institute of dental sciences, Virajpet, Karnataka, India
5. Associate Professor, Department of Prosthodontics and crown and bridge, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation-Deemed to be university Salem, TN, India
6. Assistant professor, Department of Oral Medicine and Radiology, Vinayaka Mission's Sankarachariyar Dental College, Vinayaka Mission's Research Foundation-Deemed to be university Salem, TN, India

Corresponding author: Dr. Durgadevi Pancharethinam Department of Oral Medicine and Radiology, Sree Balaji Dental College and hospital, BIHER, Chennai, TN, India. **E-mail address:** dr.durgadevi8@gmail.com

Received: *Jun 5 2025;* ***Accepted:****Jun 302025;* ***Published:*** *Jul.20,2025*

ABSTRACT

Background: Identification of a deceased person has always been essential for a variety of private, public, and legal purposes. Innovations such as DNA matching and fingerprint analysis have simplified identification over time.
Objectives: This study is aimed to compare various morphological patterns of the condyle using panoramic radiographs specific to our region, with the goal of developing more accessible methods for personal identification.
Methods: Total 200 digital Orthopantomograms (OPGs) obtained from the archives of the Department of Oral Medicine and Radiology. The images were viewed using DICOM Software-Planmeca Romexis 3.0.0. Inclusion criteria involved OPGs recorded correctly using appropriate techniques without distortions. The obtained radiographs were analysed to assess the various morphological shapes of the condyle.
Results: Data regarding the various shapes of the coronoid process, condyle, and sigmoid notches on the left and right sides of 200 study participants were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, Version 20 (IBM Corp., Armonk, N.Y., USA). The data were tested for normality using the Shapiro-Wilk test, revealing deviations from normal distribution ($p<0.05$).
Conclusion: According to our research, condyles most frequently have a round shape, which is followed by angled, convex, and flat forms. In addition, females typically have spherical condyles. This work emphasises the use of mandibular condyle morphological variations as shown in single panoramic radiography views as a forensic anthropology complement to personal identification.

Keywords: Condyle, Panoramic radiograph, anthropological.

INTRODUCTION

Posthumous identification of an individual has always been vital for various personal, civic, and legal reasons. Over the years, advancements like DNA matching and fingerprint analysis have streamlined the process of identification. However, in cases of catastrophic accidents or natural disasters, identifying individuals can be challenging, as their bodies may be reduced to skeletal remnants due to complete incineration. In such circumstances, the reliance on anthropological and dental studies for identification becomes paramount[1].

The smooth and efficient functioning of the mandible during activities such as chewing, swallowing, and speaking owes much to the temporomandibular joint (TMJ). The TMJ not only facilitates these movements but also maintains mandibular posture, preventing dislocation caused by unexpected external stresses. Notably, the mandibular condyle plays a crucial role in mandibular growth expression [2].

The typical morphological characteristics of the condyle vary based on factors such as age, gender, facial structure, occlusal force, functional load, malocclusion, and differences between the right and left sides. In elderly individuals, changes in condylar morphology are often observed due to degenerative alterations in the TMJ.

Comparing radiographic information from ante-mortem and post-mortem records can aid in identifying individuals, whether they are alive or deceased. This is because panoramic images frequently reveal diverse morphologies of the coronoid process, condyle, and sigmoid notch. The primary aim of this study was to compare various morphological patterns of the condyle using panoramic radiographs specific to our region, with the goal of developing more accessible methods for personal identification.

MATERIAL AND METHODS

A retrospective study was conducted using 200 digital Orthopantomograms (OPGs) obtained from the archives of the Department of Oral Medicine and Radiology at Vinayaka Mission's Sankarachariyar Dental College, Salem, Tamil Nadu, India. All digital OPGs were acquired using a Planmeca Proline XC under standard exposure parameters recommended by the manufacturer. The images were viewed using DICOM Software-Planmeca Romexis 3.0.0. Inclusion criteria involved OPGs recorded correctly using appropriate techniques without distortions, while exclusion criteria included the presence of developmental defects of the mandible, trauma, or other bone-affecting diseases.

