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Linear measurement of condyles in edentulous patients with Kennedy classification based on panoramic radiographs

(Study at Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital Banjarmasin)

ABSTRACT

Objectives: This research is aimed to determine the value of linear measurement of the condyle position in partial edentulous patients of Kennedy classification based on panoramic radiographs at Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital.

Materials and Methods: This research is a descriptive-analytic study with a cross-sectional study design. The population used in the study is a digital panoramic radiograph from the Radiology Installation of Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital from January 2018 - January 2024 database. Condyle linear measurement landmarks used are anterior joint space, superior joint space, and posterior joint space, according to the research of Ikeda and Kawamura (2013).

Results: The results showed that the largest AJS value is the Kennedy Class I and the smallest is the Kennedy Class IV. The largest SJS value is the Kennedy class III and the smallest is the Kennedy class IV. The largest PJS value is Kennedy class II and the smallest is Kennedy class I. Based on gender, men's joint space value is bigger than women's. However, a significant difference was found in the PJS value of Kennedy class I patients, whose value for men is smaller than that of women.

Conclusion: The condyle linear measurement of partially edentulous patients based on Kennedy classification Class I, II, III, IV has an abnormal condyle position and has experienced disc displacement with reduction.

Keywords: *Condyle, linear measurement, Kennedy classification, partial edentuolous, joint space*
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INTRODUCTION

Tooth loss is a condition where teeth are removed, which forms a space in the oral cavity called the edentulous space. [1,2] The data from Riskesdas 2018 stated that the proportion of the Indonesian population who experienced partial tooth loss was 19%.[3] The cause of tooth loss is partly due to various factors, including tooth loss due to periodontal disease, caries, trauma, indications for prosthodontics and orthodontics, impaction, supernumerary teeth, hypoplasia, neoplastic and cystic lesions, as well as various other systemic diseases.[4]

Kennedy classified tooth loss into four classes based on the relationship of the edentulous space to the supporting teeth. The Kennedy classification is widely used in dental practice due to its ease of application and direct visualization of partial tooth loss.[1] The four classes in the Kennedy classification include class I (bilateral free-end), class II (unilateral free-end), class III (unilateral edentulous area with natural teeth both anterior and posterior to it), and class IV (single, bilateral edentulous area located anterior to the remaining natural teeth).[4,5]

Loss of teeth in the oral cavity can result in occlusion imbalance which disturbs the stomatognathic system. The imbalance of occlusion load that occurs continuously on one or both sides of the temporomandibular joint can cause changes in the position of the mandible vertically and horizontally so the position of the condyle in the glenoid fossa also changes. Masticatory component changes can affect the temporomandibular joint structure, which can cause Temporomandibular Joint Disorder (TMD).[6–8]

According to Basic Health Research 2018, it shows that cases of partial tooth loss in South Kalimantan province had a proportion of 17.8%.[3] The most frequent cases of partial tooth loss at RSGM Gusti Hasan Aman Banjarmasin are partial tooth loss with Kennedy class III classification, both mandible and maxilla. This results in the loss of class III teeth in the Kennedy classification, becoming one of the most common dental diseases at RSGM Gusti Hasan Aman Banjarmasin.[9] In a study conducted at Ulin General Hospital, Banjarmasin, by Shofi N et al., it was stated that

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cases of temporomandibular joint disorder based on the etiology of functional disorders had a percentage of 100%. Functional disorders occur due to malocclusion, chewing muscle disorders or one-sided chewing habits, and dental disorders accompanied by chewing muscle disorders.[10]

Panoramic radiography examination has been widely used in dentistry because of its relatively affordable cost and low radiation dose. Panoramic radiography can provide a clear picture of the structure of the articular eminence, glenoid fossa, and condyle head. Changes in the position of the condyles indicate TMD, which is related to disc displacement in the TMJ. Displacement of the disc position causes a change in the position of the condyle in the glenoid fossa.[11]

Radiographically, the position of the condyle in the glenoid fossa can be identified by measuring the joint space. The joint space is a radiolucent zone between the condyle and glenoid fossa containing the articular disc. Joint space measurements via panoramic radiography can be done using linear measurements based on Ikeda and Kawamura's research. Linear measurement measures the anterior, superior, and posterior joint space of the mandibular condyle.[12,13] Based on the background above, researchers are interested in research to determine the results of linear measurements on the condyles of edentulous patients classified as Kennedy class I, II, III, IV based on panoramic radiography at Ulin General Hospital and Gusti Hasan Aman Hospital, Banjarmasin.

