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Condylar position and morphology in bilateral partially edentulous patients: a radiographic perspective

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ABSTRACT

Objectives: Tooth loss is a common oral health issue in the general population, with its prevalence increasing significantly with age. Tooth loss that is not immediately rehabilitated with dentures can lead to disruption of the occlusion pattern. This condition may be affected by the position of the condyle, but it can also lead to morphological alterations of the mandibular condyle. If this condition is left untreated for an extended period, these changes can significantly impact the temporomandibular joint (TMJ).

Materials and Methods: The sample used in this study was secondary data from panoramic radiographs of bilateral partially edentulous patients who had high-quality radiograph standards.

Results: The findings of this study demonstrate the alteration in mandibular condyle position, with 57.7% of cases showing anterior position and 13.7% showing retroposition in patients with bilateral partial edentulism. The most dominant condyle morphology distribution was found to be the pointed shape (36.3%), whereas the least was the flat shape (5.7%).

Conclusion: In this study, the results showed that the anterior position and pointed shape were the most common position and morphology of the condyle. The distribution of this position was found to be higher in women than in men, with hormonal, anatomical, and habitual factors influencing the distribution of pressure on the TMJ.

Keywords: *Edentulous, condyle, morphology, panoramic*
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INTRODUCTION

Tooth loss, also known as edentulous, describes the state of losing teeth, which can be either partial or total.[1] According to the World Health Organization criteria, edentulous patients are considered to have physical limitations, disabilities, and impaired functions due to their inability to chew and speak properly.[2] Tooth loss is a common oral health issue in the general population, with its prevalence increasing significantly with age. Based on the 2018 Basic Health Research study conducted in Indonesia, the prevalence of edentulous was recorded as the lowest at 0.1% in the 35-44 age group, increasing to 2.6% in the 55-64 age group, and reaching 9.0% in the 65 years and older age group.[3] Tooth loss that is not immediately rehabilitated with dentures can lead to disruption of the occlusion pattern due to disruption of the continuity of the dental arch within the oral cavity. This loss of occlusion integrity often results in changes in tooth position, inclination, and extrusion of the antagonist teeth, causing an alteration in the occlusion pattern. If this condition is left untreated for an extended period, these changes can significantly impact the temporomandibular joint (TMJ).[4]

The temporomandibular joint (TMJ) is one of the most important joints in the human body, functioning as part of a harmonious stomatognathic system that integrates teeth, masticatory muscles, oral and maxillofacial nerves, and facilitates functional jaw movements. Tooth loss may disrupt the balance of forces and create differential pressure between teeth in contact and those lacking antagonistic contact. If these edentulous areas remain untreated, tooth migration and changes in the position of the mandible can occur vertically and horizontally. As a result, the position of the condyle in the mandibular fossa may also shift.[4] In addition to positional changes, tooth loss can lead to morphological alterations of the mandibular condyle.[5] This condition can contribute to temporomandibular joint disorders, which play a crucial role in mastication, swallowing, and speech. As a result, TMJ dysfunction can have a significant impact on the oral function and quality of life of affected patients.

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Panoramic radiography is widely recognized as a diagnostic imaging modality in dental practice that offers multiple benefits, such as reduced radiation exposure, efficient and simple image acquisition, and affordability.[6] This modality provides a broad overview of the maxillofacial region in a single radiograph, including the temporomandibular joint (TMJ). Edentulous has been closely associated with changes in occlusal patterns, condylar position, and the development of temporomandibular disorders (TMD). TMD encompasses a range of conditions affecting the TMJ, masticatory muscles, and associated structures, often leading to pain, limited mandibular function, and decreased quality of life. Panoramic radiographs play a critical role in this context by offering detailed visualization of the TMJ, allowing for assessment of condylar morphology and positional alignment. This capability makes panoramic radiography an essential tool not only for evaluating the consequences of tooth loss but also for facilitating the early detection and diagnosis of TMD.

