Evaluation of condylar morphology using panoramic radiography

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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. It also yields a favorable cost-benefit relationship and exposes patients to relatively low doses of radiation. Human mandibular condyle may be categorized into five basic types: Flattened, convex, angled, rounded, and concave. Morphologic changes of condyle occur due to developmental variations, remodeling, various diseases, trauma, endocrine disturbances, and radiation therapy. Among various imaging modalities used for temporomandibular joint (TMJ) imaging panoramic radiographs still remain the main screening modality for TMJ abnormalities.

Aims and Objectives: This study, aims at observing and recording the variation in the shapes of condyle on an OPG and thereby evaluates whether dentate or non-dentate oral cavity shows any peculiarities in Indian population and whether it could have a deterministic value in forensic science.

Materials and Methods: This study comprised radiographic evaluation of 400 condylar heads after visualizing 200 digitalised OPGs taken for routine investigation. The radiographs were evaluated by two oral radiologists for the formulation of operational definitions. Condylar morphology of four types was identified according to a particular classification. Trends occurring in the shapes were evaluated, and combinations of the condylar shapes present in population were identified.

Results: The present study is an attempt to scout the prevalent radiographic shapes of the condylar head on the OPG. Of the 200 pairs of condylar heads evaluated, 60% were oval in shape, followed by bird beak (29%), diamond (9%) and least being crooked finger (2%). This raised a curiosity whether the TMJ followed any typical feature of symmetry. Oval-oval was commonly occurring combination (67%), whereas crooked/crooked finger was a rarity.

Conclusion: Low exposure dose and ease of prescription makes 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.

Introduction

Numata and Paatero’s invention of panoramic radiography has come a long way from just being able to visualize both the arches in a single glance. It is the most common form of specialized radiological technique prescribed and interpreted by dental surgeons. The appearance of the mandibular condyle varies greatly among different age groups and individuals. Osteology states that morphologic alterations occur on the basis of simple developmental variability as well as remodeling of condyle to accommodate developmental variations, malocclusion, trauma and other developmental abnormalities and diseases\cite{1,2}. A thorough understanding of the anatomy and morphology of the temporomandibular joint (TMJ) is essential so that a normal variant is distinguished from abnormal condition.
Investigative modalities like orthopantomograph (OPG) yield replicable results, they have a favorable cost-benefit relationship and exposes patients to relatively low doses of radiation.[3,4] Panoramic radiography has been used as the initial imaging technique for TMJ screening when clinical examination suggests some type of joint pathology. Although there have been continued effort toward studying the dimensional analysis of the condyle and its surrounding structures-little attention has been paid to the variety of condylar morphology and configuration.

The present study is aimed at observing and recording the variation in the shapes of condyle on an OPG and thereby evaluate whether the determination of the shapes could aid in diagnostics. The mandibular condyle varies considerably both in size and shape. When viewed from above, i.e., the bird’s eye view condyle appears roughly ovoid in outline. It is 15-20 mm mediolaterally and 8-10 mm postero-anteriorly.[1] There is great variation in the size and shape of the components of the TMJ, and its relationship to each other.

It is often assumed that the normal condylar head must have a convex configuration throughout and that symmetry should exist between contralateral sides in the same individual. Several studies have attempted to evaluate the morphology of the human condyle. Variation in the human mandibular condyle shapes was noted by previous researchers.[1] A normal variation of the condylar morphology occurs with age, gender, facial type, occlusal force, functional load, malocclusion type and between right and left sides.

Review of literature reveals Yale et al. was first to report varied shapes of mandibular condyle.[5] They classified condylar head based on superior view into three categories namely concave, convex and flat. Chaudhry et al. classified TMJ appearance on OPG in various types which will be discussed further in this article.

The objective of the study was:
1. To evaluate the variation in shape of TMJ in adult Indian population
2. To determine the shape dominant in the population
3. To assess whether there is a peculiarity in either gender
4. To determine the occurrence of symmetry in shapes of TMJ on either side.

