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A Retrospective Study of Morphology of Mandibular condylar process in adult population by OPG

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Abstract:
Background*: The morphology of the mandibular condyle exhibits variations which may be helpful in temporomandibular joint assessment and forensic identification. Orthopantomograms (OPGs) are one of the most convenient methods for evaluating these variations.*
Aim: *To assess mandibular condylar morphology and bilateral symmetry in adult population of Ahmedabad, Gujarat and determine their association with age and gender.*
Materials and Methods: *This retrospective study evaluated 370 OPGs obtained from the Department of Oral Medicine and Radiology, AMC Dental College and Hospital, Ahmedabad. Participants were categorized into three age groups: 18–30, 31–40, and 41–50 years. Condyles were classified as oval, bird-beak, diamond, or crooked-finger shaped according to Chaudhary et al. (2015). Bilateral symmetry was also assessed. Associations were analyzed using the chi-square test.*
Results: *The most frequent form of condyle is oval (50.0%), followed by crooked finger (19.2%), beak bird (16.1%), and diamond shape (14.2%). Bird beak-shaped condylar processes were seen more frequently among males than females; Diamond-shaped condylar processes were found more frequently among females than males. Bilateral symmetry was observed in 65.9% of participants, without a significant difference between sexes.*
Conclusion: *Oval morphology and bilateral symmetry were predominant. These results have value in forensic identification, radiographic inspection of the mandible, and for evaluating the physiological condition of the temporomandibular joint.*
Keywords: *Mandibular condyle, OPG, morphology, symmetry, temporomandibular joint.*

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I. INTRODUCTION: -

The Temporomandibular joint (TMJ) is a ginglymoarthroidal joint that is formed by articulation between two bones, the condyle of the mandible and glenoid fossa at the base of the skull and is the only joint in head which helps in opening and closing of jaw.[1,2] The study of condylar morphology is useful in various aspects. The shape of mandibular condyle and condylar height show sexual dimorphism and therefore can be used for sex determination. [3,4] It is helpful in orthodontic treatment planning. [1,5] Forensic odontology, branch of study, also takes account of mandible and TMJ as it is the most durable bone of skull and is known to resist post-mortem changes. [4,6,7] The density of bone and contours can be used to estimate a person's age, sex, stature, ancestry and comparative human identification.[4]

Panoramic radiographs (orthopantomograms) are widely used by dentists to examine the teeth, mandible, TMJ and other related structures. [8,9,10]. They provide relatively less dose of radiation exposure for the patient. [11] OPG can be used to study the different shapes of condyle of Temporomandibular Joint. However, intrinsic anatomy distortion, ghost image and lack of precise spatial relationship between structures are the limitations of OPG.[10]

➔ Classification of condylar process in dry skull [12] :-

(a) Oval shaped
(b) Diamond shaped
(c) Hook shaped

(d) L-shaped

Or

(a) Rounded [13]
(b) Angled
(c) Flattened
(d) Mixed

➔ Classification of condylar process according to yale [14,15,17,18]

(a) Convex
(b) Flattened
(c) Angled
(d) Rounded

➔ Classification of condylar process surgical exposure [16]:-

(a) Excavated form
(b) Oblique shape
(c) Small round condyle
(d) Flattened condyle

➔ Classification of condylar process according to chaudhary et al (2015) [19,20]

(a) Oval shaped
(b) Bird beak shaped
(c) Diamond shaped
(d) Crooked finger shaped

II. MATERIAL AND METHODS: -

The OPG images were taken from the ORAL MEDICINE AND RADIOLOGY DEPARTMENT, AMC DENTAL COLLEGE, AHMEDABAD, in closed mouth position.

After receiving approval from the ethical committee, a study with 370 radiographs of panoramic view was obtained and analyzed retrospectively using KODAK 8000 Digital Panoramic System(orthopantomograph) at 82 kV, 10 mA exposed for 15.8 seconds and CS 8000C Carestream.