MATERIALS AND METHODS

The research design used in this research is descriptive-analytical research with a cross-sectional research design. The population in this study is secondary data archives of panoramic radiography recorded at the radiology installation of Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital Banjarmasin from January 2018 to January 2024. The sampling technique used in this study was non-probability sampling with a purposive sampling method. The sample from this research is archived secondary data from panoramic radiography photos of edentulous patients classified as Kennedy class I, II, III, IV, which were recorded at the radiology installation at Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital Banjarmasin for the period January 2018 January 2024.

The sample inclusion criteria in this study were panoramic radiographs with complete data on patients aged 30-70 years, panoramic radiographs of patients with partially edentulous upper and lower jaws based on the Kennedy classification class I, II, III, IV aged 30-70 years, panoramic radiograph with a good quality evaluation, and panoramic radiograph with the head of the condyle located in the glenoid fossa. The research was conducted at Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital Banjarmasin from November 2023 to January 2024.

The data collection procedure was obtained by screening to determine which samples were taken according to the inclusion criteria or exclusion. Samples that meet the criteria are continued with measurements using ImageJ software. Linear measurements were based on the method in Ikeda and Kawamura's research. The landmarks used are the anterior joint space (AJS), superior joint space (SJS), and posterior joint space (PJS). Measurements are made by determining the highest point of the condyle head (SC) and closest to the glenoid fossa (SS). A vertical line is drawn from point S to the deepest point in the glenoid fossa. The vertical line length shows the superior joint space (SJS). Next, draw a line from the deepest point of the glenoid fossa tangent to the most anterior point (AC) of the condyle head and draw a line from the deepest point of the glenoid fossa tangent to the most posterior point (PC) of the condyle head. Anterior

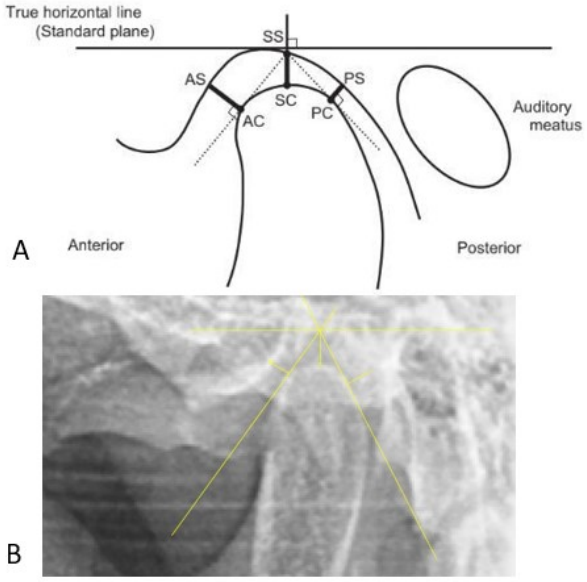

Figure 1. (A) Landmark of Condyle Linear Measurement[12], (B) Linear Measurement on Panoramic Radiograph

joint space (AJS) is obtained by drawing a vertical line from point (AC) to the nearest point of the glenoid fossa (AS). Posterior joint space (PJS) is obtained by drawing a vertical line from point (PC) to the closest point of the glenoid fossa (PS).[12] Measurements were taken on the right and left condyles. The data obtained will be analyzed using analytical descriptive statistical analysis presented in table form.

RESULTS

This research was conducted using digital panoramic radiographs of edentulous patients classified as Kennedy class I, II, III, and IV obtained from the secondary data archives of Ulin General Hospital and Gusti Hasan Aman Oral and Dental Hospital Banjarmasin. Sample characteristics based on age are shown in table 1. The research results in Table 1 show that most of the samples aged 51-60 years with 37 samples. The sample characteristics in Table 2 show that the number of female samples is greater than that of male samples. The highest number of female samples was in the Kennedy class II classification, with 21 samples, and the lowest was in the Kennedy class IV classification, with 15 samples. The highest number of male samples were found in the Kennedy class I and class IV classifications, with 12 samples in each class, and the lowest number of male samples was found in class II, with six samples.