The obtained radiographs were analysed to assess the various morphological shapes of the condyle. A sketching tool from Planmeca Romexis 3.0.0 was employed to outline the right and left side condyles(Fig1). These shapes were recorded for both sides in each panoramic image, encompassing both genders. In total, 400 sides were evaluated and compared, considering both sides and both sexes. The condyle shapes were interpreted according to Hegde et al.[3], which included triangular (Fig2a), round (Fig3b), beak (Fig4c) and flat shapes (Fig5d).

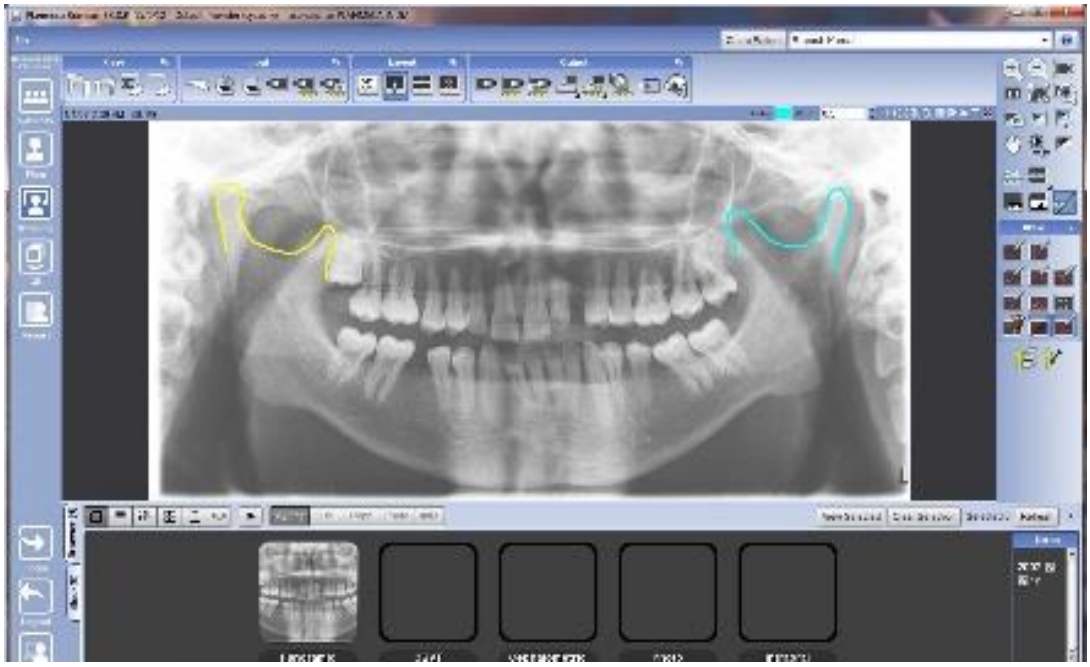


Figure 1. Tracing of the coronoid process, condyle and sigmoid notch on the right and left side using Planmeca Romexis 3.0.0 software.

