ANALYSIS

23(100), November - December, 2019

ISSN
2321–7359
EISSN
2321–7367

Medical Science

Prevalence of various morphological types of Condyle seen among Malaysian Ethnic groups using Conventional Orthopantomogram

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Article History
Received: 03 July 2019
Reviewed: 09/July/2019 *to* 20/August/2019
Accepted: 23 August 2019
Prepared: 28 August 2019
Published: November - December 2019

Citation
Priyadarshini Karthikeyan, Lau Peng Hoe, Koh Pei Yen, Lau Wen Weng, Ramesh Kumaresan. Prevalence of various morphological types of Condyle seen among Malaysian Ethnic groups using Conventional Orthopantomogram. *Medical Science*, 2019, 23(100), 869-875

ABSTRACT

Background: Orthopantomograph (OPG) is a routine imaging modality utilized by most dental surgeons for obtaining general information about the teeth, mandible, and adjacent regions of the jaw as it yields a favorable cost-benefit relationship and exposes patients to relatively low doses of radiation. Among various imaging modalities used for temporomandibular joint (TMJ) and condyle imaging panoramic radiographs still remain the main screening modality for TMJ abnormalities. *Aims and objectives:* The current study was done to evaluate variations of TMJ condylar morphology among various ethnic groups (Malay, Chinese and Indian) in Malaysia using conventional OPG. *Materials and Methods*: 300 conventional OPGs free of any projection errors showing a full condylar view on either side with optimal density and contrast were selected for this retrospective study. They were categorized into three groups i.e group A (50 Malay males and 50 Malay females), group B (50 Chinese males and 50 Chinese females) and group C (50 Indian males and 50 Indian females). Result of the condylar morphology was obtained and divided into Type I (Oval shape), Type II (Diamond shape), Type III (Bird beak shape) and Type IV (Crooked finger shape) and all the results were evaluated. The variations which are observed were tabulated. All the data was statistically analyzed. *Results*: Oval-shaped of the mandibular right condyle which constitutes about 82% is the most prevalent shape amongst all ethnic groups. *Conclusion:* Low exposure dose and ease of prescription make OPG a common choice of imaging prescription. Evaluation of condyle on OPG seems to attract clinicians to make fine observations.

Keywords: Condyle, Orthopantomogram, Temporomandibular Joint, Mandible.

1. INTRODUCTION

The temporomandibular joint (TMJ) is a ginglymo-diarthroidal joint which consists of the glenoid fossa, (Durgha K, 2014) the mandibular condyle and the articular disc which are enclosed within a fibrous capsule and the joint is stabilized by the extracapsular temporomandibular and sphenomandibular ligament (Katsavrias EG et al., 2015). The TMJ is capable of producing a variety of movements like opening, closing, lateral and translator movements. This is possible due to the coordination between the various muscles, ligaments and the associated movements of the condyle. The human condyle has a capacity for remodelling (Saccucci M et al., 2012) which is influenced by a variety of factors which can result in morphological diversity and variations in shape. Several studies have dealt with the position of the condyle but not much emphasis has been laid on the shape of the condyle.

The condyle of the mandible articulates with the temporal bone in the mandibular fossa (Moss ML., 1972). A fundamental question in dentistry is what the optimal position of the condyle is in the articular fossa when teeth are in maximum intercuspation. Despite the way the teeth come together in occlusion can be observed directly in the patient's mouth, the condylar position into the articular fossa is impossible to be seen by the clinician's naked eye (Dawson PE., 1996).

In order to estimate the condylar positions, several methodologies have been proposed at the current literature. However, all those methodologies have shown many controversies. Various radiographic modalities have been used to visualize the condylar positions. In spite of that, the radiographies obtainment represents a non-precise method for this analysis, for the various magnificence radiographic degrees and also, because there is a restriction related to the two-dimensional diagram. Another important imaging resource is the magnetic resonance, a much applied method along the clinical studies, which refers to the articular disc positioning. Despite this study has not employed the magnetic resonance method, attention can be called to the association of magnetic resonance technology and computerized tomography techniques of great contribution to a better comprehension of the temporomandibular area (Dawson PE., 1985). The appearance of the mandibular condyle varies greatly among different age groups and individuals. Morphologic changes may occur on the basis of simple developmental variability as well as remodelling of condyle to accommodate developmental variations, malocclusion, trauma and other developmental abnormalities and diseases (Alomar X et al., 2007).