MATERIALS AND METHODS

This study is qualitative research with a descriptive observational method to provide data on the position and morphology of the mandibular condyle in bilateral partially edentulous patients. The sample used in this study was secondary data from panoramic radiographs of bilateral partially edentulous patients that had high-quality radiograph standards. The radiographs were collected in 2023 from the Radiology Unit of the Dental and Oral Hospital (RSGM) of Airlangga University. All panoramic radiographs were taken using the Instrumentarium OP 300 panoramic imaging system. The inclusion criteria in this study were panoramic radiographs of bilateral partially edentulous patients with good radiograph quality evaluation, especially with a clear picture of the TMJ structure. The exclusion criteria were panoramic radiographs with loss of all upper and lower jaw teeth, pathological abnormalities in the TMJ structure, a history of maxillofacial trauma, and condylar fractures. This study was ethically approved by the RSGM ethics committee under approval number 23 / UN3.9.3 / Etik / PT / 2024 in July 2024.

The evaluation of the condyle position was performed subjectively by three examiners in the MIH (maximum intercuspidation) using criteria proposed by Menesez et al in 2008, which categorized condylar as follows: (a) retroposition: the condylar peak is located posteriorly to the glenoid fossa, (b) concentric: the condylar peak is centered of the glenoid fossa and (c) anterior position: the condylar peak is located anteriorly to the glenoid fossa.[7] Meanwhile, the condylar morphology was assessed using criteria modified by Arayapisit et al, as follows; (a) round: symmetrical, with smooth and concave anterior, posterior, and superior surfaces, (b) angled: asymmetrical with an acute angle at the posterior surface, (c) pointed: symmetrical, with an acuter angle at the mid-point of the superior surface, (d) flat: smooth with a flattened condylar head from the anterior surface to the posterior surface, (e) irregular: any form other than type a-d.[8]

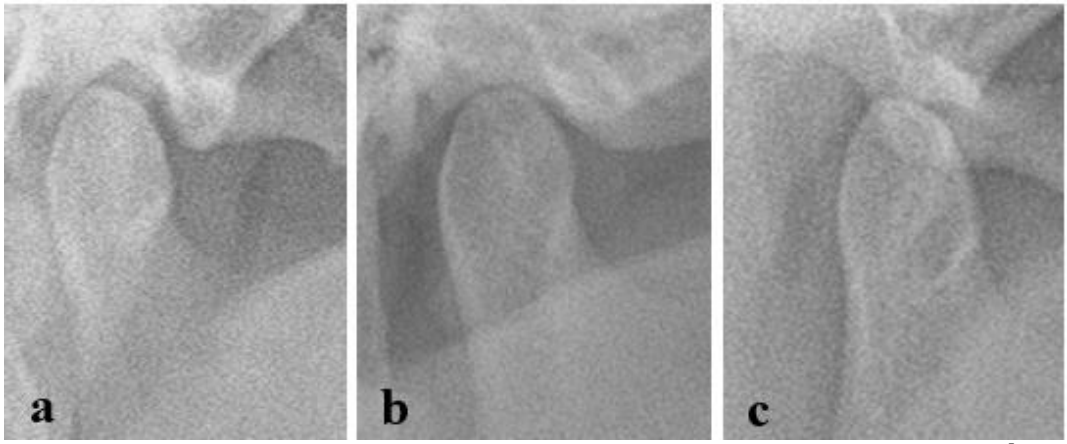

Figure 1. Subjective evaluation of the condyle position by Menesez et al. (a) retroposition; (b) concentric; (c) anterior position.[7]

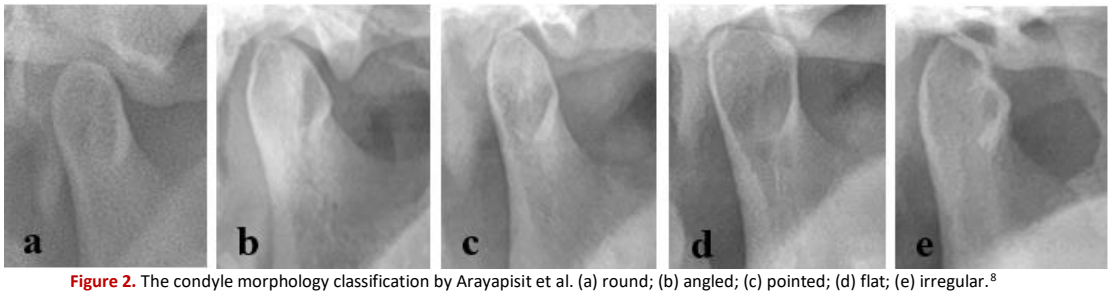

Figure 2. The condyle morphology classification by Arayapisit et al. (a) round; (b) angled; (c) pointed; (d) flat; (e) irregular.[8]

