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Morphological variations of condylar process and sigmoid notch using Orthopantomograms in Western part of Maharashtra population

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Abstract
Aim: To evaluate the morphological variations of the condylar process and the sigmoid notch and their correlation with gender and sides using Orthopantomograms in Western part of Maharashtra population.
Materials and Methods: The study was conducted using 368 Conventional Orthopantomograms of patients. The different shapes of condylar process and sigmoid notch were traced using marker pencil for both right and left sides. The data obtained were subjected to statistical analysis, Chi-square test was done to evaluate the *P* value which was ascertained to be significant if <0.05.
Results: The condylar shapes commonly observed among the males and females were angled and round shapes, respectively. The sigmoid notch most commonly observed was wide form followed by sloping and round form in both the gender. These variations when compared between gender and sides had shown no statistical significance differences.
Conclusion: The Present study has showed variation in morphological shapes of condylar process and sigmoid notch pertaining to Western part of Maharashtra population. Knowing variation helps in detection of gender and diagnosis of pathologies in those regions.

Keywords: Sigmoid notch, condylar process, mandible

Introduction
Temporomandibular Joint (TMJ) is one of the unique joints of body which is freely movable articulation between the condyle of the mandible and squamous portion of the temporal bone at the base of the skull [1]. The function of TMJ is to provide smooth, efficient movement of the mandible during mastication, swallowing and speech and to provide stability of mandibular position and prevent dislocation from external or unusual forces. The condyle is very important since expression of the mandibular growth is provided by mandibular condyle. The sigmoid notch also called as mandibular notch is a deep notch separating the coronoid process and condyle.
A Variation of normal condylar morphology occurs with age, gender, facial type, occlusal force, functional load, malocclusion and between right and left sides. Degeneraive changes in TMJ leads to morphologic changes of elderly persons. Various studies have been done on TMJ morphology using dry and autopsy human skulls, histology, Orthopantomograms (OPGs) magnetic resonance imaging, computed tomography and Cone-Beam Computed Tomography methods [2, 3].
A thorough understanding of the anatomy and morphology of the TMJ is essential so that a normal variant is distinguished from pathological conditions. The current research focuses to evaluate the morphological variations of mandibular condylar process and sigmoid notch in Western part of Maharashtra population.

Materials and Methods
A prospective study was conducted in the Department of Oral Medicine and Radiology, School of Dental Sciences. Institutional Ethical Clearance was obtained from Krishna Institute of Medical Sciences, Karad. A total of 400 OPGs were exposed, out of which only 368 OPGs were included in the study. The patients were explained about the objectives of the study and informed consent was obtained before enrolling them in the study.

Patients undergoing conventional OPGs for diagnostic, periodontal, surgical (for impacted teeth) or orthodontic purposes were recruited for the study. Patients with history of trauma to maxillofacial region and hemifacial atrohy were excluded from the study. All OPGs were captured using Xtropan 2000 machine (tube potential: 50–85 KV, tube current: 12 mA, and time: 14 s) using Carestream (T Mat GIRA) films. A single observer analyzed the OPG and traced in the condylar region and sigmoid notch region using marker pencil. The various shapes of condylar process and sigmoid notch were interpreted as given by Hedge *et al* [4] and Shakya *et al*. [2] [Figure 1, Figure 2] The shapes are recorded for both right and left sides and for both gender. Thus a total of 736 sides were assessed and comparison was made for right and left sides and between the gender. The data obtained were tabulated and subjected to statistical analysis.