- ***Exclusion criteria involve***
  - Any history of trauma involving fractured bone, missing teeth (any anterior or posterior)
  - Pediatric patients (up to age of 18 years)
  - Patients with any pathologies and occlusal discrepancies
  - Poor quality OPGs.

- ***The Classification System used: -***

Condylar morphology of few types by **Chaudhary et al (2015)[21]** were identified as follows(see figures below):

- Oval shaped
- Bird beak shaped
- Diamond shaped
- Crooked finger shaped



OVAL SHAPED



BIRD BEAK SHAPED



CROOKED FINGER SHAPED



DIAMOND SHAPED



ASYMMETRICAL CONDYLES



SYMMETRICAL CONDYLE

- ***Statistical Analysis*** was done using Chi-square test. This test was helpful to find correlation between demographic details and morphology of condyle. [4,8] Variations in shapes and sizes of condyle help to diagnose TMJ disorders associated with malocclusion such crossbite, deep bite and open bite. [1,9,21]

The Participant OPGs were divided into 3 groups according to age:

(1) age 18 to 30 years
(2) age-31 to 40 years
(3) age -41 to 50 years

to assess the difference in frequency of normal condylar morphological variation about age and gender.

III. RESULTS AND DISCUSSION:

370 participants					
185 females			185 males		
65 participants aged 18-30 years	60 participants aged 31-40 years	60 participants aged 41-50 years	65 participants aged 18-30 years	60 participants aged 31-40 years	60 participants aged 41-50 years

Shape of condyle

Shape of condyle (among females)

The majority of the females had oval-shaped condyle (48.4%), followed by crooked fingers (26.7%), followed by diamond-shaped (17.0%), followed by beak bird (13.2%).

Among females, the shape of the condyle was found to differ significantly between different age groups (p-value <.05). The percentage of subjects with diamond-shaped condyle was significantly more in the age group of 18-30 years (22.3%) and significantly less in the age group of 41-50 years (9.2%). Other condyle shapes were not found to have any significant association with age.

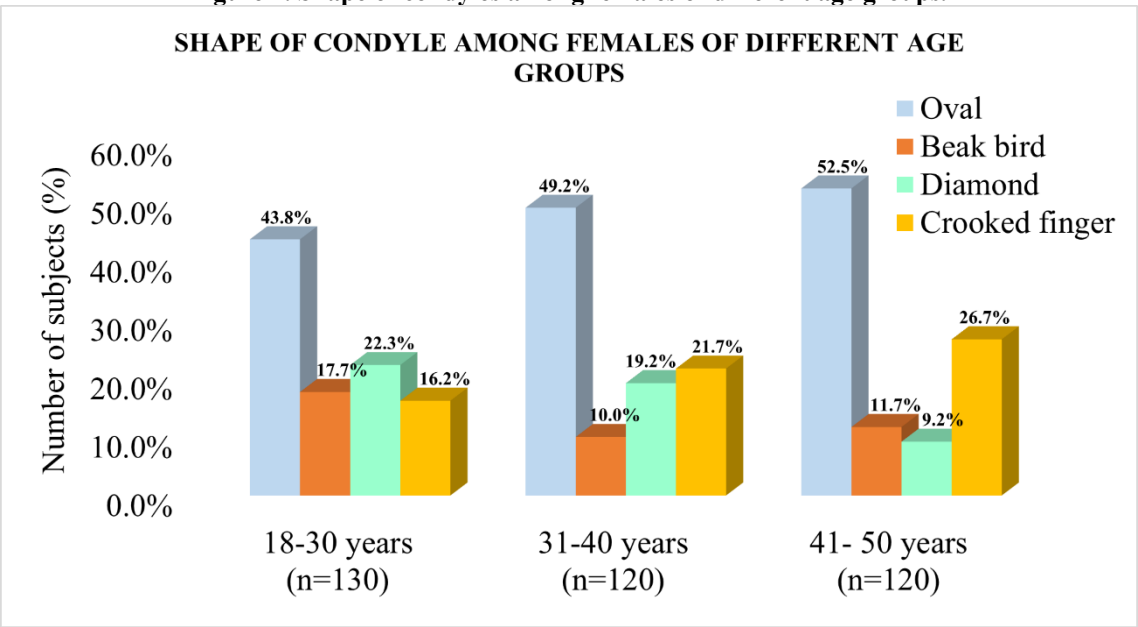
Table 1. Comparison of shape of condyle between different age groups among females.