RESULTS

Based on the findings, the anterior position emerged as the most frequently observed condylar position in both male and female subjects, with a total of 224 out of 388 samples. In male subjects, the anterior position was identified in 72 subjects (56.25%), while in female subjects, it was observed in 152 subjects (58.5%). The centric position ranked as the second most prevalent, with 36 subjects (28.12%) in males and 75 subjects (28.8%) in females. Conversely, the retroposition was the least frequently observed condylar position, found in only 20 subjects (15.63%) among males and 33 subjects (12.7%) among females (Table 1). In terms of condylar morphology, the pointed type was the most dominant form, observed in 42 male and 99 female subjects. In contrast, the flat type was the least commonly identified morphology, with only 11 subjects observed in both male and female groups (Table 2).

Table 1. Distribution of condyle position according to sex

	Condyle Position			
Sex	**Retroposition**	**Concentric**	**Anterior Position**	**Total**
Male	20 (15.63)	36 (28.12%)	72 (56.25%)	128 (100%)
Female	33 (12.7%)	75 (28.8%)	152 (58.5%)	260 (100%)
Total	**53 (13.7%)**	**111 (28.6%)**	**224 (57.7%)**	**388**

Table 2. Distribution of condyle morphology according to sex

Sex	**Pointed**	**Round**	**Angled**	**Flat**	**Irreguler**	**Total**
Male	42	37	27	11	11	**128**
Female	99	81	43	11	26	**260**
Total	141	118	70	22	37	**388**

This study utilized Cohen's kappa reliability test to assess the level of inter-rater agreement, providing a measure of consistency in evaluating each category among the observers. Cohen's kappa is a precise statistical tool that adjusts for agreement that could occur by chance, making it more accurate than simple percentage-based agreement measures. The results demonstrated an Almost Perfect Agreement among the observers, with kappa values (κ) ranging from 0.81 to 1.00. This finding indicates an exceptionally high level of concordance among the raters, reflecting minimal variability in their assessments and ensuring the consistency and reliability of the data collection process. The high inter-rater reliability achieved in this study enhances the validity of the findings, affirming the precision of the methodologies employed to evaluate condylar position and morphology. This result is critical in minimizing potential biases and ensuring the reproducibility and scientific integrity of the research outcomes. The results of the Cohen's kappa calculation are presented in Tables 3 and 4.

Table 3. Cohen's kappa analysis for condylar position

Measure of Agreemant		**Kappa**	**Asymptomatic Standart Error**	**Approximate T**	**Significance (p-value)**
Kappa	Right	0.942	0.021	18.215	< 0.001
	Left	0.928	0.024	17.352	< 0.001
N *of Valid Cases*	388				

Table 4. Cohen's kappa analysis for condylar morphology

Measure of Agreemant		**Kappa**	**Asymptomatic Standart Error**	**Approximate T**	**Significance (p-value)**
Kappa	Right	0.827	0.032	21.038	<0.001
	Left	0.826	0.033	20.406	<0.001
N *of Valid Cases*	388				

DISCUSSION

Panoramic radiography is one of the most widely utilized extraoral imaging modalities due to its low radiation dose, cost-effectiveness, non-invasive nature, and minimal preparatory requirements. This imaging technique offers a comprehensive visualization of the dentomaxillofacial structures, including anatomical features of the temporomandibular joint (TMJ), particularly the mandibular condyle, a critical component of the TMJ, which is the object of this study to analyze its position and morphology in bilateral partially edentulous patients.

The findings of this study demonstrate a notable alteration in mandibular condyle position, with 57.7% of cases exhibiting anterior position and 13.7% showing retroposition in patients with bilateral partial edentulism. Bilateral partial edentulism is a condition that disrupts the balance of occlusal load distribution on both sides of the jaw, predominantly due to the absence of posterior

teeth. This loss results in a diminished structural support, critical for maintaining stability during masticatory function. Consequently, the imbalance in occlusal forces impacts mandibular function and the temporomandibular joint (TMJ). A primary outcome of this imbalance is a reduction in vertical occlusal dimension, defined as the vertical distance between the maxilla and mandible, which alters due to the absence of occlusal contact. This reduction compels the mandible to shift anterosuperiorly, leading to changes in mandibular kinematics and pressure distribution within the TMJ. These findings are consistent with previous studies by Ammanna et al. and Amara et al., which demonstrated that posterior tooth loss significantly increases the risk of vertical dimension collapse, thereby compromising the biomechanical stability of the jaw.[9,10]