A thorough understanding of the anatomy and morphology of the TMJ is essential so that a normal variant is distinguished from an abnormal condition. The current study evaluated variations of TMJ condylar morphology among various ethnic groups (Malay, Chinese and Indian) in Malaysia using conventional OPG.

2. MATERIALS AND METHODS

Ethical clearance has been taken from Institutional Ethical committee before the commencement of study. [Ethical clearance number: AUHAEC/FOD/2017/09].

300 conventional OPGs from the database of Faculty of Dentistry, AIMST University that free of any projection errors, which show a full condylar view on either side with optimal density and contrast following the inclusion criteria were selected in this retrospective study.

Inclusion criteria:

1. Patient's age group 18-60 years.
2. No history of TMJ dysfunction, occlusal discrepancy and trauma.
3. Patients who seek treatment for caries and periodontitis.

Exclusion criteria:

1. Patients with TMJ pain, Arthritis.
2. Patients with syndromes like Down's syndrome.
3. Autoimmune diseases like Rheumatoid arthritis. Patient's with previous history of trauma in TMJ.

The patients were divided into three groups:

Group A: 100 OPGs of Malay population (50 males and 50 females)

Group B: 100 OPGs of Chinese population (50 males and 50 females)

Group C: 100 OPGs of Indian population (50 males and 50 females)

The respective demographic details such as age, sex and ethnic groups of the patients were recorded from Aimst Dental patient database. Examination of the TMJ condyles is done using OPG whereby both right condyle and left condyle was done by the three examiners. Result of the condylar morphology is obtained and divided into Type I (Oval shape); Type II (Diamond shape), Type III (Bird beak shape) and Type IV (Crooked finger shape) and all the results were tabulated and statistically analysed.

3. RESULTS

Table 1 Frequency of the Different Condyle Types in Total Study Population

Types Condyle	Right		Left	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Oval	246	82.0	242	80.7
Diamond	14	4.7	15	5.0
Bird Beak	22	7.3	30	10.0
Crooked Finger	18	6.0	13	4.3

Table 2 Shape of Mandibular Condyle in Patient of all Ethnic Groups

Table 2a Right Mandibular Condyle

Ethnic Group	OVAL		DIAMOND		BIRD BEAK		CROOKED FINGER	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Malay	73	73	4	4	12	12	11	11
Chinese	94	94	3	3	2	2	1	1
Indian	79	79	7	7	8	8	6	6

Table 2b Left Mandibular Condyle

Ethnic Group	OVAL		DIAMOND		BIRD BEAK		CROOKED FINGER	
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)
Malay	71	71	4	4	18	18	7	7
Chinese	94	94	3	3	2	2	1	1
Indian	77	77	8	8	10	10	5	5

Table 3 Combination of condyles shape for Malay ethnics

Ethnicity	Oval/Oval		Oval/Diamond		Oval/Bird beak		oval/crooked finger	
Malay	No.	%	No.	%	No.	%	No.	%
	60	60	1	1	10	10	2	2

Ethnicity	Diamond/ diamond		Diamond/ oval		Bird beak/ bird beak		Bird beak/oval		Bird beak/ crooked finger	
Malay	No.	%	No.	%	No.	%	No.	%	No.	%
	3	3	1	1	8	8	3	3	1	1

Ethnicity	Crooked finger/oval		Crooked finger/ crooked finger	
Malay	No.	%	No.	%
	7	7	4	4