Shape of condyle		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=130)	31-40 years (N=120)	41- 50 years (N=120)				
Oval	Number	57	59	63	179	14.154	6	.028*
	Percentage	43.8%	49.2%	52.5%	48.4%			
Beak bird	Number	23	12	14	49			
	Percentage	17.7%	10.0%	11.7%	13.2%			
Diamond	Number	29	23	11	63			
	Percentage	22.3%	19.2%	9.2%	17.0%			
Crooked finger	Number	21	26	32	79			

	Percentage	16.2%	21.7%	26.7%	21.4%			

Chi-square test. *p-value<.05 was considered statistically significant.

Figure 1. Shape of condyles among females of different age groups.



Shape of condyle (among males)

The majority of the males had oval-shaped condyle (52.7%), followed by beak bird (15.9%), followed by crooked fingers (17.0%), followed by diamond-shaped (11.4%).

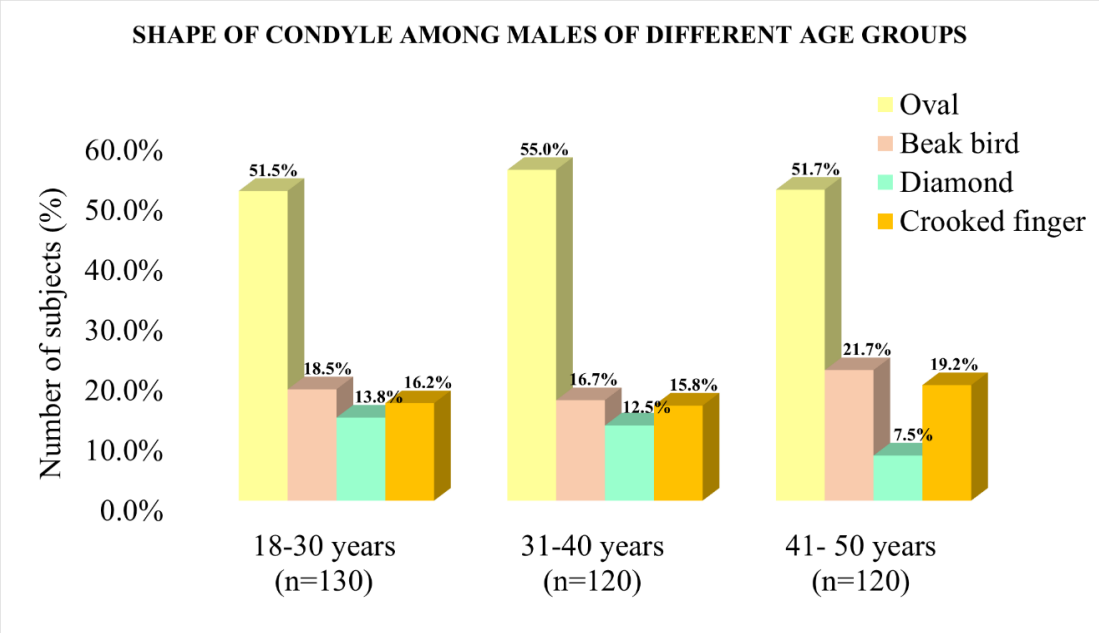
Among males, the shape of the condyle was not found to differ significantly between different age groups (p-value>.05).

Table 2. Comparison of shape of condyle between different age groups among males.