In this study, the most frequently observed condylar position was the anterior position, found in 224 subjects (57.7%) across both male and female groups. This observation corroborates the findings of Ammanna et al., who reported that anterior displacement is common in patients exhibiting an enlarged posterior joint space.[9] The second most prevalent position was the centric position, identified in 111 subjects (28.6%). The centric position is regarded as the optimal position for the mandibular condyle and is often used as a reference point for assessing positional deviations due to tooth loss, malocclusion, or temporomandibular disorders (TMD). It is more commonly observed in patients with a stable maximum intercuspal position, particularly in those with harmonious occlusion or those who have undergone appropriate prosthodontic rehabilitation, indicating a balanced distribution of occlusal forces in the anterior and posterior joint spaces.[9]

Retroposition or posterior displacement was the least prevalent condylar position in our investigation, accounting for 53 participants (13.7%). The mandibular condyle is posteriorly displaced when the condylar head shifts posteriorly within the glenoid fossa. This shift is typically linked to the loss of posterior teeth, which act as key occlusal support structures. The absence of these teeth reduces vertical occlusal dimension, resulting in higher pressure inside the anterior joint area, forcing the condyle into a posterior position as an adaptive mechanism for redistributing occlusal stresses. In bilateral partly edentulous patients, the loss of posterior teeth frequently results in posterior condylar displacement due to occlusal instability and TMJ imbalance.[9]

In the female population, changes in the condyle position are more common than in men. Not only in retroposition, but also in anterior position, in this study, it was found more in the female population. This difference can be explained by anatomical, hormonal, and functional habit factors. Anatomically, women tend to have smaller TMJ joint sizes, making them more susceptible to biomechanical changes. This condition increases the risk of condyle shift when there is an imbalance in pressure due to tooth loss. Hormonal factors also contribute, because fluctuations in estrogen levels in women affect the soft tissue around the TMJ. Amara et al. stated that low estrogen levels, especially during menopause, weaken the ligaments and supporting tissues of the TMJ, which can trigger condyle shift.[10]

Tooth loss also affects the morphology of the condyle, where, in this study, the most dominant condyle morphology distribution was found to be the pointed shape (36.3%). This follows the research of Varsha et al., which stated that the pointed morphological shape is more common than other shapes.[11] This can be caused by functional adaptation or changes in the morphological structure of the condyle due to tooth loss, which changes the occlusion load and affects the formation of the articular surface of the condyle. This remodeling process is an adaptive response of the temporomandibular joint to ongoing mechanical stress due to occlusion imbalance.[12]

The round shape is the second most common condylar morphology in partial edentulous patients (30.4%). This follows the research of Varsha et al., which stated that the round morphology is more common in partial edentulous patients than the pointed shape. The round condyle is often considered an adaptive shape that describes the process of stabilization of the temporomandibular joint (TMJ) after changes in functional load due to tooth loss. When partial tooth loss occurs, especially if prosthetic rehabilitation is not performed, the masticatory load becomes uneven. In response to this biomechanical stress, the condyle can undergo remodeling, producing a larger and rounder shape to distribute the load more evenly.[13]

The third most common condylar shape, angled, was found in 18% of the total distribution of condylar morphology in this study. The angled shape has an asymmetric angle on the posterior surface of the condyle. Singh et al. stated that the angled shape is most commonly found on the edentulous side. If there is an imbalanced occlusion due to tooth loss on one side, individuals will tend to use a particular side for chewing.[14] This is in accordance with the study of Zheng et al., which stated that tooth loss on one side of the jaw is related to the severity of changes in the shape and surface of the condylar head on the contralateral side.[15] The distribution of irregular condylar morphology was found in 37 (9.5%) samples. Valenzuela et al. stated that irregular condylar shape is a malformation or variation in the temporomandibular joint (TMJ) that can affect the biomechanical function of the area. This condition is often identified as a rare anatomical abnormality but has significant clinical implications for the structure and function of the TMJ.[16] The distribution of condylar morphology is rarely found, namely, the flat shape in this study was only found in 22 (5.7%) of the total samples. This is in accordance with the study of Varsha et al., which states that flat shapes are rarely found in partial edentulous.[11]