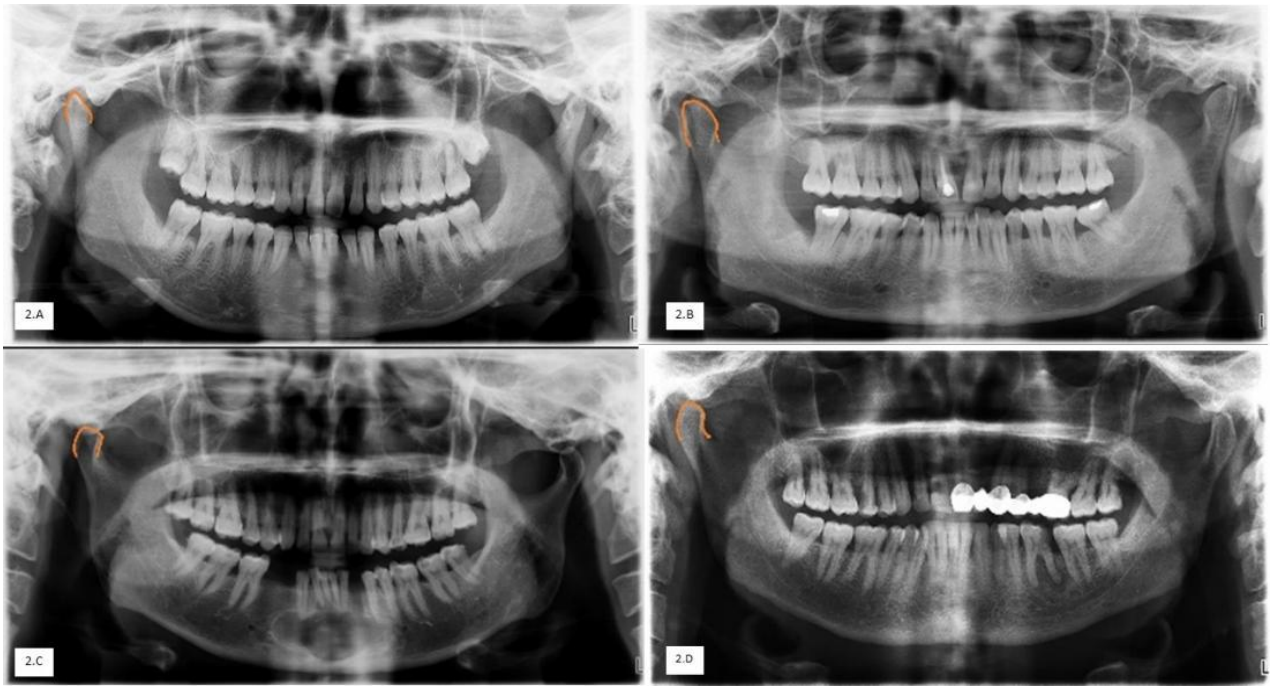


Figure 2.A: Triangular shape of condyle, 2.B: Round shape of Condyle 2.C: Beak shape of Condyle, 2.D: Flat shape of Condyle

STATICTIAL ANALYSIS

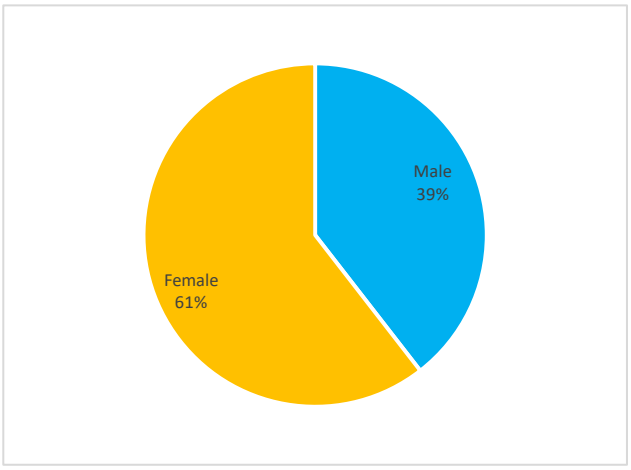
Data regarding the various shapes of the coronoid process, condyle, and sigmoid notches on the left and right sides of 200 study participants were entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 20 (IBM Corp., Armonk, N.Y., USA). The data were tested for normality using the **Shapiro-Wilk test, revealing deviations from normal distribution ($p<0.05$).** Descriptive statistics were computed, including mean, standard deviation, and 95% confidence interval. To assess the differences in proportions between the various types of coronoid process, condyle, and sigmoid notches on the left and right sides, the Chi-square test was employed to determine the relationship between categorical variables ($\alpha=0.05$). Additionally, the relationship within and between gender and different morphological variations of the coronoid process, condyle, and sigmoid notches on the left and right side was analyzed using the Chi-square test ($\alpha=0.05$). The level of statistical significance was set at $p<0.05$.

RESULTS

The study included individuals within the age range of 20-60 years, with a mean age of 38.62. The study population was comprised of 39.5% males and 60.5% females.

