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Description of the shape and position of the condyles in Kennedy classification class I, II, III, and IV patients through panoramic radiography

(At RSUD Ulin and RSGM Gusti Hasan Aman Banjarmasin from January 2018—January 2024)

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ABSTRACT

Objectives: Tooth loss occurs when the tooth detaches from the socket. Cases of partial tooth loss can cause differences in the shape and position of the condyles. This study aimed to know the description of the frequency distribution of normal and abnormal condyle shapes and positions in Kennedy classification case patients class I, II, III, IV.

Materials and Methods: This research used a cross-sectional descriptive approach. The sample used secondary data from 120 digital panoramic radiographic photos of patients aged 30-70 from January 2018 to January 2024 at Ulin Hospital and Gusti Hasan Aman Hospital Banjarmasin.

Results: Based on the research results at RSUD Ulin and RSGM Gusti Hasan Aman Banjarmasin, the round shape was the most common condyle shape found in patients with Kennedy classification, with most condyle positions pointing to the anterior. The change in the shape and position of the condyle becomes pathological due to the long-term loss of part of the tooth.

Conclusion: The frequency distribution of the shape and position of the condyle of patients with Kennedy classification class I, II, III, IV was the round shape as the most common condyle shape experienced by patients which is one of the normal condyles shapes, and an abnormal position of TMJ condition pointing anteriorly.

Keywords: *Edentulous, tooth loss, condyle, shape, position, temporomandibular joint*
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INTRODUCTION

Tooth loss is a condition where a tooth is detached from its socket. Tooth loss is one of the dental and oral health problems that is often found in society. This can interfere with speech, chewing, aesthetics, and social relationships. Based on WHO data in 2023, the estimated global prevalence of tooth loss is almost 7% among people aged 20 years or older, while those aged 60 years or older have a more than 23% prevalence. The results of the Basic Health Research (RISKESDAS) in 2018 stated that the prevalence of tooth loss in Indonesia was 19% of the total population. Partial tooth loss in South Kalimantan was 17.8%, while in Banjarmasin, 14.10% of the total population.[1–4]

Tooth loss is divided into two types, namely partial tooth loss and complete tooth loss. Partial tooth loss has another name, partial edentulous, a condition where one or more teeth are lost but not completely lost in the part of the dental arch called the edentulous space and is classified by Kennedy's classification class I, II, III, and IV. Complete tooth loss is when both jaw arches no longer have teeth. This tooth loss can interfere with the balance of the arrangement of the teeth and the jaw arch, which disrupts functional activities. The loss of one or more teeth can cause differences in the shape and position of the condyle.[5–8]

The shape of the condyle in the TMJ has two types of shapes: normal and pathological. The condyle's normal shape has five types: round, crooked finger, pointed, angled, and flat. Condyles with pathological shapes are divided into flattening, sclerosis, osteophyte, and erosion. The pathological shape of this condyle is because the mandibular condyle gets a huge load when the mandible functions. This causes adaptive and generative changes. The occurrence of this shape change causes a clicking sound in the TMJ. The correct condyle position is in the mandible's central fossa and shows centric occlusion, affecting the TMJ's physiological function. Condylar dislocation is distinguished based on the location of the condyle relative to the articular fossa of the temporal bone, namely anterior, posterior, superior, and lateral

dislocations, each of which can be caused by trauma.[6,9,10]

Temporomandibular conditions can be seen using two-dimensional radiography techniques: panoramic, transcranial, trans pharyngeal (intracranial), and tomography. Among these radiography techniques, panoramic radiography is a two-dimensional technique widely used in dental practice to examine TMJ disorders. The shape and position of the abnormal or changed condyle can be seen using panoramic radiography. All parts of the tooth structure, including the supporting tissues of the jaw, including the condyle, can be seen from the results of the panoramic radiography examination images. Changes in the shape and position of the condyle caused by tooth loss can cause occlusion misalignment. Occlusion misalignment can cause excessive pressure on the temporomandibular joint, which triggers a shift in the position of the condyle to a pathological or abnormal state. Loss of some teeth often causes changes in occlusion which cause changes in occlusion which trigger temporomandibular disorder (TMD).[5,7–9]