Shape of condyle		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=130)	31-40 years (N=120)	41- 50 years (N=120)				
Oval	Number	67	66	62	195	3.895	6	.691
	Percentage	51.5%	55.0%	51.7%	52.7%			
Beak bird	Number	24	20	26	70			
	Percentage	18.5%	16.7%	21.7%	18.9%			
Diamond	Number	18	15	9	42			
	Percentage	13.8%	12.5%	7.5%	11.4%			
Crooked finger	Number	21	19	23	63			
	Percentage	16.2%	15.8%	19.2%	17.0%			

Chi-square test

Figure 2. Shape of condyle among males of different age groups.



Shape of condyles (all subjects)

Overall, the most commonly observed condyle shape was oval (50.0%), followed by crooked finger (19.2%), followed by beak bird (16.1%), followed by diamond shape (14.2%).

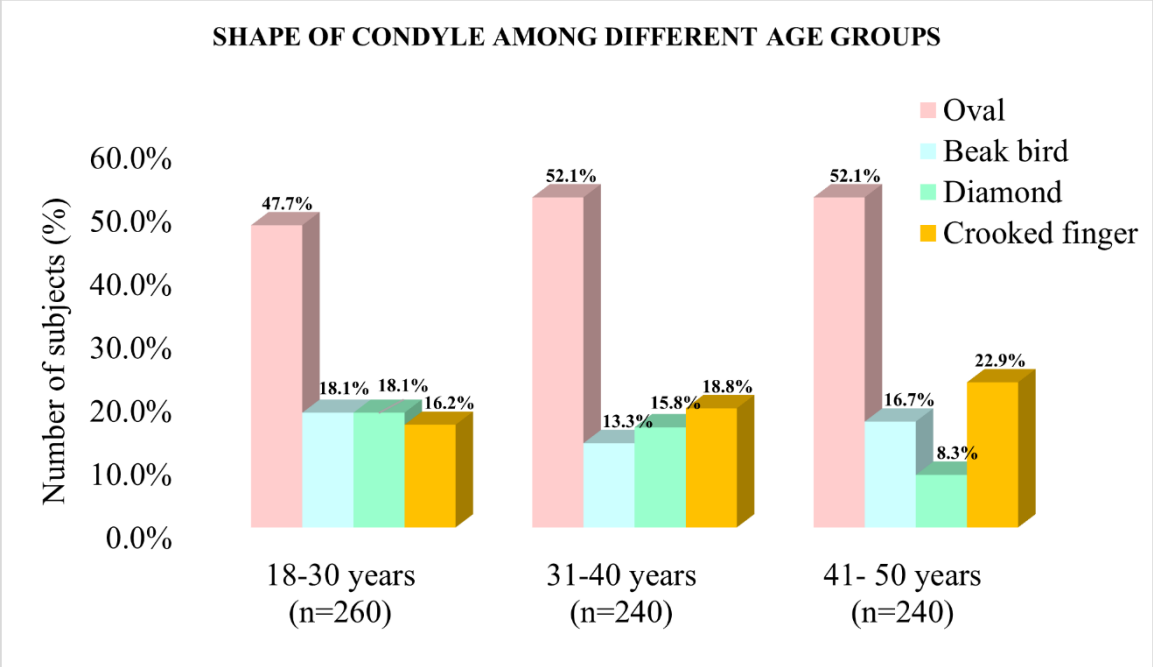
It was found that the percentage of subjects with diamond-shaped condyle was significantly more in the age group of 18- 30 years (22.3%) and significantly less in the age group of 41-50 years (9.2%). Other condyle shapes were not found to have any significant association with age.

Table 3. Comparison of shape of condyle between different age groups among all subjects.

Shape of condyle		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=260)	31-40 years (N=240)	41- 50 years (N=240)				
Oval	Number	124	125	125	374	14.502	6	.025*
	Percentage	47.7%	52.1%	52.1%	50.5%			
Beak bird	Number	47	32	40	119			
	Percentage	18.1%	13.3%	16.7%	16.1%			
Diamond	Number	47	38	20	105			
	Percentage	18.1%	15.8%	8.3%	14.2%			
Crooked finger	Number	42	45	55	142			
	Percentage	16.2%	18.8%	22.9%	19.2%			

Chi-square test. *p-value<.05 was considered statistically

Figure 3. Shape of condyles among subjects of different age groups.