Table 1 and Graph 1: Demographic characteristics of the study population

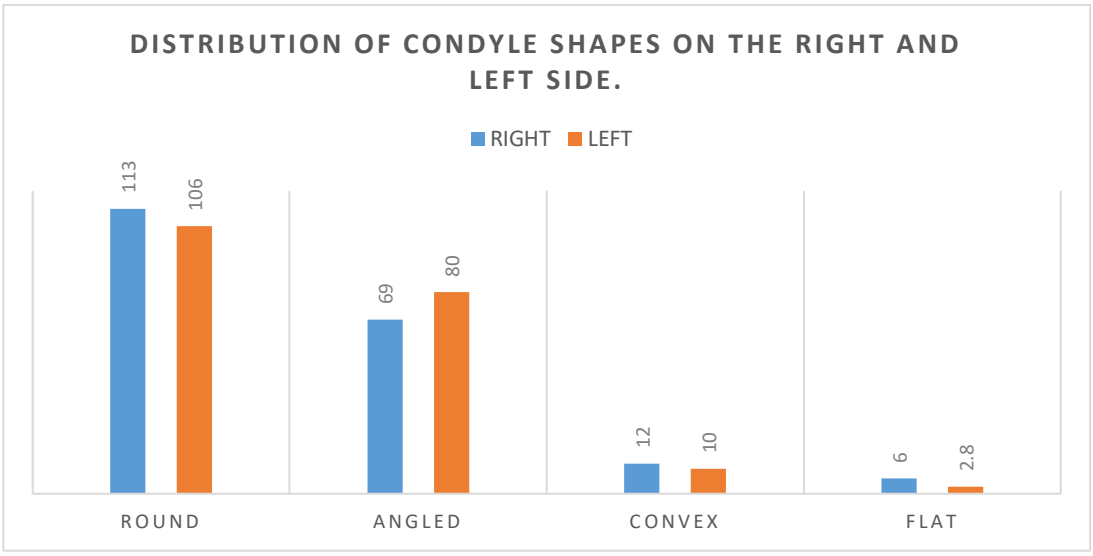
Demographics (n = 200)	**Mean ± SD**	**Median**	**Min. – Max.**
Age	38.62 ± 12.34	40	20 - 60
Gender	**Frequency (n)**	**Percent (%)**	
Male	79	39.5	
Female	121	60.5	



Graph 1. Demographic characteristics of the study population

Table and Graph 2. Distribution of Condyle shapes on the right and left side

Condyle shapes		Side of the mandible		Total	Chi-square test value	p-value
		Right side	Left side			
Round	n (%)	113 (51.6)	106 (48.4)	219 (100)	1.618	0.655
Angled	n (%)	69 (46.3)	80 (53.7)	149 (100)		
Convex	n (%)	12 (54.5)	10 (45.5)	22 (100)		
Flat	n (%)	6 (60)	4 (40)	10 (100)		
Total	n (%)	200 (50)	200 (50)	400 (100)		



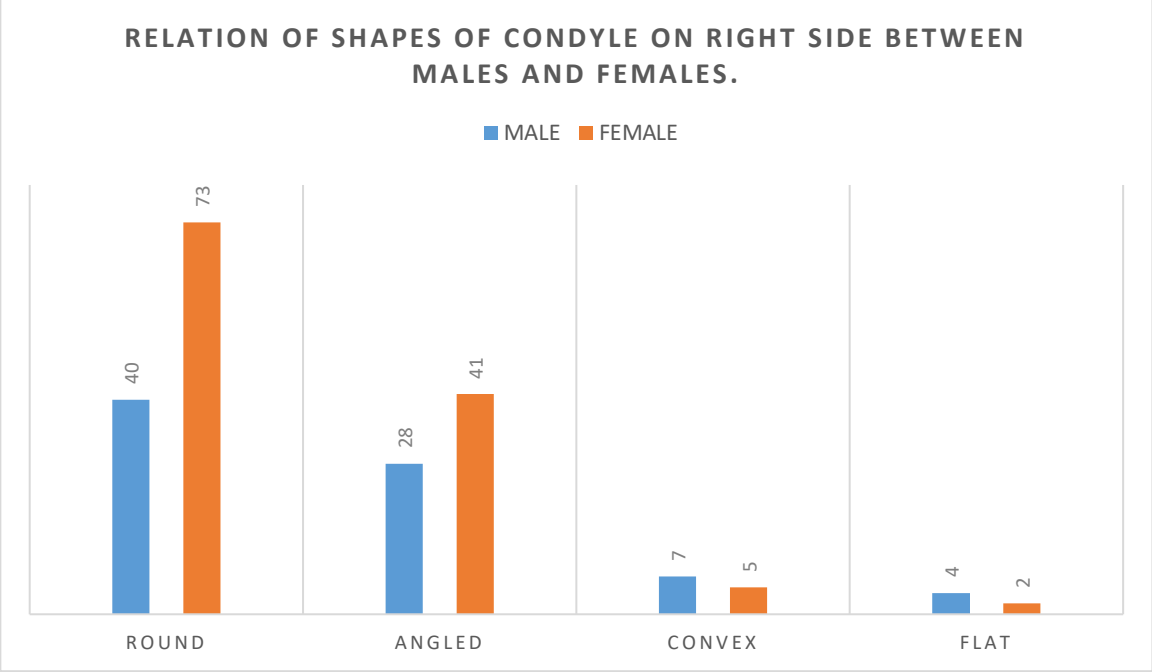
Graph 2 represents the distribution of condyle shapes on the right and left side.