Temporomandibular joint disorders (TMD) are disorders that occur in the neuromuscular and musculoskeletal caused by a misalignment between the components of the stomatognathic system, teeth, and surrounding tissues that cause various disorders such as pain in the TMJ and the complex tissues around it, namely muscles, blood vessels, nerves, ligaments, tendons, fibrocartilage, and synovial fluid. Another characteristic of temporomandibular dysfunction is pain in the face, which is called myofascial. This occurs due to occlusal misalignment when chewing food.[5,10,11]

Temporomandibular joint disorders are orofacial disorders that humans often suffer because the symptoms are uncertain and can disappear. Damayanti et al. (2023) stated that the epidemiological prevalence of TMD is that 40-75% of the general population is likely to experience at least one symptom of TMD, but only 3-7% are reported to have received treatment, with the largest number being adults to middle-aged individuals ranging from 20-45 years old and generally female. The prevalence of TMD in women is greater than in men because women tend to have complex physiological characteristics and hormonal variations, such as the hormone estrogen. Najma et al. (2014) stated that 59 out of 100 patients in the dental clinic of Ulin Hospital, Banjarmasin, had TMD disorders. The percentage of TMD according to gender in patients who came to the dental clinic of Ulin Hospital was 41% in men, while female patients were 59%. [5,10,11]

Ulin Banjarmasin Regional General Hospital is a class A teaching hospital in Banjarmasin City, South Kalimantan. This hospital has complete medical facilities and is the largest referral hospital in South Kalimantan and Central Kalimantan. One of Ulin Regional Hospital's facilities is a dental X-ray, located in the radiology installation section of Ulin Banjarmasin Regional Hospital. Gusti Hasan Aman Dental and Oral Hospital is a regional hospital that provides dental and oral health services using modern and the best technology and has superior human resources. Gusti Hasan Aman Hospital is a pioneer of the leading teaching hospital licensed as a teaching hospital with facilities for education, research, and community service.[5,11–13]

This study aimed to determine the shape and position of the condyle in Kennedy class I, II, III, and IV patients using panoramic radiography at Ulin Regional Hospital and Gusti Hasan Aman Banjarmasin General Hospital. This research focused on Kennedy classes I, II, III, and IV so the specification of changes from edentulous teeth can be identified.

MATERIALS AND METHODS

The type of research design used is descriptive research with a cross-sectional design obtained from secondary data from patient examinations using panoramic radiography techniques at the radiology installation of Ulin Hospital and Gusti Hasan Aman Banjarmasin Hospital. Descriptive research is a method used to see a picture of a phenomenon that occurs in a specific population without treating the variables.[14,15]

A cross-sectional design is used to conduct research, and data collection and analysis are carried out only once during one study. Descriptive research is a cross-sectional approach to conduct descriptions without in-depth analysis.[14,16]

The following are the inclusion criteria in this study: partially edentulous panoramic radiograph of the upper and lower jaw with Kennedy classification class I, II, III, IV period January 2018–January 2024 with good quality evaluation, panoramic radiographs with patients aged 30-70 years, complete patient data in the form of name and age, anatomical landmarks such as the inferior and posterior borders of the mandible, as well as the condyle area are visible. Here are the exclusion criteria in this study: panoramic radiograph in the presence of a fracture of the lower jaw, panoramic radiograph in the presence of diseases affecting the mandible such as odontogenic cysts, odontogenic and non-odontogenic tumors, osteomyelitis, ankylosis/hypoplasia/hyperplasia of the temporomandibular joint.

This type of research is descriptive with a cross-sectional design. Sampling used a purposive sampling technique. This research has received ethical approval from the ULM Banjarmasin Faculty of Dentistry Health Research Ethics Committee with No. 145/KEPKG-FKGULM/EC/XI/2023. The population of this study consisted of patient data and panoramic radiographs with Kennedy classification at Ulin Regional General Hospital and Gusti Hasan Aman Banjarmasin General Hospital taken in the period January 2018-January 2024.

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with good quality evaluation, panoramic radiographs with patients aged 30-70 years, complete patient data in the form of name and age, anatomical landmarks such as the inferior and posterior borders of the mandible, as well as the condyle area are visible. Here are the exclusion criteria in this study: panoramic radiograph in the presence of a fracture of the lower jaw, panoramic radiograph in the presence of diseases affecting the mandible such as odontogenic cysts, odontogenic and non-odontogenic tumors, osteomyelitis, ankylosis/hypoplasia/hyperplasia of the temporomandibular joint.

