Analysis of Morphological Variation of Condyle Based On Gender- A Digital Panoramic Study

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Abstract

Introduction:

The temporomandibular joint (TMJ) plays a crucial role in various functions. Its morphology varies significantly, influencing both physiological and pathological conditions. Understanding the nuances of condylar morphology is paramount for comprehending the physiological and pathological aspects of the TMJ, and it holds significant implications for various dental and medical disciplines.

Aim- This study aimed to investigate the prevalence of different condylar shapes in a population.

Materials and Methods:

Panoramic radiographs of males and females aged 20-80 were analyzed.. Cohen's K was run to determine if there was agreement between two investigator's classification of the condyle type in 100 patients. During the first examination , There was moderate agreement between the two examiners ($k=.411$, $p<0.01$) on the right side and left side ($k=.513$, $p<0.01$) respectively.During the second examination ,there was fair agreement between the two examiners ($k=.400$, $p<0.01$) on the right side and moderate agreement between the two examiners ($k=.524$, $p<0.01$) on the left side . In retest reliability both the examiners showed excellent agreement for both right and left side.

Results: Round condyles were most prevalent, followed by bird-beak, diamond, and crooked finger. Males exhibited a higher frequency of shape variations compared to females. Inter-observer reliability was moderate to fair.

Conclusion: Males were more likely than females to have changes in the usual shape of the condyles based on gender, with round, bird beak, diamond, and crooked fingers being the most and least prevalent, respectively. In contrast, the female samples had diamond, crooked fingers, spherical bodies, and bird beaks.

Keywords: condyle, Bird Beak, crooked finger, diamond

INTRODUCTION

The temporomandibular joint (TMJ) serves as a pivotal structure in the complex biomechanics of the craniofacial system, playing a crucial role in functions such as mastication, speech, and facial expression.TMJ is a joint on the base of the skull that is situated between the mandibular condyle and the glenoid fossa. The purpose of this joint is to stabilize the stomatognathic system and preserve occlusion. The mandibular and temporal components of the TMJ are made up of the condyles, glenoid fossa, articular eminence, and articular disc, which can continue to remodel long after growth has stopped (1),(2). The anatomy of the TMJ differs throughout individuals and can also differ in shape(2,3). The TMJ's morphology can change due to a number of causes, including pathological processes, functional variations, and occlusal loads. Understanding the nuances of condylar morphology is paramount for comprehending the physiological and pathological aspects of the TMJ, and it holds significant implications for various dental and medical disciplines.

The mandible's growth, which has an upward and backward direction of growth, indicates the key areas of face growth(4). An essential component of the TMJ, the condyle serves as the main hub for mandibular growth. Understanding the morphology of the TMJ is necessary because it provides crucial guidelines for assessing the proper growth and development of the joint. Individual differences in condyle shape are due to developmental variations and the condyle remodeling process, which can lead to pathological abnormalities such as trauma and malocclusion. Disorders of the temporomandibular joint can be diagnosed with the use of condyle morphology research. In addition, due to the TMJ's strong sexual dimorphism, condyle morphology may be helpful in future advancements in forensic odontology(5). This study delves into the analysis of morphological variations of the condyle, specifically examining the influence of gender on its structural characteristics. The advent of digital panoramic imaging has revolutionized the field of craniofacial research, providing high-resolution, three-dimensional representations of the temporomandibular region. Leveraging the capabilities of digital panoramic studies, we aim to explore and quantify the gender-based differences in condylar morphology, shedding light on potential anatomical variations that may have clinical relevance.

Gender-specific differences in craniofacial anatomy have been a subject of increasing interest in recent years, with research indicating that variations extend beyond the superficial features to encompass deeper structures such as the condyle. These differences, if understood comprehensively, could contribute to the refinement of diagnostic and treatment approaches in various dental and medical specialties. Furthermore, a detailed analysis of condylar morphology based on gender could enhance our understanding of the factors influencing craniofacial growth and development. Male condyles are larger than female condyles, according to a 1980 study on the morphology of condyles linked to malocclusion in children. The similar observation was made by Tadej et al., who reported that males' anteroposterior condyles were greater than those of females. There is sexual dimorphism in this. On the other hand, the mediolateral condyle is more susceptible to expansion than the anteroposterior dimension. The condyle's morphological modifications show a strong sexual dimorphism that could aid in the gender identification process(6–8) Changes in condyles are also influenced by hormones. Skeletal growth is significantly influenced by sexual hormones. Periosteal development in males is mediated by androgen hormones.Males have more muscle mass and thicker cortical bone than females due to high amounts of androgen hormones.In contrast, the hormone estrogen has a significant role in maintaining bone health in females." To avoid altering the body, a hormone's level must be at its ideal level. Reduced levels of estrogen in the body might lead to structural alterations in the TMJ. Condyle erosion, a reduction in subchondral bone volume, an increase in TMJ cartilage thickness, and other degenerative changes are among these alterations(9).