Symmetry between condyles

Symmetry between condyles (among females)

The majority of the females had symmetrical condyles (61.6%).

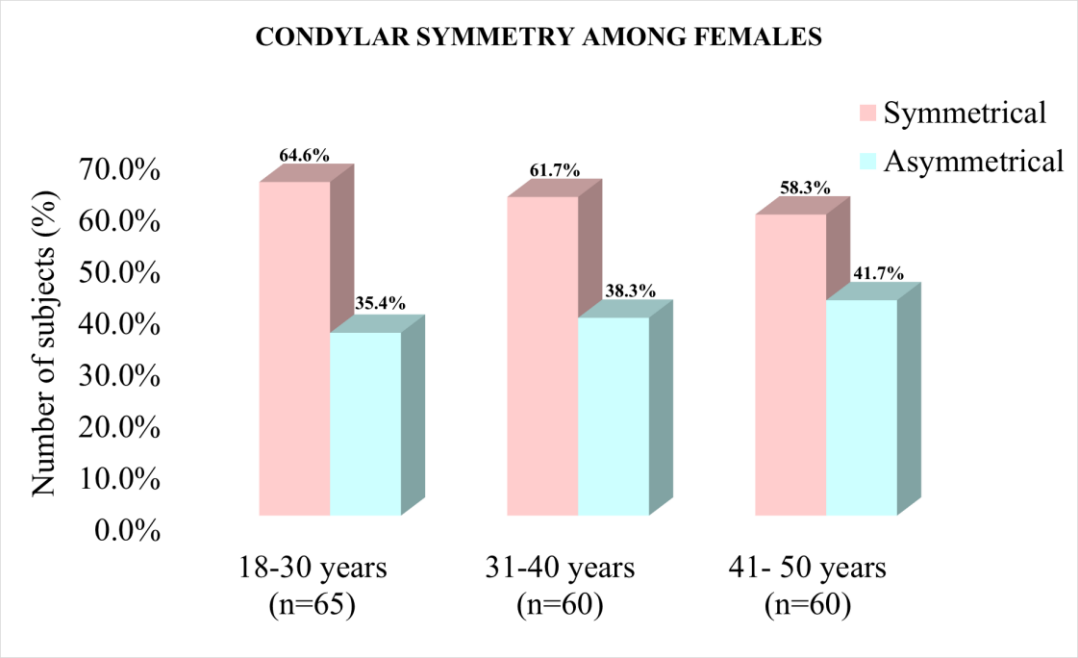
Among females, the percentage of subjects with symmetrical or asymmetrical condyles was not found to differ significantly between different age groups (p-value>.05).

Table 4. Comparison of symmetry between condyles on right and left side between different age groups among females.

Symmetry between condyle on right and left sides		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=130)	31-40 years (N=122)	41- 50 years (N=122)				
Symmetrical	Number	42	37	35	114	.521	2	.771
	Percentage	64.6%	61.7%	58.3%	61.6%			
Asymmetrical	Number	23	23	25	71			
	Percentage	35.4%	38.3%	41.7%	38.4%			

Chi-square test.

Figure 4. Condylar symmetry among females.



Symmetry between condyles (among males)

The majority of the males had symmetrical condyles (70.3%).