Round shape on the right side is 51.6% and left side is 48.4%. Angled shape is 46.3% and 53.7% on the right and left side respectively. Convex shape distribution on the right is 54.4% and on the left side is 45.5%. Flat is 60% on the right side and 40% on the left side. The Chi-square test value for this is 1.618 and the p-value is 0.655.

Table and Graph 3 Relation of shapes of condyle on right side between males and females

Table 3 shows the relation of shapes of condyle on right side between males and females.

Condyle shapes on right side		Gender		Total	Chi-square test value	p-value
		Male (n = 79)	Female (n = 121)			
Round	n (%)	40 (35.4)	73 (64.6)	113 (100)	4.463	0.216
Angled	n (%)	28 (40.6)	41 (59.4)	69 (100)		
Convex	n (%)	7 (58.3)	5 (41.7)	12 (100)		
Flat	n (%)	4 (66.7)	2 (33.3)	6 (100)		



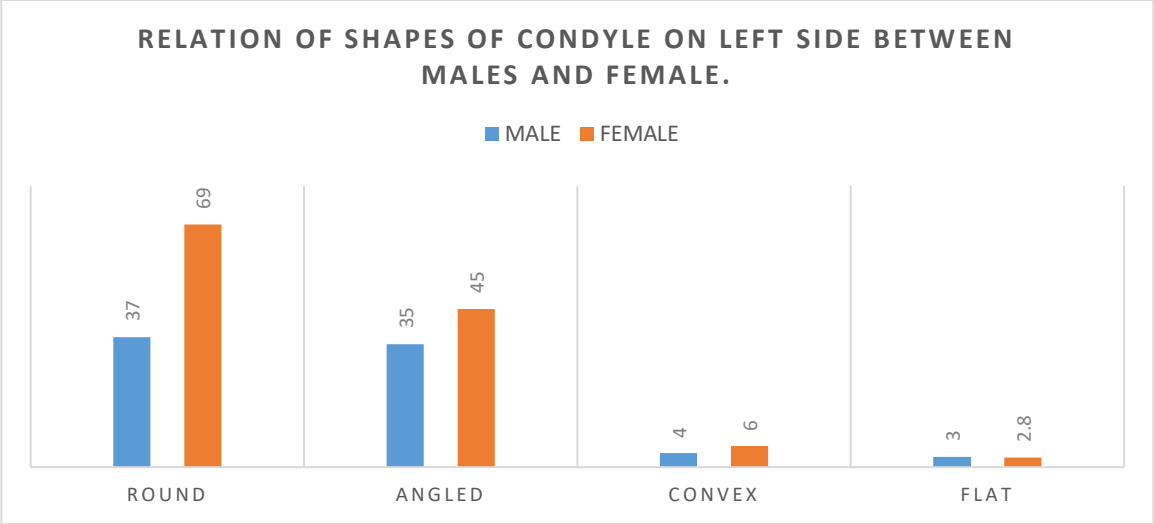
Graph 3. Relation of shapes of condyle on right side between males and females

Round shape is 35.4% for males and 64.6% for females. Angled shape is 40.6% and 59.4% for males and females respectively. Convex is found 58.3% among males and 41.7% among females. Flat shape is 66.7% in case of males and 33.3% in females. The Chi-square test value for this is 4.463 and the p-value is 0.216.

Table 4. Relation of shapes of condyle on left side between males and females

Condyle shapes on left side		Gender		Total	Chi-square test value	p-value
		Male (n = 79)	Female (n = 121)			
Round	n (%)	37 (34.9)	69 (65.1)	106 (100)	3.651	0.302
Angled	n (%)	35 (43.8)	45 (56.2)	80 (100)		
Convex	n (%)	4 (40)	6 (60)	10 (100)		
Flat	n (%)	3 (75)	1 (25)	4 (100)		

Table 4 represents the relation of shapes of condyle on left side between males and female.