Table 4 Combination of condyles shape for Chinese ethnics

Ethnicity	Oval /oval		Oval/diamond		Oval/crooked finger		Diamond/diamond	
Chinese	No.	%	No.	%	No.	%	No.	%
	91	91	2	2	1	1	1	1

Ethnicity	Diamond/oval		Bird beak/bird beak		Crooked finger/oval	
Chinese	No.	%	No.	%	No.	%
	2	2	2	2	1	1

Table 5 Combination of condyles shape for Indian ethnics

Ethnicity	Oval / oval		Oval / diamond		Oval / bird beak		Diamond / diamond		Bird beak / bird beak		Crooked finger / bird beak		Crooked finger / crooked finger	
Indian	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	76	76	1	1	1	1	7	7	9	9	1	1	5	5

Table 6 Common condyle shape combination among all ethnics groups

Condyle shape	Oval / oval		Oval / diamond		Oval / bird beak		Oval / crooked finger		Diamond / diamond		Diamond / oval	
All Ethnics groups	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	227	75.67	4	1.33	11	3.67	3	1.00	11	3.67	3	1.00

Condyle shape	Bird beak / bird beak		Bird beak / oval		Bird beak / crooked finger		Crooked finger / oval		Crooked finger / crooked finger		Crooked finger / bird beak	
All Ethnics groups	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
	19	6.33	3	1.00	1	0.33	8	2.67	9	3.00	1	0.33

Figure 1 Orthopantomogram images showing Morphological variations for Type I to Type IV

4. DISCUSSION

Morphological knowledge of the temporomandibular joint (TMJ) is a tool for understanding development and growth, including phylogenetic aspects and the capacity for bone remodelling characteristic of the skeleton. It may also be helpful in the future development of forensic odontology (Ribeiro EC et al., 2015).

Morphologic changes of condyle occur due to developmental variations, remodelling, various diseases, trauma, endocrine disturbances, and radiation therapy. Among various imaging modalities used for TMJ orthopantomograph (OPG) still remains the main screening modality for TMJ abnormalities. This is because OPG include both maxillary and mandibular dental arches along with other surrounding structures such as the maxillary antrum, nasal fossa, TMJ, styloid processes and hyoid bone (Westesson PL, 1993). It is also a routine imaging modality utilized by dental surgeons for obtaining general information about the teeth, mandible, and adjacent regions of the jaw. Furthermore, it also yields a favourable cost-benefit relationship and exposes patients to relatively low doses of radiation (Mongini F, 1981). The appearance of mandibular condyle varies greatly among different age & ethnic groups in different individuals. Condyle shape classification has been elaborated and argued for decades by means of antero-posterior, superior and lateral view radiograph. Human mandibular condyles may be categorized into four basic types: oval, bird beak, diamond and crooked finger (Hegde S et al., 2013).

In our study, we included 600 TMJs of 300 people each from all three predominant ethnicity in Malaysia, which consists of 100 people from Malay population, 100 people from Chinese population and 100 people from Indian population. Out of those 100

subjects from each ethnicity, 50 were male and 50 were female, aged between ages of 20 to 50 years old. All 600 TMJ were subjected to OPG and the images were interpreted by the three observers separately. The three observers who interpreted the images were blinded to each other, so that inter-observer variations can be assessed. All the three observers interpreted the OPG images once for all ethnic groups in order to assess intra-observer's variations. The mandibular condylar shapes as well and their prevalence as seen by the three observers in the OPG are shown in Tables 1. In Table 2a and 2b, the appearances of both mandibular condyles in difference ethnic groups are depicted. Whereas the combination of both the mandibular condylar shapes in individual ethnic groups and their commonest shape are illustrated in Tables 3 to Table 6.