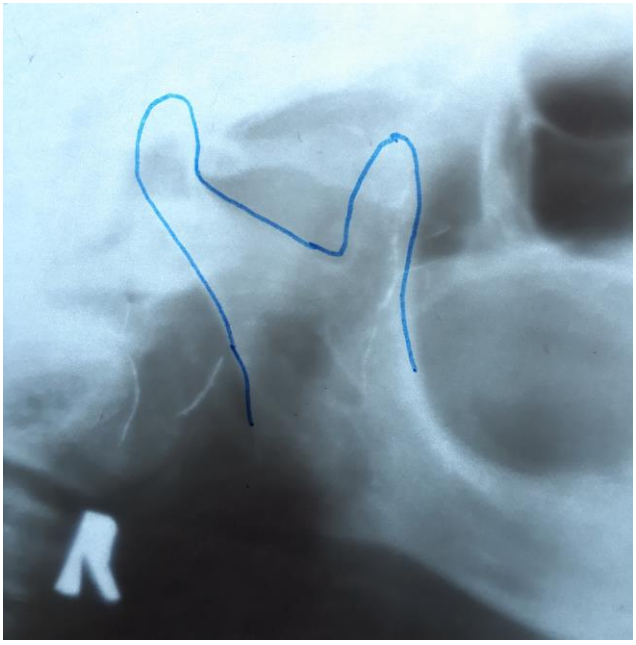

Fig 1: Orthopantomogram showing bilateral round condylar process with sloping sigmoid notch in right side and round sigmoid notch on left side.

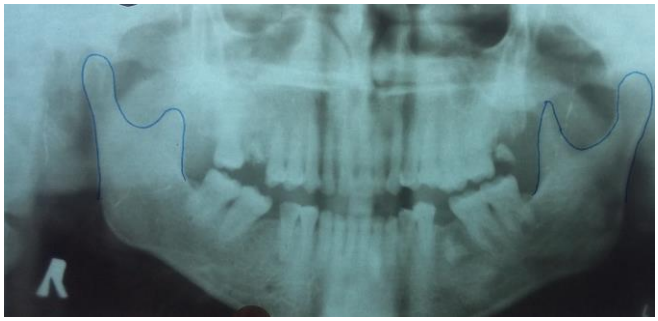

Fig 2: Orthopantomogram showing angled condylar process on right with sloping sigmoid notch

Results

Total 368 OPGs obtained (736 sides), out of which 205 (410 sides) were of males and 163 (326 sides) were of females. The most common shape of the sigmoid notch observed was wide form (308 sides), out of which 163 were present in males and 145 were there in females. The second most common shape of sigmoid notch was sloping form (249 sides) out of which 138 were in males and 111were in females followed by round shape (179 sides), out of which 109 were in males and 70 in females. The distribution of sigmoid notch among males and females had shown no statistical significance differences. [Table 1]

Table 1: Genderwise distribution of sigmoid notch shapes

Shapes of sigmoid notches	Wide	Sloping	Round	Total	Chi square value	P value
Males	163	138	109	410	0.96	0.61
Females	145	111	70	326		
Total	308	249	179	736		

In males sidewise distribution of sigmoid notch showed 86 and 77 wide form of sigmoid notches in right and left sides respectively followed by 65 sloping form on right side and 73 on left side. The least form was round form with 54 on right side and 55 on left side. The distribution of sigmoid notch in males among right and left sides had shown no statistical significant difference. [Table 2]

Table 2: Sidewise distribution of sigmoid notch in males

Types	Right	Left	Total	Chi square value	P value
Wide	86	77	163	1.65	0.47
Sloping	65	73	138		
Round	54	55	109		
Total	205	205	410		

In females sidewise distribution of sigmoid notch showed 76 and 69 wide form of sigmoid notch in right and left sides respectively followed by 50 sloping form on right side and 61 on left side. The least type of sigmoid notch observed was round form with 37 on right side and 33 on left side. The distribution of sigmoid notch in females among right and left sides had shown no statistical significant differences. Table 3.

Table 3: Sidewise distribution of sigmoid notch in females

Types	Right	Left	Total
Wide	76	69	145
Sloping	50	61	111
Round	37	33	70
Total	163	163	326

The most frequently observed condylar shape was round in 289 cases, out of which 146 were in males and 143 were in females. The angled shape was second most common shape accounting for 281 sides, with 168 in males and 113 in females followed by convex shape of 152 sides, with 90 sides in males and 62 sides in females. Flat shape was least common type which accounts for only 14 sides with 8 in females and 6 in males. The most common type in males was angled where as in females it was round shape. The distribution of condylar shapes among males and females had shown no statistical significant differences. [Table 4]