Table 3 shows the results of linear measurements of the right and left condyle of edentulous patients classified by Kennedy class I, II, III, IV. The largest AJS value for the right condyle was in class I at 2.17 ± 0.950 mm and the smallest AJS value for the right condyle was in class IV at 1.58 ± 0.872 mm. The largest AJS value for the left condyle was in class I at 2.07 ± 0.978 mm and the smallest AJS value for the left condyle was in class IV at 1.74 ± 1.018 mm. The largest SJS value for the right condyle was in class III at 2.97 ± 1.124 mm, and the smallest SJS value for the right condyle was in class IV at 2.52 ± 1.235 mm. The largest SJS value for the left condyle was in class III at 3.08 ± 1.065 mm, and the smallest SJS value for the left condyle was in class IV at 2.65 ± 1.164 mm. The largest PJS value for the right condyle is in class II at 2.63 ± 0.994 mm, and the smallest PJS value for the right condyle is in class I at 2.18 ± 0.840 mm. The largest PJS value for the left condyle is in class II at 2.64 ± 0.922 mm, and the smallest PJS value for the left condyle is in class I at 2.13 ± 0.738 mm.

Table 4 shows the results of linear measurements of the condyles of edentulous patients classified by Kennedy class I, II, III, and IV based on gender. The largest AJS value in the female sample was in class I at 2.05 ± 0.688 mm, and the smallest AJS value was in class IV at 1.42 ± 0.865 mm. The largest SJS value in the female sample was in class II at 2.88 ± 1.093 mm, and the smallest SJS value was in class IV at 2.49 ± 1.127 mm. The largest PJS value in the female sample was in class II at 2.55 ± 0.828 mm, and the smallest PJS value was 2.11 ± 1.050 mm. The largest AJS value in the male sample was in class I at 2.20 ± 1.224 mm, and the smallest AJS value was in class II at 1.82 ± 0.698 mm. The largest SJS value in the male sample was in class III at 3.33 ± 1.228 mm, and the smallest SJS value was in class IV at 2.71 ± 1.279 mm. The largest PJS value in the male sample was in class II at 2.94 ± 1.286 mm, and the smallest PJS value was in class I at 1.95 ± 0.745 mm.

The research results in Table 5 show the overall average value of condyles linear measurement of edentulous patients classified by Kennedy Class I, II, III, IV. The largest AJS value is in

Table 1. Sample characteristics based on age

Kennedy Classification		Age			
		30-40 years	41-50 years	51-60 years	61-70 years
Maxilla	Mandibula	n	n	n	n
I	I	0	1	6	2
	II	2	2	3	2
	III	2	4	0	3
II	I	1	2	4	2
	II	1	1	6	1
	III	1	4	4	0
III	I	0	3	5	1
	II	3	4	2	0
	III	4	3	2	0
IV	I	0	3	3	3
	II	5	3	1	0
	III	6	2	1	0
Total		25	32	37	14

Table 2. Sample characteristics based on gender

Kennedy Classification		Gender	
		Female	Male
Maxilla	Mandibula	n	n
I	I	3	6
	II	6	3
	III	6	3
Class I Total		15	12
II	I	6	3
	II	7	2
	III	8	1
Class II Total		21	6
III	I	5	4
	II	6	3
	III	7	2
Class III Total		18	9
IV	I	5	4
	II	6	3
	III	4	5
Class IV Total		15	12
Total		69	39

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Table 3. Average Value of Condyle Linear Measurement of Edentulous Patients With Kennedy Classification Class I, II, III, IV Based On Right and Left Side