The present study is an attempt to scout the prevalent radiographic shapes of the condylar head on the OPG. The shapes were classified by looking at condylar head structure in the orthopantomographic records obtained from our records of 300 patients. Several authors have studied the symmetry and non-symmetry of the isolated Condyle in the three views, yielding significant results for both structures in the lateral view, with predominance of non-symmetry for the diamond shape and of symmetry for the oval shape (9)(10). According to our study, distribution of condylar shapes showed greater frequency of oval shaped in both individual condyles in orthopantomogram (OPG) accounting to about 82% for right condyle and 80.7% for left condyle followed by bird beak (Right – 7.3% , Left – 10.0%), crooked finger (Right – 6.0%, Left – 4.3%) and diamond (Right – 4.7%, Left – 5.0%) type respectively (Table 1). Hence it can be proposed that oval shaped condyles shows greatest frequency and prevalence amongst different ethnic groups of both genders amongst aged 20-50 years. This raised a curiosity whether the TMJ followed any typical feature of symmetry. We have found that bilateral symmetrical shape of condyle to be comparatively high. We have discovered that for oval shape with bilateral shape symmetry of condyle constituting for about 76% of the total subjects for all ethnic groups .In this present study we found that bilaterally symmetrical condyle is more frequent in Chinese subjects (91%) as compared to Indian (76%) and Malay (60%) subject. Oval-oval was commonly occurring combination (67%), whereas crooked/crooked finger was a rarity.

Our research has several similarities with other researches regarding the most prevalent shape which is oval-shape for both right and left mandibular condyles respectively. Furthermore, in the present study, we also found out that the symmetry of bilateral condyle is Oval-Oval in shape for the 3 most predominant ethnic groups in Malaysia. In contrast, our study has shown to have some dissimilarity in terms of the appearance of the mandibular condyle which are observed via two-dimensional depiction of the three dimensional TMJ. Hence, there is need of the condyle to be viewed at different positional aspects especially knowing the tilt and rotation of the condyles anatomically. Various other modalities have now developed like dental cone beam computed tomography (CBCT) is able to give detailed, accurate multiplanar 3-dimensional imaging about the information of the condyle. This means of condylar identification has been used by some authors such as Christiansen EL et al., in 1987. Another study by Matsumoto et al in 1985 evaluated condyle shape in dry skulls, finding in the anterior view (our posterior): a flat or a slightly convex shape in 58.4%, well rounded or convex in 25% (this was most frequent in our study), pointed in 16.6% and others in 3.1%; in the superior view: oblong 60%, laterally pear-shaped 20%, medially pear-shaped 18.4% and rounded or oval 1.6% (our most frequent shape was mixed); in the lateral view: pointed 55%, convex 31.7% and flat or slightly convex 13.3% (our most frequent shape was rounded). In addition to that, our study exclude the age changes on the appearance of both the condylar shape as well as any abnormalities of the TMJ related to the increasing age of the patients of all ethnic groups regardless of their genders. Also, our studies have almost not included studies on the mandibular condylar shape unilaterally or bilaterally in case of patients with TMJ disorders and occlusal disharmony.

A few limitations has been pinpointed out regarding the result on the appearance of the mandibular condyle that can be improvised via several ways which includes obtaining a better and more precise result by utilizing the dental cone beam computed tomography which is able to assess and fully view the shape of the condylar head in a 3-dimensional aspect. In addition to that, the initiative to include personnel of oral radiology as well as oral radiologist who are well trained and more experienced to interpret the OPG on the shapes of the condyles either an oval, bird-beak, crooked finger, diamond or any other combinations of shapes can help in better improvement of accuracy in the research studies regarding the prevalence of mandibular condyle shape.

5. CONCLUSION

Low exposure dose and ease of prescription make OPG a common choice of imaging prescription. Evaluation of condyle on OPG seems to attract clinicians to make fine observations. Oval-oval being most common in both genders. More sample size and evaluation of other parameters may aid in giving more information about the population and thereby generating interest in forensics.

Conflict of interest

This work is free of conflicts of interest; financial support is exclusive to the authors.

Ethical approval

In this work, all the ethical principles for the investigation were respected. Ethical clearance has been taken from Institutional Ethical committee. [Ethical clearance number: AUHAEC/FOD/2017/09].

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