The sampling technique used in this study was the non-random sampling method (non-probability sampling) with the purposive sampling method, namely the sample selected for the study based on inclusion and exclusion criteria. The sample size in this study was 120 samples. The variables studied in this study were the shape and position of the condyle from the results of panoramic radiographs in patients with partial tooth loss classified based on Kennedy's classification class I, II, III, IV. This study did not use independent or dependent variables because there was no proof of the hypothesis regarding the relationship or strength of one variable to another. The data that had been collected was then processed and analyzed—data processing using the MS Excel application (Microsoft Office Excel). The data analysis used in this study was descriptive statistical analysis.

RESULTS

The description of the condyle shape of Kennedy classification patients from panoramic radiography results at Ulin Banjarmasin Hospital and Gusti Hasan Aman Banjarmasin General Hospital from January 2018-January 2024 on the right and left sides can be seen in Table 1. Namely, Kennedy classification class I has a round shape with 20 condyle shapes (33.3%), and the majority in class I-II have eight condyle shapes. Kennedy classification class II has the most round shapes with 22 condyle shapes (36.7%). The majority in classes II-I and II-II have the same number of eight condyle shapes. Kennedy classification class III has the most round shapes, with 28 condyle shapes (46.7%), and the majority in class III-III has 11 condyle shapes. Kennedy classification class IV has the most round shapes with 22 condyle shapes (36.7%). The majority in classes IV-II and IV-III have the same number of eight condyle shapes. The most common condylar shape on the right and left sides were round, with a total of 92 condylar shapes (38.3%) from a total of 240 condylar shapes from 120 patients, the majority of which were class III with a total of 28 patients (46.7%). This research was observed by a Dentomaxillofacial Radiology Specialist with several repetitions in the calculations.

The description of the condyle position of Kennedy classification patients from panoramic radiography at Ulin Banjarmasin Hospital and Gusti Hasan Aman Banjarmasin General Hospital for the

Table 1. Description of the Condyle Shape of Kennedy Classification Patients Class I, II, III, IV Period January 2018-January 2024 Right and Left Sides

Kennedy Classification		n	Condyle Shape									Total
Upper	Lower		Right and Left Side									
Class			R	A	P	C	F	O	E	FG	S	
	I	20	6	0	3	0	3	0	0	3	5	20
I	II	20	8	0	1	0	0	0	0	9	2	20
	III	20	6	3	3	0	1	0	1	5	1	20
Total		**60**	**20**	**3**	**7**	**-**	**4**	**-**	**1**	**17**	**8**	**60**
%		**100**	**33,3**	**5**	**11,7**	**0**	**6,7**	**0**	**1,7**	**28,3**	**13,3**	**100**
	I	20	8	1	0	0	1	1	0	6	3	20
II	II	20	8	0	2	0	2	2	0	2	4	20
	III	20	6	0	1	1	1	3	0	5	3	20
Total		**60**	**22**	**1**	**3**	**1**	**4**	**6**	**-**	**13**	**10**	**60**
%		**100**	**36,7**	**1,7**	**5**	**1,7**	**6,7**	**10**	**0**	**21,7**	**16,7**	**100**
	I	20	8	0	0	0	3	0	1	5	3	20
III	II	20	9	1	0	0	2	0	0	7	1	20
	III	20	11	0	1	0	3	1	0	4	0	20
Total		**60**	**28**	**1**	**1**	**-**	**8**	**1**	**1**	**16**	**4**	**60**
%		**100**	**46,7**	**1,7**	**1,7**	**0**	**13,3**	**1,7**	**1,7**	**26,7**	**6,7**	**100**
	I	20	6	2	4	0	2	2	2	2	0	20
IV	II	20	8	0	2	0	3	2	0	2	3	20
	III	20	8	1	1	3	1	3	0	1	2	20
Total		**60**	**22**	**3**	**7**	**3**	**6**	**7**	**2**	**5**	**5**	**60**
%		**100**	**36,7**	**5**	**11,7**	**5**	**10**	**11,7**	**3,3**	**8,3**	**8,3**	**100**
Amount		240	92	8	18	4	22	14	4	51	27	240
Percentage (%)		100	38,3	3,3	7,5	1,7	9,2	5,8	1,7	21,3	11,3	100