Among the extraoral imaging methods that can show the condyles is panoramic radiography. This method has been employed and has the potential to be a diagnostic tool in dentistry as it aids in the diagnosis of jaw conditions(10). Its wide scope area gives a general overview of the teeth, angle, body, condyle, coronoid process, and surrounding issues. Panoramic radiographs can also show abnormalities related to the jaw, such as trauma, fractures, and TMD. This method is recommended over other intraoral and extraoral radiography techniques because it has a number of benefits. These include quick and simple radiography techniques, low radiation doses, and helpfulness for trismus patients who have trouble with intraoral radiography. Furthermore, it is helpful for visualization when presenting cases and educating parents(11–14).

This manuscript presents a systematic investigation utilizing digital panoramic imaging techniques to evaluate condylar morphology in a gender-specific context. By employing advanced digital tools for morphometric analysis, we aim to quantify and qualify the observed variations, providing valuable insights into the potential clinical implications of gender-based differences in condylar anatomy. Ultimately, this research seeks to contribute to the growing body of knowledge in craniofacial science and inform clinical practices for a more personalized approach to patient care.

The purpose of this study was to use panoramic radiography views to gather data regarding gender-based differences in the typical morphology of the condyles.

MATERIALS AND METHOD

The secondary data used in this descriptive observational analysis came from panoramic radiographs of both males and females between the ages of 20 and 80.The condyles were categorized into four forms by these two researchers: The condyle is round, with convex, diamond-like anterior, posterior, and superior surfaces that resemble a bird's beak and crooked finger. Two supervisors made up the observers, who used their eyes to examine the condyles without the use of any instruments. Following condyle observations, the data will be displayed as tables and graphs along with basic statistical computations like mode. After that, spss software was used to process the data.

RESULTS

Based on the results of the above mentioned, it can be concluded that the study's findings are consistent with earlier research, which indicated that crooked fingers are the least common shape and round fingers are the most common. To find out if two investigators' classifications of the condyle type in 100 patients agreed, Cohen's K was calculated.On the right side ($k=.411$, $p<0.01$) and left side ($k=.513$, $p<0.01$) of the first examination, there was moderate agreement between the two examiners.There was moderate agreement between the two examiners ($k=.524$, $p<0.01$) on the left side and fair agreement ($k=.400$, $p<0.01$) on the right side during the second examination. Regarding retest reliability, both examiners demonstrated.There was moderate agreement between the two examiners (k=.524, p<0.01) on the left side and fair agreement (k=.400, p<0.01) on the right side during the second examination. Both examiners demonstrated high agreement for both the left and right sides in terms of retest reliability. **(Figure 1-4)**