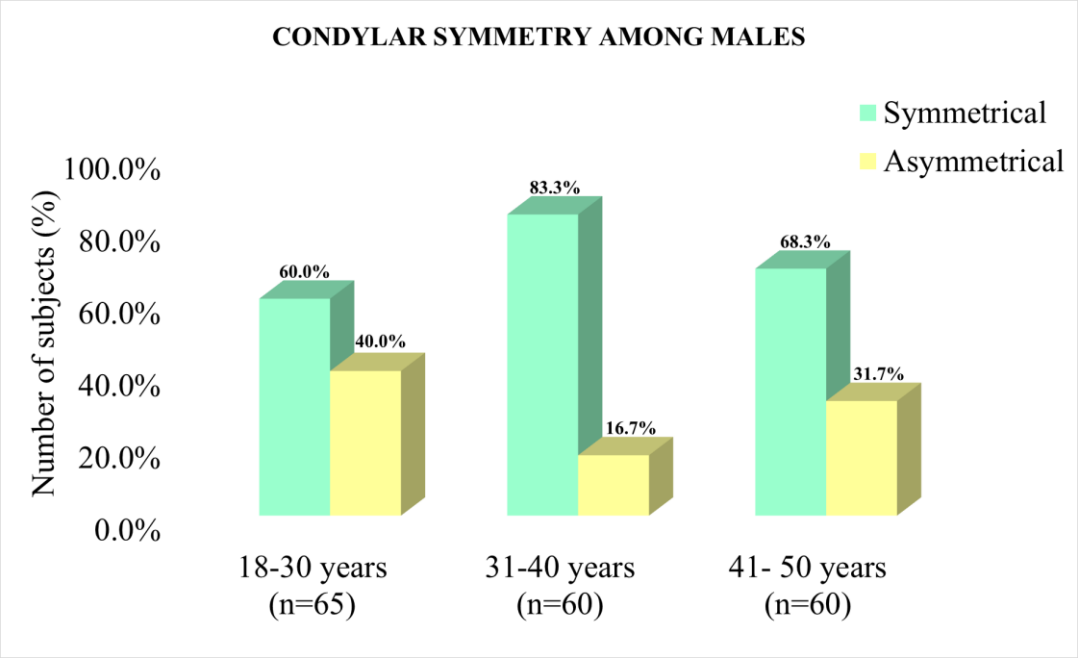
Among males, the percentage of subjects with symmetrical or asymmetrical condyles was significantly different between different age groups (p-value<.05). The percentage of subjects with symmetrical condyles was significantly greater among the subjects in the age group of 31-40 years and significantly lesser in the age group of 18-30 years (p-value<.05).

Table 5. Comparison of symmetry between condyles on right and left side between different age groups among males.

Symmetry between condyle on right and left sides		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=65)	31-40 years (N=60)	41- 50 years (N=60)				
Symmetrical	Number	39	50	41	130	8.291	2	.016*
	Percentage	60.0%	83.3%	68.3%	70.3%			
Asymmetrical	Number	26	10	19	55			
	Percentage	40.0%	16.7%	31.7%	29.7%			

Chi-square test. *p-value<.05 was considered statistically significant.

Figure 5. Condylar symmetry among males.



Symmetry between condyles (all subjects)

The majority of the subjects had symmetrical condyles (65.9%).

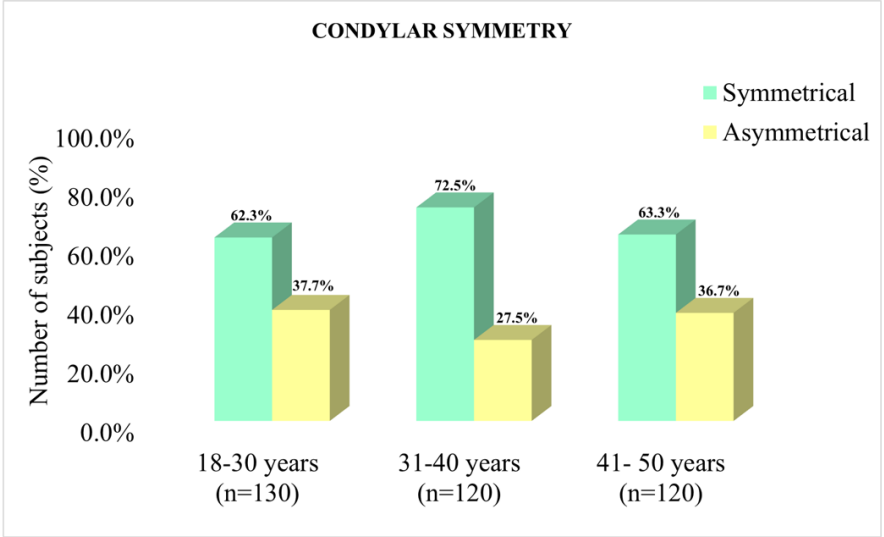
Among males, the percentage of subjects with symmetrical or asymmetrical condyles was non-significantly different between different age groups (p-value>.05).