Kennedy Classification		Right			Left		
		AJS (mm) (Mean± SD)	SJS (mm) (Mean± SD)	PJS (mm) (Mean± SD)	AJS (mm) (Mean ± SD)	SJS (mm) (Mean ± SD)	PJS (mm) (Mean ± SD)
I	I	2,02±0,398	2,54±1,359	1,88±0,729	1,60±0,775	2,77±0,971	2,31±0,751
	II	1,93±1,386	2,82±1,103	2,25±0,743	2,30±0,784	3,00±0,837	2,19±0,475
	III	2,55±0,776	3,35±1,200	2,62±0,604	2,32±1,231	2,98±2,020	1,88±0,934
TOTAL		**2,17±0,950**	**2,91±1,226**	**2,18±0,840**	**2,07±0,978**	**2,92±1,331**	**2,13±0,738**
II	I	1,71±0,773	2,45±1,011	2,63±0,985	1,43±0,739	2,61±1,345	2,91±0,980
	II	1,96±0,405	3,36±1,081	2,45±1,323	2,00±0,769	3,05±0,740	2,14±0,762
	III	1,69±0,901	2,79±1,240	2,80±0,649	1,81±1,064	3,14±0,944	2,87±0,895
TOTAL		**1,79±0,707**	**2,87±1,138**	**2,63±0,994**	**1,75±0,871**	**2,93±1,026**	**2,64±0,922**
III	I	2,19±0,902	2,57±0,691	2,06±0,834	2,07±0,680	3,06±0,993	2,59±0,826
	II	1,49±0,666	3,06±1,551	2,99±0,674	1,75±1,034	3,23±1,229	2,63±0,948
	III	2,28±1,465	3,28±0,960	2,68±1,420	2,09±0,757	2,96±1,071	2,28±1,097
TOTAL		**1,99±1,086**	**2,97±1,124**	**2,58±1,061**	**1,97±0,820**	**3,08±1,065**	**2,50±0,939**
IV	I	1,72±0,460	3,24±0,680	2,42±1,119	1,58±1,097	3,51±0,813	2,69±1,210
	II	1,66±0,326	2,23±0,896	2,01±0,776	1,86±0,668	2,49±1,016	2,01±1,189
	III	1,36±1,439	2,10±1,675	2,83±0,947	1,78±1,293	1,95±1,144	1,92±0,806
TOTAL		**1,58±0,872**	**2,52±1,235**	**2,42±0,981**	**1,74±1,018**	**2,65±1,164**	**2,21±1,099**

Table 4. Average Value of Condyle Linear Measurement of Edentulous Patients With Kennedy Classification Class I, II, III, IV Based On Gender

Female			
Kennedy Classification	**AJS (Mean± SD)**	**SJS (Mean± SD)**	**PJS (Mean± SD)**
Class I	**2,05±0,688**	2,87±1,212	2,32±0,789
Class II	1,75±0,817	**2,88±1,093**	**2,55±0,828**
Class III	1,90±0,828	2,87±0,991	2,38±0,852
Class IV	**1,42±0,865**	**2,49±1,127**	**2,11±1,050**
Male			
Kennedy Classification	**AJS (Mean± SD)**	**SJS (Mean± SD)**	**PJS (Mean± SD)**
Class I	**2,20±1,224**	2,97±1,358	**1,95±0,745**
Class II	**1,82±0,698**	2,98±1,043	**2,94±1,286**
Class III	2,13±1,178	**3,33±1,228**	2,85±1,197
Class IV	1,97±0,963	**2,71±1,279**	2,57±0,982

Table 5. Average Value of Condyle Linear Measurement of Edentulous Patients With Kennedy Classification Class I, II, III, IV

Kennedy Classification	AJS (mm) (Mean±SD)	SJS (mm) (Mean±SD)	PJS (mm) (Mean±SD)
Class I	**2,12±0,806**	2,91±1,010	**2,20±0,587**
Class II	1,77±0619	2,90±0,898	**2,63±0,765**
Class III	1,98±0,832	**3,03±1,017**	2,54±0,815
Class IV	**1,66±0,794**	**2,59±1,117**	2,32±0,848

class I at 2.12 ± 0.806 mm, and the smallest AJS value is in class IV at 1.66 ± 0.794 mm. The largest SJS value was in class III at 3.03 ± 1.017 mm and the smallest in class IV at 2.59 ± 1.117 mm. The largest PJS value was in class II at 2.63 ± 0.765 mm, and the smallest PJS value was in class I at 2.20 ± 0.587 mm.

DISCUSSION

Mastication patterns can influence the position of the condyle according to the functional load received.[14–16] The condyle surface that experiences the most pressure during mastication is located on the superior aspect.[17] This can affect the value of superior joint space on the condyles of edentulous patients. Table 3 shows the results of linear measurement research on the condyles based on the right and left sides. Kennedy Class I patients experience loss of posterior teeth, which causes them to use teeth still in the oral cavity, namely premolars or anterior teeth.[18] Mastication in premolars or anterior teeth has a chopping type of chewing, and mandibular movements are shorter and slower. The SJS values on the right and left sides of the Kennedy class I classification group showed no significant differences between the two sides. It occurs because the bite force and chewing load are concentrated in the anterior region of the mandible, increasing the TMJ load on both sides of the joint, resulting in the right and left SJS values not experiencing significant differences.[19]