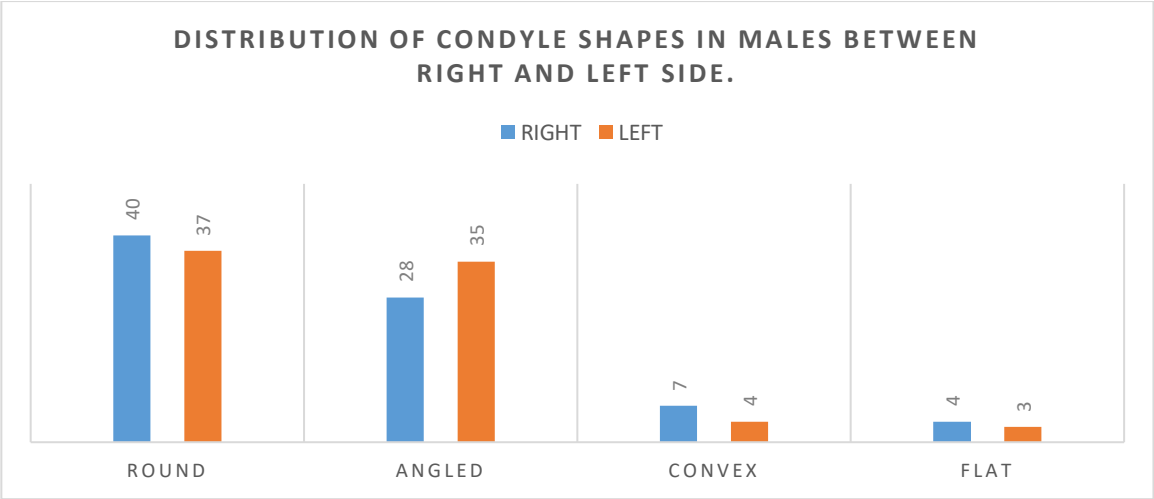
Graph 4. Relation of shapes of condyle on left side between males and females

Round shape is 34.9% for males and 65.1%for females. Angled shape is 43.8% for males and 56.2% for females. Convex shape is 40% and 60% in males and females respectively. Flat shape is seen to be 75% in males and 25% in females. The Chi-square test value for this is 3.651 and the p-value is 0.302.

Table 5. Distribution of Condyle shapes in Males between right and left side

Condyle shapes		Male study population		Total	Chi-square test value	p-value
		Right side	Left side			
Round	n (%)	40 (51.9)	37 (48.1)	77 (100)	1.856	0.603
Angled	n (%)	28 (44.4)	35 (55.6)	63 (100)		
Convex	n (%)	7 (63.6)	4 (36.4)	11 (100)		
Flat	n (%)	4 (57.1)	3 (42.9)	7 (100)		

Table 5 represents the distribution of condyle shapes in males between right and left side.
Round shape on the right side is 51.9% and left side is 48.1%. Angled shape is 44.4% and 55.6% on the right and left side respectively. Convex shape distribution on the right is 63.6% and on the left side is 36.4%. Flat is 57.1% on the right side and 42.9% on the left side. The Chi-square test value for this is 1.856 and the p-value is 0.603.