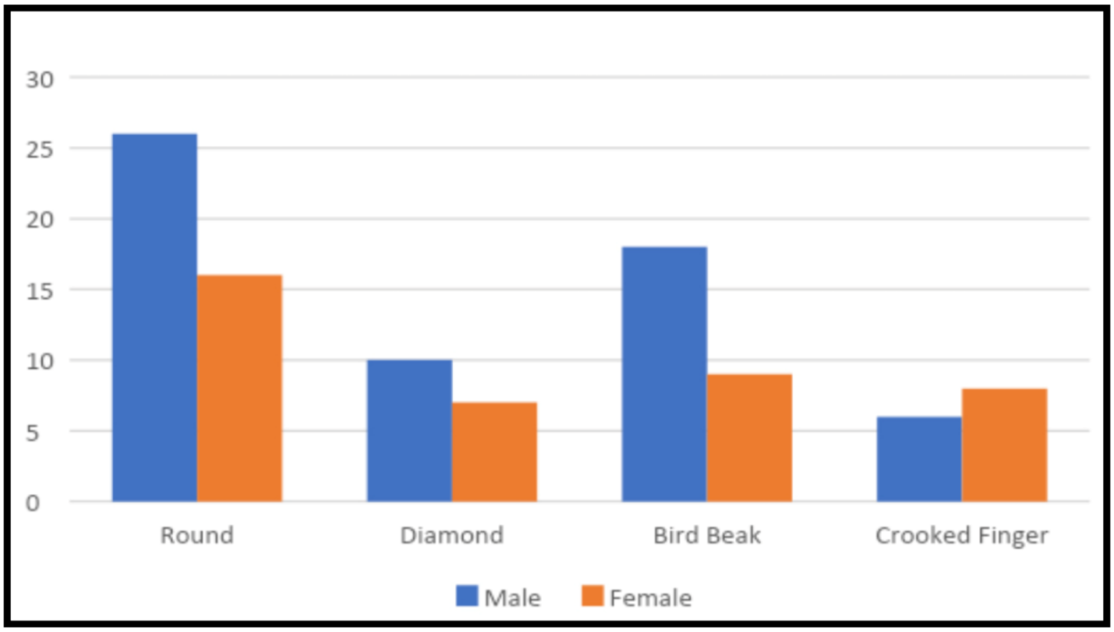

FIGURE 1 illustrates the differences in condylar morphology between males and females.

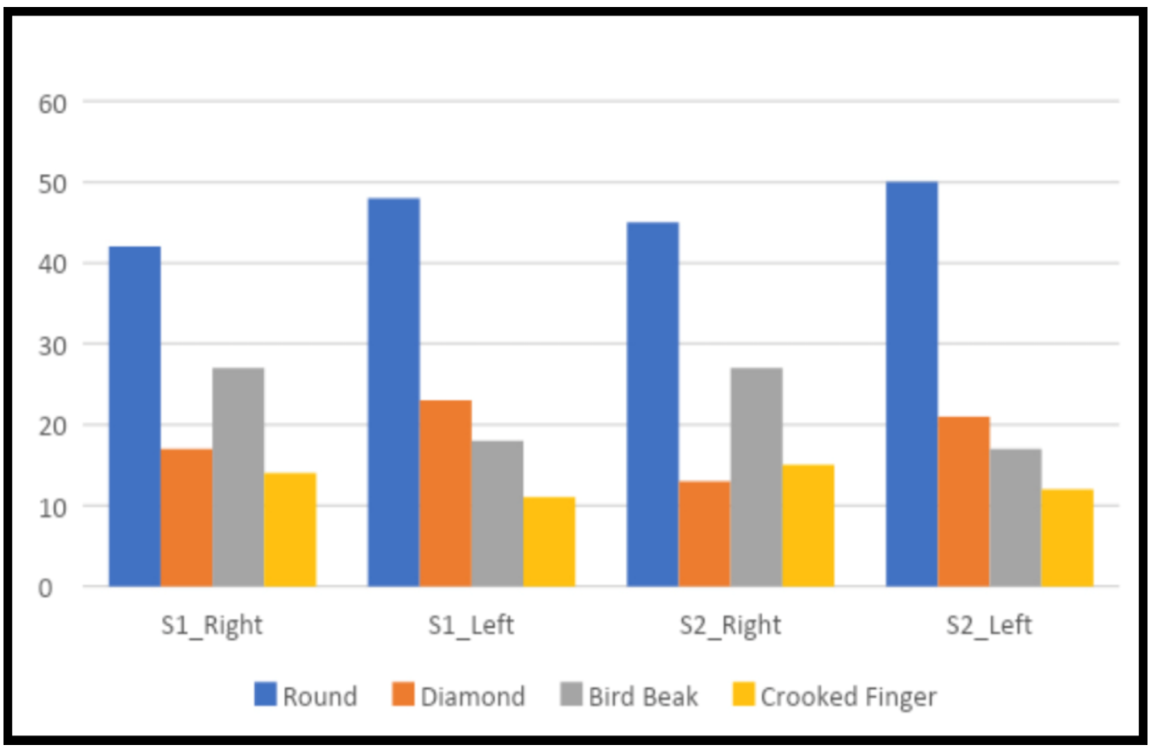

FIGURE 2 depicts the graphical representation provided by Observer 1, showcasing the variation in condylar morphology between the right and left sides.