*Notes: R: Round; A: Angled; P: Pointed; C: Crocked Finger; F: Flat; O: Osteophyte; E: Erosion; FG: Flattening; S: Sclerosis

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Table 2. Condylar Position of Kennedy Classification Patients Class I, II, III, IV Period January 2018-January 2024 Right and Left Side

Kennedy Classification		n	Condyle Position				
Upper Class	Lower Class		Right and Left Side				
				Abnormal Position			Total
			Normal	Heading to the Anterior	Heading to the Posterior	Heading to the Superior	
I	I	20	6	8	5	1	20
	II	20	4	11	1	4	20
	III	20	3	11	3	3	20
Total		**60**	**13**	**30**	**9**	**8**	**60**
Percentage (%)		**100**	**21,7**	**50**	**15**	**13,3**	**100**
II	I	20	2	12	5	1	20
	II	20	0	12	7	1	20
	III	20	1	13	2	4	20
Total		**60**	**3**	**37**	**14**	**6**	**60**
Percentage (%)		**100**	**5**	**61,7**	**23,3**	**10**	**100**
III	I	20	3	2	13	2	20
	II	20	4	5	10	1	20
	III	20	4	9	7	0	20
Total		**60**	**11**	**16**	**30**	**3**	**60**
Percentage (%)		**100**	**18,3**	**26,7**	**50**	**5**	**100**
IV	I	20	2	10	8	0	20
	II	20	4	7	7	2	20
	III	20	2	10	6	2	20
Total		**60**	**8**	**27**	**21**	**4**	**60**
Percentage (%)		**100**	**13,3**	**45**	**35**	**6,7**	**100**
Total		240	35	110	74	21	240
Percentage (%)		100	14,6	45,8	30,8	8,8	100

period January 2018-January 2024 on the right and left sides can be seen in Table 2, namely, Kennedy classification class I with the most condyle positions being in an abnormal position leading to the anterior with a total of 30 condyle bones (50%) the majority being in class I-II and I-III with each class having the same number of 11 condyle bones. Kennedy classification class II has the most condyle positions, being in an abnormal position leading to the anterior, with 37 condyle bones (61.7%), the majority being in class II-III, with 13 condyle bones. Kennedy classification class III has the most condyle positions, being in an abnormal position leading to the posterior with 30 condyle bones (50%), the majority being in class III-I with a total of 13 condyle bones. Kennedy Classification Class IV, with the most condylar positions, is in an abnormal position that leads to the anterior with 27 condylar bones (45%). The majority are in classes IV-I and IV-III. Each class has the same number of 10 condylar bones. The most significant number of right and left condylar positions of all classes (I, II, III, IV) is an abnormal condylar position that leads to the anterior, with a total of 110 condylar bones (45.8%) of the total 240 condylar bones observed, the majority are in class II with a total of 37 condylar bones (61.7%) whose position is abnormally leading to the anterior.

DISCUSSION

Most of the condyle shapes of Kennedy class I, II, III, and IV patients through panoramic radiography examination results at Ulin Hospital and Gusti Hasan Aman Banjarmasin General Hospital are round with 92 (38.3%). The second most common shape is flattening, with 51 (21.3%) from a population of 120 patients with a total of 240 condyles observed. In contrast, the least common shapes are crooked fingers and erosion, each with four (1.7%). Changes in the condyle change significantly during growth. Variations in the shape of the condyle can occur because the condyle can adjust to the shape of the glenoid fossa during its development.[6,17–20]

The round shape is the most common condylar shape found in Kennedy class I, II, III, and IV patients through panoramic radiography results at Ulin Banjarmasin Hospital and Gusti Hasan Aman General Hospital. Based on previous studies, namely Gupta et al., as much as 79%, Khanal 63.6%, Maqbool et al. 60.6%, and Sonal et al. 60%. This can be caused by the loss of occlusal contact or an imbalance in the patient's occlusion, which disturbs the stability of the jaw arch and increases the occurrence of degenerative disorders.[14,16,18,19,21–23] The changes in the shape of the condyle are due to the patient losing some teeth for a long period, allowing for increased morphological remodeling of the TMJ skeletal structure. This follows previous research, which states that abnormalities in the TMJ can cause several changes to the surface of the condyle.[17–19,21,23–27]