The difference in condylar morphology can be associated with differences in the distribution and magnitude of stress on the condyle. In a study by Ahmed et al., it was stated that tooth loss, especially in posterior teeth, can cause changes in the occlusal load that will be received by the temporomandibular joint and will affect the formation of the condylar articular surface.[17] This condylar remodeling process is an adaptive response of the body to continuous mechanical stress due to occlusal imbalance, where the shape and structure of the condyle can change to adjust to changes in function and the load received. Each individual certainly has a different response and adaptation, causing variations in shape between individuals.[12] Bilateral tooth loss in this study significantly affected the distribution of occlusal load on both sides of the jaw. Tooth loss on both sides causes a mastication pattern that tends to decrease in intensity due to occlusal imbalance, which can trigger the remodeling process on the mandibular condyle. Zheng et al. mentioned that bilateral tooth loss causes biomechanical stress that spreads to both sides of the temporomandibular joint (TMJ), resulting in adaptation in the form of condyle morphology, such as pointed and round.[15] In this study, the pointed shape dominates due to functional adaptation of the condyle to reduce the unevenly distributed stress load. Differences were found between patients with bilateral and unilateral tooth loss. Patients with unilateral tooth loss tend to show higher differences in condyle shape compared to bilateral loss.[17] This shows that a more balanced load distribution on both sides of the bilateral jaw provides a more uniform adaptation effect than unilateral, where biomechanical stress is more concentrated on one side. In this study, as many as 28% of samples showed differences in condyle shape on both sides. This is likely due to the patient's habit of chewing on one side that is more dominant, even though tooth loss occurs bilaterally. If this condition is not immediately replaced with prosthetic teeth, it will affect the condyle morphology on the side that is used more often.[18]

CONCLUSION

In this study, the results showed that the anterior position was the most common (57.7%), followed by the concentric position (28.6%), and retroposition as the least common position (13.7%). The distribution of this position was found to be higher in women than in men, with hormonal, anatomical, and habitual factors influencing the distribution of pressure on the TMJ. The morphology of the mandibular condyle in bilateral partially edentulous patients through panoramic radiographic observations was most commonly found to be pointed and round.

Although panoramic radiography does not provide the same level of precision as cone-beam computed tomography (CBCT) for three-dimensional assessment, it remains an essential preliminary imaging modality for evaluating the morphology and position of the mandibular condyle. Its wide availability, relatively low radiation dose, and cost-effectiveness make it highly advantageous for both clinical practice and large-scale epidemiological studies. Furthermore, panoramic radiography offers a broad overview of maxillofacial structures, enabling clinicians to identify potential temporomandibular joint (TMJ) alterations associated with tooth loss. These characteristics make panoramic radiography a practical and reliable imaging modality for population-level screening and long-term evaluation of temporomandibular joint changes related to tooth loss.

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article.

This article does not contain any studies with human or animal subjects performed by the any of the authors.