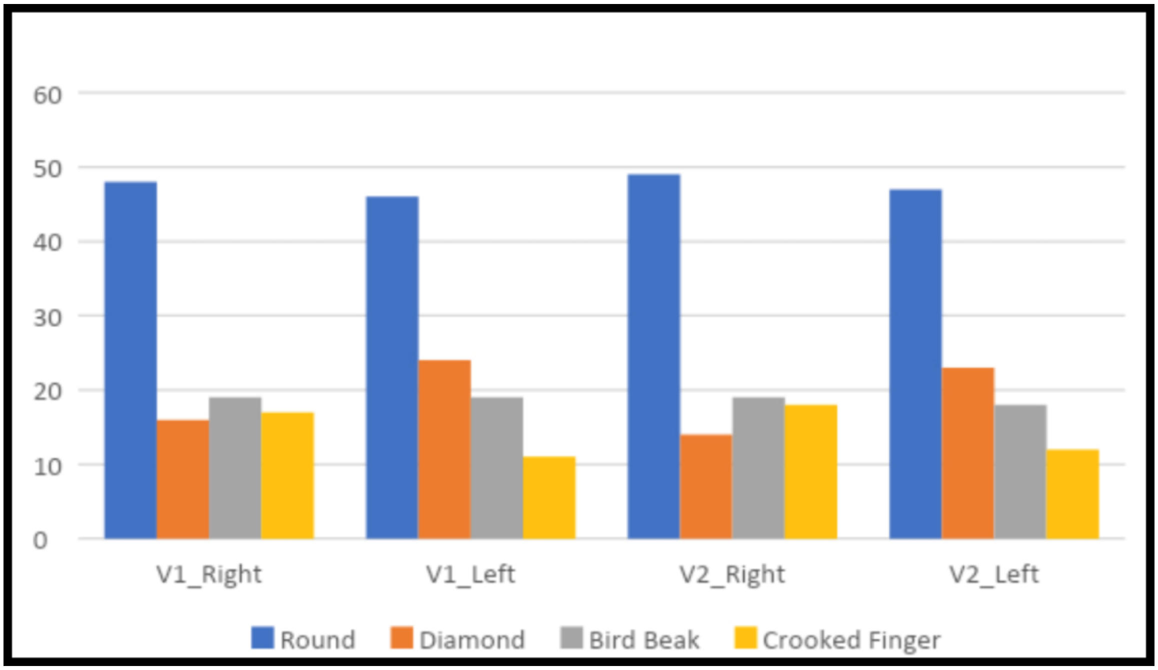

FIGURE 3 depicts the graphical representation provided by Observer 2, showcasing the variation in condylar morphology between the right and left sides.