Table 6. Comparison of symmetry between condyles on right and left side between different age groups among all subjects.

Symmetry between condyle on right and left sides		Age group			Total	Chi-square value	df	p-value
		18-30 years (N=130)	31-40 years (N=120)	41- 50 years (N=120)				
Symmetrical	Number	81	87	76	244	3.426	2	.180
	Percentage	62.3%	72.5%	63.3%	65.9%			
Asymmetrical	Number	49	33	44	126			
	Percentage	37.7%	27.5%	36.7%	34.1%			

Chi-square test.

Figure 6. Condylar symmetry.



COMPARISON BETWEEN MALES AND FEMALES

Condyle shape

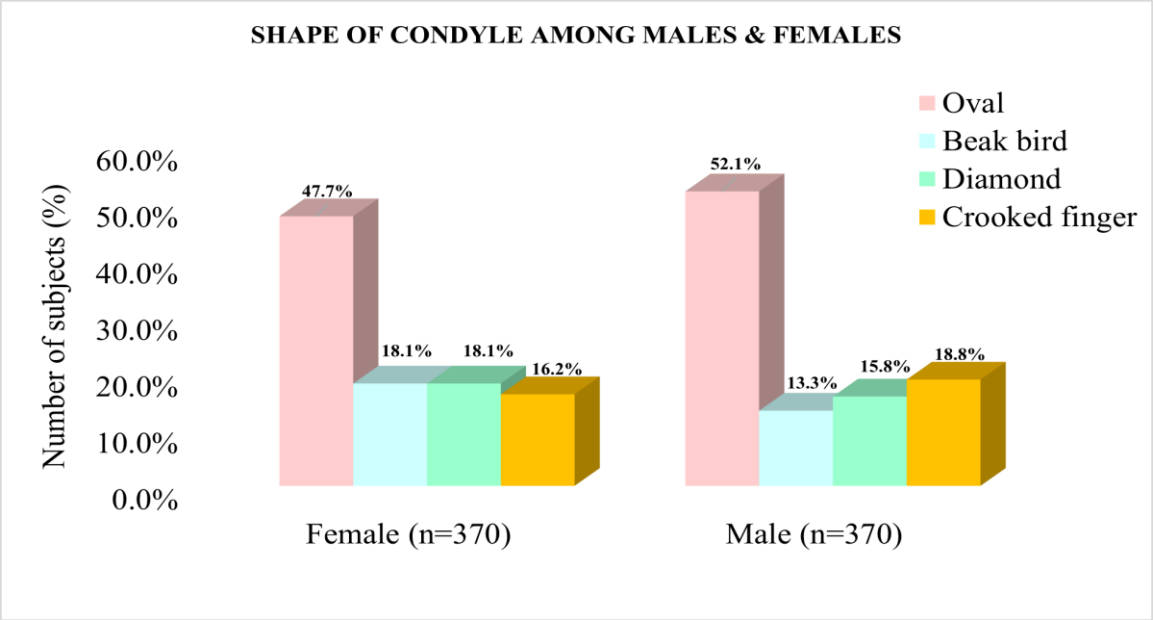
Overall, irrespective of gender and age, the most commonly observed condyle shape was oval (50.5%), followed by crooked finger (19.2%), followed by beak bird (16.1%), followed by diamond (14.2%).On comparing males and females it was found that beak bird-shaped condyles were significantly more common among males than females (18.9% vs. 13.2%) and diamond-shaped condyles were significantly more common among females than males (17.0% vs. 11.4%) (p-value<.05).