The changes in the condyle shape are due to the patient losing some teeth for an extended

period, allowing for increased morphological remodeling of the TMJ skeletal structure. This follows previous research, which states that abnormalities in the TMJ can cause several changes to the surface of the condyle.[22,26–29]

The occurrence of abnormal condylar changes is caused by each patient experiencing a different development process and having bad habits, which trigger abnormal condylar changes. In this study, the most common abnormal condylar change was flattening. Flattening is caused by the patient experiencing partial tooth loss and causing the patient to chew more with one side so that one side changes shape to become pathological. Excess joint load causes the condylar to change shape by increasing the surface area of the condylar in contact with the articular surface so that the load received is lighter.[22,28,29]

Diernberger et al. (2008) stated that more than 45% of the general population has a habit of chewing on one side. Some are more comfortable chewing unilaterally because of a cavity that hurts, a tooth that hurts when chewing, habits, tooth loss, and others. Bad habits of chewing on one side can cause unbalanced occlusal fatigue, changes in the occlusal plane, mandibular deviation when closing and opening the mouth, changes in bone structure, decreased temporomandibular joint function, headaches, and affect hard tissue, tooth-supporting tissue such as alveolar bone, periodontal ligament, gingiva or other oral mucosa. These conditions can result in excessive biomechanical pressure distribution on one side of the joint only if left untreated and unbalanced remodeling occurs, which will cause damage to the condyle.[22,30–32]

The condyle position in Kennedy class I, II, III, IV patients through panoramic radiography results at Ulin Hospital and Gusti Hasan Aman Banjarmasin General Hospital is mostly directed anteriorly, namely 110 (45.8%) and the second most directed posteriorly as many as 74 (30.8%) while the condyle position in Kennedy class I, II, III, IV patients is least directed superiorly, namely 21 (8.8%). The normal position of the mandibular condyle is in the glenoid fossa, but there are several variations in the position of the condyle, namely directed posteriorly, anteriorly, superiorly, and interiorly. This is because the condyle can adjust to the shape of the glenoid fossa during its development. Asymptomatic joints can experience disc shifting; therefore, variations in the normal condyle position can be found. However, joints with disc positions that do not shift (normal) can be found to have variations in the position of the condyle. [8,9,17,20] The second most common condyle position on panoramic radiographs is posterior. This is indicated by the anterior space being wider than the posterior space and the posterior space being narrower. Normal development of the ramus and condyle of the mandible can cause the adult mandible to move downward and forward, causing facial movement in the anterior and posterior directions. Kurita et al. (2001) where, in their study on patients with internal derangement with reduction, showed a tendency for the condyle to shift more posteriorly.[8,33,34]

The condyle is located above the narrow neck of the mandible, 15 to 20 mm from side to side and eight to 10 mm from front to back. According to Rosado et al. (2021), there is a significant decrease in bone volume in the glenoid fossa in edentulous patients. Further investigations conducted by Chen et al. (2022) revealed that tooth loss, even unilaterally, can cause a decrease in condylar bone volume in an in vivo experimental model. Therefore, the duration of tooth loss can affect changes in the morphology of the condylar process and its position in the TMJ.[17,28,33–36]

The weakness of this research is that the Data used is secondary data. The hope for the future is to use primary data. Then, the data can give the best results from anamnesis and physical examinations in the patients to evaluate the correlation of edentulous teeth in Kennedy classification with habit from patients and many causes that can be a risk factor for TMD.

CONCLUSION

Based on the research that has been done, the conclusion in the frequency distribution of the shape and position of the condyle of patients with Kennedy classification class I, II, III, IV was the round shape as the most common condyle shape experienced by patients which is one of the normal condyles shapes, and an abnormal position of TMJ condition pointing anteriorly. The existence of variations or changes in the shape and position of the condyle can be caused by the loss of some teeth for too long a period, increasing morphological remodeling of the TMJ skeletal structure, especially the glenoid fossa.

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article. . This research has received ethical approval from the ULM Banjarmasin Faculty of Dentistry Health Research Ethics Committee with No. 145/KEPKG-FKGULM/EC/XI/2023. All procedures conducted were in accordance with the ethical standards.

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