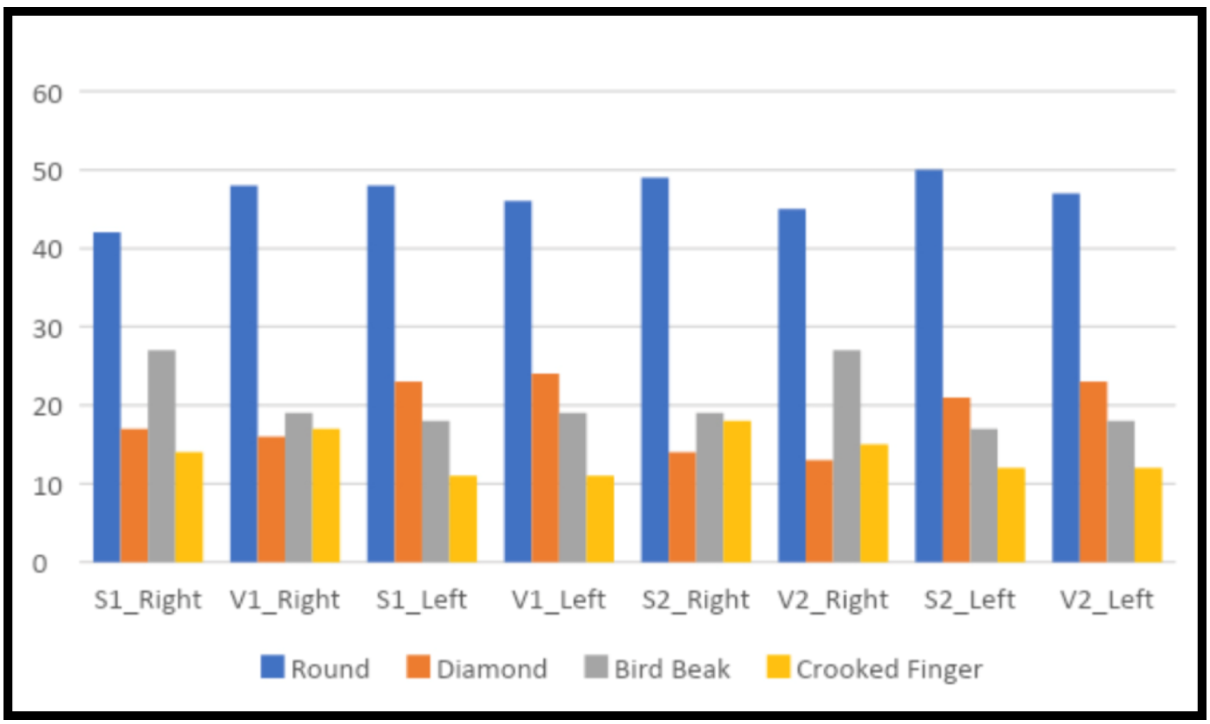

FIGURE 4 represents the association between the observations of the two observers.

Cohen's Kappa:

< 0.20: Poor agreement

0.21–0.40: Fair agreement
0.41–0.60: Moderate agreement
0.61–0.80: Good agreement
0.81–1.00: Very good agreement

DISCUSSION

The results of the study indicate that the usual shape of condyles varies based on previous studies(15,16)(17,18) which indicated that the most common shape was round. However, this variety is more common in men than in women. This assertion aligns with the research carried out by Arayapisit et al. (19). The spherical shape is common, especially in younger individuals. The condyles' forms have evolved over time, becoming more rounded, pointed, and angled.(20,21)The second most common shape is a pointed shape. Males typically have a more dominant round, as has been said before. It is more common to see pointed in women.This is consistent with studies by Arayapisit et al. (2020) . The pointed shape is most commonly seen on the lateral aspect of the condyle (Arayapisit et al., 2020). Gender identification may be aided by the pointed shape's prevalence, which is higher in females than in males.(22–24)The previous studies indicate that a person's right and left side condyles differ from one another. This investigation showed that several male and female participants had different condyles in one jaw. In this study, the frequency of variations between the right and left sides of the condyles was higher in females. The reason for this is that females usually chew in a single direction. The condyles of atypical people may have a distinct form as a result of an imbalance in the jaw's development.Variations in the occlusal load intensity on the right and left sides of the condyle also result in differences between the two sides.

When massaging, people with lower intensity occlusal loads feel less pressure on their condyles. During the masticatory process, people with high intensity occlusal loads will also feel a lot of pressure on their condyles. Condyles on people with high occlusal load intensity are typically bigger and rounder.The left and right condyles' volumes varied between males and females as well. The size of the condyles is larger in males than in females. Additionally, the volume of the right condyle is greater than that of the left.(20)Condyle asymmetry is the difference between the two sides of the condyles.

One of the disadvantages of this study is the paucity of research on condition differences, especially when it comes to the gender variable. A skewed condyle form and subjectivity-based disagreements among observers can also arise via direct observation of the condyles without the use of software, which leaves room for varying opinions.

CONCLUSION

According to this study, variations in the normal shape of the condyles based on gender were observed to differ significantly between males and females. In males, the most commonly observed shapes were ranked in the following order: round, birdbeak, diamond, and crooked finger, with the round shape being the most frequent and the crooked finger shape being the least common. On the other hand, the female samples exhibited a slightly different pattern, with the shapes ranked as round, birdbeak, crooked finger, and diamond. This suggests that while both genders share some similarities in the prevalence of certain shapes, notable differences exist in the order of occurrence, particularly with the diamond and crooked finger shapes, which show contrasting frequencies between males and females.

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CONFLICT OF INTEREST

The author declares that there was no conflict of interest in the present study.