Table 4: Genderwise distribution of condylar process shapes

Gender	Round	Angled	convex	Flat	Total	Chi square value	P value
Males	146	168	90	6	410	6.74	0.08
Females	143	113	62	8	326		
Total	289	281	152	14	736		

In males sidewise distribution of condyle showed 68 and 78 round shaped on right and left sides respectively followed 79 angled on right side and 89 on left side with 53 convex type on right side and 37 on left side followed by least type of flat shape which was 5 on right side and 1 on left side. The distribution of condylar shape among right and left sides had shown no statistical significance differences. [Table 5]

Table 5: Sidewise distribution of condylar process in males

Shape	Right side	Left side	Total	Chi square value	P value
Round	68	78	146	6.79	0.07
Angled	79	89	168		
Convex	53	37	90		
Flat	5	1	6		
Total	205	205	410		

In females the most frequently observed shape of the condyle was round (70 on the right side and 73 on the left side) followed by angled (55 on the right side and 58 on the left side), convex (35 on the right side and 27 on the left side and flat shapes (3 on the right side and 5 on the left side). The distribution of condylar shape among right and left sides in femlaes had shown no statistical significance differences. [Table 6]

Table 6: Sidewise distribution of condylar process in females

Shape	Right side	Left side	Total	Chi square value	P value
Round	70	73	143	1.67	0.64
Angled	55	58	113		
Convex	35	27	62		
Flat	3	5	8		
Total	163	163	326		

Discussion

Mandibular condyle is a bony ellipsoid structure connected to ramus by narrow neck. It isapproximately 20mm long mediolaterally and 8-10 mm thick anteroposterioly. Variations in the size and shape of condyle may be physiological or pathological. The superior aspect of condyle may be flattened, rounded or convex whereas mediolateral aspect is convex. Several studies have attempted to evaluate the morphology of the human condyles and coronoid process and sigmoid notch [5].

In 1961, Yale *et al*. was the first one to report about the different shapes of mandibular condyle [6]. Initially Yale classified condylar head based on superior view into three categories namely concave, convex and flat, however later on he simplified it into four categories namely convex, flattened, angled and rounded [6, 7].

A study in 1980's on mandibular condyle morphology in relation to malocclusion in children revealed that the condylar size in males was greater than in females and midline discrepancy significantly altered the increase in condylar size during growth [8].

In this study, relating to Western part of Maharashtra population the wide form of the sigmoid notch was commonly observed followed by the sloping form and the least common form was round. Where as in a study conducted by Sahithi *et al t*he most common form was wide followed by round and sloping forms [5].

Nagaraj T *et al* conducted a study to asses the different morphological types of condylar process and sigmoid notch and their correlation with age and gender using panoramic radiographs in North Bengaluru population showed sloping form most common type followed by wide and round forms [9]. In a study conducted by Shakya *et al* higher prevalence of sloping form was found followed by round form and wide form [2]. However, in our study the variation of sigmoid notch when compared on either side and among both the gender were not statistically significant which were similar to Nagaraj T *et al* and Shakya *et al* studies [9, 2].

In our study, the most common shape of condyle was round followed by angled, convex and least common type was flat shape which was in accordance with Nagaraj T *et al* study [9]. Among genders the most common type was angled type in males and round type in females which were in accordance with Sahithi *et al* study [5]. In our study flat shape condylar process was more common in females than males which was in accordance with Sahiti *et al* study [5].

The studies reported by Ribeiro *et al* in Brazilian population, [10] and Chaudhary *et al* [11] in East Indian population, showed that round/ oval shape to be common in both the gender, which goes in accordance with our study. A study conducted by Oliveira *et al* had shown the round shape to be more frequent followed by pointed and flat shapes, which was a similar finding among females in this study [12]. The distribution of condylar shapes among gender and between right and left sides were not significant in our study which was in accordance with Nagaraj T *et al* and Sahithi *et al* studies [9, 5].

Conclusion

In our study pertaining to Western part of Maharshtra population the most common shape of sigmoid notch was wide form and condylar process was round shape. There were no variations in shapes of sigmoid notch and condylar process among gender determinations. Larger sample sizes with different population studies are required.

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