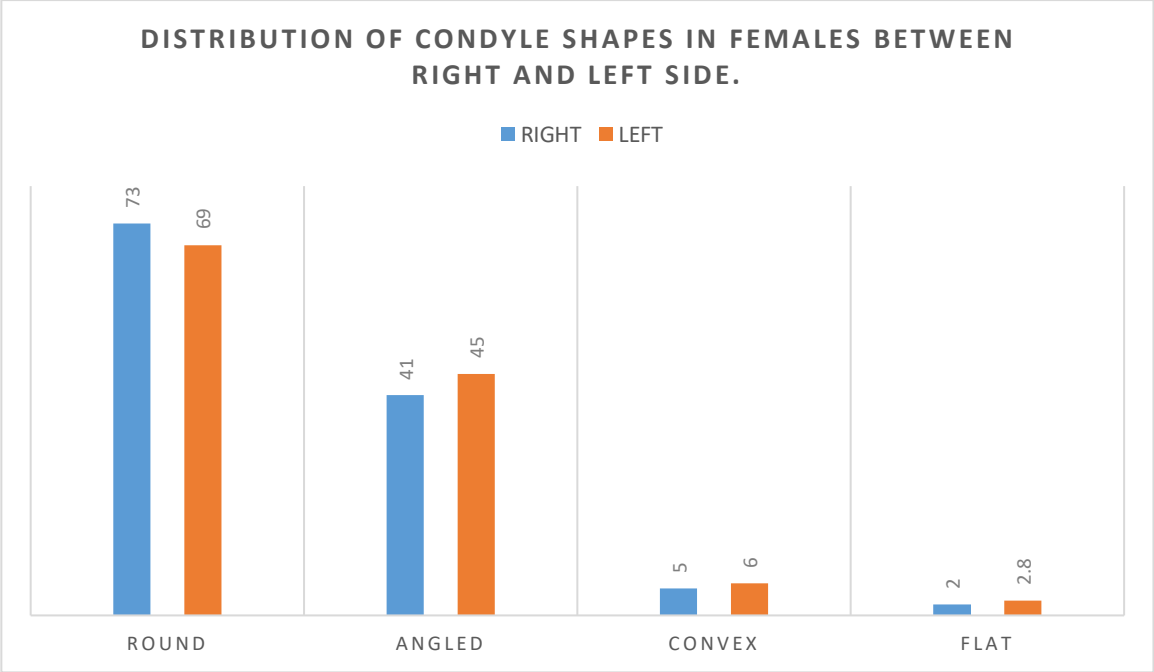


Graph 5. Distribution of Condyle shapes in Males between right and left side

Table 6. Distribution of Condyle shapes in Females between right and left side

Condyle shapes		Female study population		Total	Chi-square test value	p-value
		Right side	Left side			
Round	n (%)	73 (51.4)	69 (48.6)	142 (100)	0.723	0.868
Angled	n (%)	41 (47.7)	45 (52.3)	86 (100)		
Convex	n (%)	5 (45.5)	6 (54.4)	11 (100)		
Flat	n (%)	2 (66.7)	1 (33.3)	3 (100)		

Table 6 represents the distribution of condyle shapes in females between right and left side.
Round shape on the right side is 51.4% and left side is 48.6%. Angled shape is 47.7% and 52.3% on the right and left side respectively. Convex shape distribution on the right is 45.5% and on the left side is 54.4%. Flat is 66.7% on the right side and 33.3% on the left side. The Chi-square test value for this is 0.723 and the p-value is 0.868.



Graph 6. Distribution of Condyle shapes in Females between right and left side

DISCUSSION

The size and form of the mandibular condyle exhibit significant variation. When viewed from above, the condyle outline is roughly ovoid, measuring 15 to 20 mm on each side and 8 to 10 mm on the front and back. These variations are influenced by factors such as age, gender, face type, occlusal force, functional load, malocclusion, and differences between the right and left sides [4]. TMJ anatomic characteristics also vary among individuals, influenced by various factors related to functional stresses on the bone [5]. Condylar remodelling, a physiological process, seeks to alter the temporomandibular joint structure to meet functional needs. It is driven by an interplay between the mechanical forces experienced by the TMJ and the adaptive capabilities of the condyle. Panoramic radiography has been proposed as a screening tool for patients with TMJ complaints and can be useful in identifying gross bony changes in the condyle [6].

In our study, we analyzed a total of 200 panoramic images from patients, encompassing 400 condyles, with 121 belonging to females and 79 to males. The study revealed that out of 400 condyles, 219 were round, with 113 on the right side and 106 on the left side. Additionally, 149 condyles displayed an angled shape, with 69 on the right side and 80 on the left side. Moreover, 22 condyles exhibited a convex shape, including 12 on the right side and 10 on the left side. Furthermore, 10 condyles were flat, with 6 on the right side and 4 on the left side. This aligns with Anisuzzaman MM's survey on the Bangladeshi population in 2019, which found the most prevalent shape to be round (68%), followed by bird beak (20%), diamond (8%), and crooked finger (4%).