REFERENCES

1. Rozylo-Kalinowska I, Orhan K. Imaging of the Temporomandibular Joint. Springer; 2018. 407 p.
2. Safi Y, Ahsaie MG, Różyło-Kalinowska I, Ansari G, Nasrabadi MT, Fazlalipour M. Atlas of Cone Beam Computed Tomography. John Wiley & Sons; 2022. 468 p.
3. Okawa A, Matsumoto M, Iwasaki M, Kawaguchi Y. OPLL: Ossification of the Posterior Longitudinal Ligament. Springer Nature; 2020. 272 p.
4. Manson-Hing LR. Panoramic Dental Radiography. Charles C. Thomas Publisher; 1980. 232 p.
5. Farah CS, Balasubramaniam R, McCullough MJ. Contemporary Oral Medicine: A Comprehensive Approach to Clinical Practice. Springer; 2019.
6. Jaju PP. Cone Beam Computed Tomography. JP Medical Ltd; 2015. 133 p.
7. Caruso P, Silvestri E, Sconfienza LM. Cone Beam CT and 3D imaging: A Practical Guide. Springer Science & Business Media; 2013. 159 p.
8. Sankaranarayanan R, Wesley RS, International Agency for Research on Cancer. A Practical Manual on Visual Screening for Cervical Neoplasia. International Agency for Research on Cancer; 2003. 49 p.
9. Berger M, Szalewski L, Bakalczuk M, Bakalczuk G, Bakalczuk S, Szkutnik J. Association between estrogen levels and temporomandibular disorders: a systematic literature review. Prz Menopauzalny. 2015 Dec;14(4):260–70.
10. Pertes RA, Gross SG. Clinical Management of Temporomandibular Disorders and Orofacial Pain. Quintessence Publishing (IL); 1995. 392 p.
11. White SC, Pharoah MJ. Oral Radiology - E-Book: Principles and Interpretation. Elsevier Health Sciences; 2014. 697 p.

12. White SC, Pharoah MJ. Oral Radiology: Principles and Interpretation. Mosby; 2009. 641 p.
13. White SC. Oral Radiology: Principles And Interpretation (6Th Edition). 2009. 641 p.
14. Stuart C. White DDS, Michael J. Pharoah DDS. Oral Radiology: Principles and Interpretation. Elsevier Health Sciences; 2013. 697 p.
15. Jawahar A, Maragathavalli G. Analysis of Condylar Morphological Variations Using Digital Panoramic Radiographs-A Retrospective Study. Indian Journal of Public Health Research & Development. 2019;10(11):3450–3.
16. Sridhar M, Dharman° S. Assessment Mandibular Condylar Morphology Using Digital Orthopantomogram Chennai Population. Indian Journal Forensic Medicine & Toxicology. 2020;4(3).
17. Shilpa Syam TNU. Assessment morphological variations Condyle between males females using orthopantomogram : Cross sectional study. Biomedicne. 2019(1):154–8.
18. Swathi KV, Maragathavalli G. Morphometric analysis mandibular angle coronoid process gender determination - retrospective interdisciplinary study. IJBPAS. 2020;9(10):2757–65.
19. Arayapisit T, Ngamsom S, Duangthip P, Wongdit S, Wattanachaisiri S, Joonthongvirat Y, et al. Understanding the mandibular condyle morphology on panoramic images: A cone beam computed tomography comparison study. Cranio. 2023 Jul;41(4):354–61.
20. Sarnat BG, Laskin DM. The Temporomandibular Joint: A Biological Basis for Clinical Practice. 1992. 536 p.
21. DeLisa JA. Gait Analysis in the Science of Rehabilitation. DIANE Publishing; 1998. 129 p.
22. Tecco S, Saccucci M, Nucera R, Polimeni A, Pagnoni M, Cordasco G, et al. Condylar volume and surface in Caucasian young adult subjects. BMC Med Imaging. 2010 Dec 31;10:28.
23. Helms CA, Katzberg RW, Franklin Dolwick M, Radiology Research and Education Foundation. Internal Derangements of the Temporomandibular Joint. 1983. 260 p.
24. Whaites E, Drage N. Essentials of Dental Radiography and Radiology. Elsevier Health Sciences; 2013. 493 p.