REFERENCES

1. The Glossary of Prosthodontic Terms. Ninth Edition. J Prosthet Dent. 2017;117(5):C1–e105. doi:10.1016/j.prosdent.2016.12.001
2. Marcus PA, Joshi A, Jones JA, Morgano SM. Complete edentulism and denture use for elders in New England. J Prosthet Dent. 1996;76(3):260–6. doi: 10.1016/S0022-3913(96)90169-9
3. Kementerian Kesehatan Republik Indonesia. Laporan Nasional Riset Kesehatan Dasar 2018. Indonesia: Sekretariat Badan Litbang Kesehatan. 2018
4. Lai S, Damayanti L, Wulansari D. Gangguan sendi temporomandibular akibat ruang edentulous pada usia dewasa muda. Padjadjaran Journal of Dental Researchers and Students 2023; 7(1): 13. https://doi.org/10.24198/pjdrs.v7i1.37693
5. Rodrigues VP, Freitas BV, De Oliveira ICV. Tooth loss and craniofacial factors associated with changes in mandibular condylar morphology. CRANIO® 2019; 37 (5):310–316. DOI:10.1080/08869634.2018.1431591
6. m YG, Lee JS, Park JI, Lim HS, Kim BG, Kim JH. Diagnostic accuracy and reliability of panoramic temporomandibular joint (TMJ) radiography to detect bony lesions in patients with TMJ osteoarthritis. J Dent Sci. 2018;13(4):396–404. doi:10.1016/j.jds.2018.08.006
7. Menezes AV, De Almeida SM, Bóscolo FN, Haiter Neto F, Ambrosano GMB, Manzi FR. Comparison of transcranial radiograph and magnetic resonance imaging in the evaluation of mandibular condyle position. Dento-maxillo-facial Radiology/Dentomaxillofacial Radiology. 2008; 37(5):293–299. https://doi.org/10.1259/dmfr/31850388
8. Arayapisit T, Ngamsom S, Duangthip P, Wongdit S, Wattanachaisiri S, Joonthongvirat Y, Mitrirattanakul S. Understanding the mandibular condyle morphology on panoramic images: A cone beam computed tomography comparison study. CRANIO. 2020;1–9. doi:10.1080/08869634.2020.1857627
9. Ammanna S, Rodrigues A, Shetty N, Shetty K. A tomographic study of the mandibular condyle position in partially edentulous population. The Journal of Contemporary Dental Practice. 2015; 16(1), 68–73. https://doi.org/10.5005/jp-journals-10024-1637
10. Amara R, Sam B, Lita YA. Asimetri ketinggian kondilus dan gejala temporomandibular disorder pada pasien edentulous: studi observasional. Padjadjaran Journal of Dental Researchers and Students. 2023; 7(3), 254. https://doi.org/10.24198/pjdrs.v7i3.48118

11. Varsha KS, Krithika CL, Anuradha G, Yesoda AK. Co-relation of condylar shapes and mandibular dimensions in partially edentulous condition-a retrospective case control cross sectional study. International Journal of Chemical and Biochemical Sciences. 2023; 23(1): 144-9.
12. Rawat P, Saxena D, Srivastava PA, Sharma A, Swarnakar A, Sharma A. Prevalence and severity of temporomandibular joint disorder in partially versus completely edentulous patients: A systematic review. Journal of Indian Prosthodontic Society. 2023; 23(3):218–225. https://doi.org/10.4103/jips.jips_136_23.
13. Prabhat KC, Verma SK, Maheshwari S, Ahmad I, Tariq M. Computed Tomography Evaluation of Craniomandibular Articulation in Class II Division 1 Malocclusion and Class I Normal Occlusion Subjects in North Indian Population. ISRN Dentistry. 2012;2012(1):1–5. https://doi.org/10.5402/2012/312031
14. Singh B, Kumar NR, Balan A, Nishan M, Haris PS, Jinisha M, Denny CD. Evaluation of normal morphology of mandibular condyle: A radiographic survey. Journal of Clinical Imaging Science. 2020; 10(1): 1–16. https://doi.org/10.25259/JCIS_84_2020
15. Zheng H, Shi L, Lu H, Liu Z, Yu M, Wang Y, Wang H. Influence of edentulism on the structure and function of temporomandibular joint. Heliyon. 2023;9(10):e20307. doi:10.1016/j.heliyon.2023.e20307
16. Valenzuela-Fuenzalida JJ, Navarro Kl, Urbina P, Trujillo-Riveros M, Nova-Baeza P, Orellana-Donoso M, Rodriguez-Luengo M, Beccerra FA, Sanchis-Gimeno JA. Prevalence of the Bifid Mandibular Condyle and Its Relationship with Pathologies of the Temporomandibular Joint: A Systematic Review and Meta-Analysis.Diagnostics. 2023; 13(20):3282. https://doi.org/10.3390/diagnostics13203282
17. Ahmed TH, Kheder K, Shekhani FH. A Panoramic Study of the Dissimilar Morphology of Mandibular Condyle in a Sample of Population in Erbil City. ARC Journal of Dental Science. 2021; 6(2):1-5. http://dx.doi.org/10.20431/2456-0030.0602001
18. Song J, Cheng M, Qian Y, Chu F. Cone-beam CT evaluation of temporomandibular joint in permanent dentition according to Angle's classification. Oral Radiology. 2020; 36: 261-266. https://doi.org/10.1007/s11282-019-00403-3