The round shape was the most common form among both males and females (69%), followed by bird beaks (20%) and crooked fingers (4%). The most prevalent shape combination in males and females was oval/oval (66%), followed by oval/bird (25%), and crooked finger/crooked finger (1%)[7].

When comparing the form of the right condyle between males and females, 113 condyles were round out of 200, with 40 belonging to males and 73 to females. Additionally, 69 individuals had angled condyles on the right side, comprising 28 males and 41 females. Convexity was found in 12 individuals out of 200, with 7 males and 5 females displaying this characteristic. Finally, out of six flat right condyles, four belonged to males and two to females. The study's findings align with Aqeel Al-Saedi's study, where the round condyle shape was the most prevalent, comprising approximately 55.6% in men and 56.3% in females [8].

Further analysis of male condyles revealed that out of 158 round condyles, 40 were on the right side and 37 on the left side. For angled condyles, 28 were on the right side and 35 on the left side. Moreover, 11 individuals displayed convex condyles, with 7 on the right side and 4 on the left side. Flat condyles were observed in 7 individuals, with 4 on the right side and 3 on the left side. In the female study population, out of 242 condyles, 142 were round, with 73 on the right side and 69 on the left side. Additionally, 86 individuals had angled condyles, with 41 on the right side and 45 on the left side. Convex shape was observed in 11 individuals, with 5 on the right side and 6 on the left side. Finally, three condyles were flat, with two on the right side and one on the left side. These findings are consistent with research conducted by Oliveira C in 2009, which found that round was the most prevalent form in the male population [9].

CONCLUSION

In conclusion, our study revealed that the most common shape of the condyle is round, followed by angled, convex, and flat shapes. Moreover, females tend to exhibit round condyles. This study underscores the utility of morphological variations in mandibular condyles, as observed through single panoramic radiographic views, as an adjunct for personal identification in forensic anthropology. Despite the advances in 3D imaging technologies such as CBCT and CT, which are effective in personal identification, orthopantomograms remain valuable due to their cost-effectiveness and lower radiation exposure.

DECLARATIONS

Acknowledgments: Not applicable
Funding: This research received no external funding.
Competing and conflicting interests
The authors declare no conflict of interest..
Ethical approval: Ethical approval and consent to participate not applicable.
Informed consent: Not applicable.

REFERENCES

1. Sahithi D, Reddy S, Divya Teja DV, Koneru J, Sai Praveen KN, Sruthi R. Reveal the concealed – Morphological variations of the coronoid process, condyle, and sigmoid notch in personal identification. Egypt J Forensic Sci. 2016;6(2):108–13.
2. Ashwinirani SR, Patil ST, Nair B, Rajmane Y, Kamala KA. Morphological variations of condylar process and sigmoid notch using Orthopantomograms in the Western part of Maharashtra population. Int J Appl Dent Sci. 2018;4(1):160–3.
3. Hegde S, Praveen BN, Shetty SR (2013) Morphological and Radiological Variations of Mandibular Condyles in Health and Diseases: A Systematic Review. Dentistry 3: 154.
4. Singh B, Kumar NR, Balan A, Nishan M, Haris PS, Jinisha M, et al. Evaluation of normal morphology of mandibular condyle: A radiographic survey. J Clin Imaging Sci 2020;10:51.
5. Sreenivasagan S, George AM, Rengalakshmi S. Variation in condylar morphology in different malocclusion among Indians. Bioinformation. 2021;17(12):1134–7.
6. Mathew AL, Sholapurkar AA, Pai KM. Condylar changes and its association with age, TMD, and dentition status: A cross-sectional study. Int J Dent. 2011;2011:413639.
7. Md Anisuzzaman M, Khan SR, Khan MTI, Abdullah MK, Afrin A. Evaluation of mandibular condylar morphology by orthopantomogram in the Bangladeshi population. Updat Dent Coll J . 2019;9(1):29–31.
8. Aqeel-Al-Saedi IL, AL-Taee R, AL-Jasim NH, AL-Bakhakh B. A panoramic study of the morphology of the mandibular condyle in a sample of the population from Basrah city. Int J Morphol. 2020;38(6):1707–12.
9. Oliveira C, Bernardo RT, Capelozza AA. Mandibular condyle morphology on panoramic radiographs of asymptomatic temporomandibular joints. Int J Dent. 2009; 8:114-8.