Materials and Methods

The present study comprised radiographic evaluation of 400 condylar heads after visualising 200 digitalised OPGs taken for routine investigation. All OPGs, where condyles were seen evidently were included in the study. The study included radiographs of 99 males and 101 females ranging from the age 18 to 62 years.

Digital OPG’s (taken on Carestream-exposure parameters being: 10 mA, 70 Kx) free of any projection errors, which showed a full condylar view on either side with optimal density and contrast were selected in this retrospective study. The OPG’s of individuals with no history of TMJ dysfunction/occlusal discrepancy/trauma were selected. Most of them belonged to patients who sought treatment for dental caries or periodontal disease. The radiographs were evaluated by two oral radiologists for the formulation of operational definitions. Condylar morphology of four types as identified by Chaudhry et al. namely: Type I - Oval shape, Type II - Diamond shape, Type III - Bird beak shape, Type IV - Crooked finger shape shown in Figure 1.

Results

A total of 400 condyles were analyzed from 200 subjects with ages ranging from 18 to 65 years, out of which 99 were males and 101 were females [Figure 2].

A. Types of shapes seen in Indian population:
1. The following shapes were perceived among the Indian population namely, (i) Oval, (ii) bird beak, (iii) diamond, and (iv) crooked finger
2. The most common shape was found to be oval (60%), followed by bird beak (29%), diamond (9%), and crooked finger (2%)
3. The most common shape observed among both the males and females was the oval where the former was accounted for 61% while the latter 46%
The combination of shapes commonly seen in male and female was oval/oval where the former was accounted for 42% while the latter 58%.

B. The shapes predominant in both genders were determined. As shown in Figure 3, the shapes commonly occurring in both genders 46% of males and 61% of females showed oval shape seemed to be most common.

C. To evaluate the common combination occurring radiographically, the statistics as shown in Figure 4, depicts oval-oval combination was most commonly occurring, whereas crooked finger-crooked finger appearance bilaterally was 1% observed in our study.

**Discussion**

The appearance of mandibular condyle varies greatly among different age groups and individuals. Human mandibular condyles may be categorized into five basic types: Flattened, convex, angled, rounded, and concave. Morphologic changes of condyle occur due to developmental variations, remodeling, various diseases, trauma, endocrine disturbances, and radiation therapy. Among various imaging modalities used for TMJ imaging panoramic radiographs still remains the main screening modality for TMJ abnormalities. Panoramic radiographs 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.\[7\] It is a routine imaging modality utilized by dental surgeons for obtaining general information about the teeth, mandible, and adjacent regions of the jaw. It also yields a favorable cost-benefit relationship and exposes patients to relatively low doses of radiation.\[8\] Panoramic radiographs are not reliable for accurately judging the shape of the mandibular condyle and inadequate for detection of the condylar changes. The appearance of mandibular condyle varies greatly among different age groups and individuals. Human mandibular condyle may be categorized into five basic types: Flattened, convex, angled, rounded, and concave. Morphologic changes of condyle occur due to developmental variations, remodeling, various diseases, trauma, endocrine disturbances, and radiation therapy.

The present study is an attempt to scout the prevalent radiographic shapes of the condylar head on the OPG. Of the 200 pairs of condylar heads evaluated, 60% were oval in shape, followed by bird beak (29%), diamond (9%) and least being crooked finger (2%). This raised a curiosity whether the TMJ followed any typical feature of symmetry. Oval-oval was commonly occurring combination (67%), whereas crooked/crooked finger was a rarity. Again radiographs are two-dimensional depiction of the three-dimensional TMJ. Hence, needs to be viewed at different positional aspect also especially knowing the tilt of the condyle anatomically. Various other modalities have now developed like cone beam volumetric imaging, which can give detailed information of the condyle.

**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.

**References**