Table 7. Comparison of shape of condyle between males and females.

Shape of condyle		Gender		Total	Chi-square value	df	p-value
		Female (N=370)	Male (N=370)				
Oval	Number	179	195	374	10.393	3	.016*
	Percentage	48.4%	52.7%	50.5%			
Beak bird	Number	49	70	119			
	Percentage	13.2%	18.9%	16.1%			
Diamond	Number	63	42	105			
	Percentage	17.0%	11.4%	14.2%			
Crooked finger	Number	79	63	142			
	Percentage	21.4%	17.0%	19.2%			

Chi-square test. *p-value<.05 was considered statistically

Figure 7. Shape of condyles among males and females.



Condyle symmetry

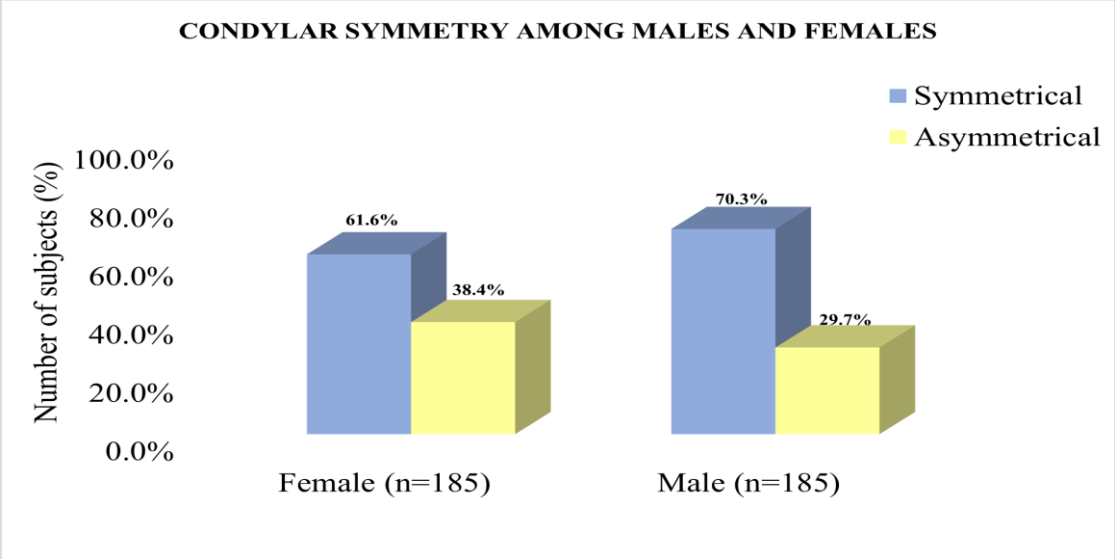
The majority of the participants have symmetrical condyle (65.9%). The condylar symmetry was not found to differ significantly between males and females (p-value>.05).

Table 8. Comparison of symmetry between males and females.

Symmetry between condyle on right and left sides		Gender		Total	Chi-square value	df	p-value
		Female (N=185)	Male (N=185)				
Symmetrical	Number	114	130	244	3.081	1	.079
	Percentage	61.6%	70.3%	65.9%			
Asymmetrical	Number	71	55	126			
	Percentage	38.4%	29.7%	34.1%			

Chi-square test.

Figure 8. Condylar symmetry among males and females.



IV. CONCLUSION:

The data from this study demonstrates that adult male and female patients have diverse shapes of their condylar process; in general, the most frequent form of condyle is oval (50.0%), followed by crooked finger (19.2%), beak bird (16.1%), and diamond shape (14.2%).2 Additional variation was seen in the condylar morphology according to sex, with bird beak-shaped condylar processes were seen more frequently among males than females; diamond-shaped condylar processes were found more frequently among females than males. Most subjects in the present study symmetrical condylar process (65.9%) when comparing both the right and left sides, which was true for both sexes. These results have value in forensic identification, radiographic inspection of the mandible, and for evaluating the physiological condition of the temporomandibular joint.

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