Kennedy class II and class III tooth loss patients experienced unilateral tooth loss. Patients with unilateral teeth loss have a chewing pattern that tends to be on one side. Patients tend to chew on the side with more teeth.[20] The research results in classes II and III show that the right side has a smaller SJS value than the left. This shows an imbalance in the distribution of TMJ load. One-sided mastication results in greater masticatory muscle strength on the chewing side, so the right side has a smaller SJS value.[21] The Kennedy classification class IV group has posterior teeth that can still be used for masticatory functions. Loss of anterior teeth is more likely to cause problems with speech function and aesthetics.[22] The chewing pattern can occur bilaterally with posterior teeth on both sides. If the contact on both sides is balanced, then the changes will be symmetrical between the two sides.[23] This study's superior joint space results have different values between the left and right sides, the SJS value on the right side is smaller than the left. It shows that there is a possibility of one-sided chewing. One-sided chewing with the remaining posterior teeth can occur because the patient tends to chew on the side with better occlusal contact during lateral glide movements when chewing.[24]

The research results based on gender in Table 4 show that in the linear measurement values in Kennedy's classification of edentulous patients, male samples have joint space values that tend to be greater than women. Various research have been found concordance to this research result.[25–28] Joint space values that tend to be greater in men than women could be due to differences of the thickness TMJ compartment soft tissue and the overall size of glenoid fossa and condyle in men and women.[29,30] There is a significant difference in the PJS values in male and female patients in the Kennedy class I classification. Male patients of Kennedy Class I have smaller PJS values than women. The PJS value in male patients in class I in the Kennedy classification has a value of 1.95 ± 0.745 mm while the PJS value of women with a Kennedy class I classification of 2.32 ± 0.789 mm. Tooth loss that occurs in men can be caused by periodontal disease. The prevalence of periodontal disease is more common in men than women. This can be caused by smoking habits, consumption of alcoholic drinks and poor oral hygiene.[31,32] Putri and Shubita's research results stated that most male patients experienced Kennedy class I tooth loss.[6,33] Male patients have an average number of tooth loss greater than females. This can be related to the patient's awareness of maintaining oral hygiene and the need for dental care. Agustina et al's research states that men tend to brush their teeth less than twice daily and only visit the dentist when seriously ill.[34] Bilateral loss of posterior teeth affects the position of the condyles for superior and posterior rotation in the mandibular movement pattern. Loss of posterior teeth can result in loss of vertical dimension and excessive load on the TMJ. The excessive loads that occur continuously and repeatedly can cause degenerative changes and anterior disc displacement.[34] Hu K et al. stated in their research results that the disc tends to move more anteriorly in male patients than in women.[35] Khabadze Z et al., in their research, stated that degenerative signs of TMJ were more common in men even though TMD was more common in women.[36] Gorurgoz C et al.'s research shows that the PJS value in patients experiencing degenerative changes has a value that is smaller than the AJS and SJS values. The data in this study shows that the class I classification sample is primarily male, aged 51-60 years. The risk of degenerative changes in men increases with age. It is related to the differences in care needs for men and women. The need for care is higher in women than in men, and there is a tendency to treat the disease when it is severe.[37] Tabatabaei S et al in their research results, showed that the group of patients who did not have bilateral posterior teeth in the 35-65-year age group had PJS values that were smaller than AJS and SJS.[38]

Table 5 shows the results of overall linear measurements of the condyles in edentulous patients classified as Kennedy class I, II, III, and IV. Based on this study result, the joint space value of each Kennedy Classification class have exceeded the normal value based on Ikeda and Kawamura's research. The normal condyle position values based on Ikeda and Kawamura's research are AJS of 1.3 ± 0.2 mm, SJS value of 2.5 ± 0.5 mm and PJS value of 2.1 ± 0.3 mm. A linear measurement

above the normal value indicates that the condyle position is far from the glenoid fossa. In contrast, a linear measurement value less than normal indicates that the condyle position is approaching the glenoid fossa. The research results show that the linear measurement classification for Kennedy Class I, II, III, and IV has AJS, SJS and PJS values that are more than the normal condyle position values. The smallest joint space value is the AJS value, and the largest is the SJS value. Based on the research results, the condyle position is abnormal which located away from the glenoid fossa in an anterior direction.

The Kennedy class I (bilateral free-end) tooth loss pattern has the largest AJS value. An increase in AJS values can be caused by resorption and anterior disc displacement.[39] Bilateral loss of posterior teeth results in the remaining teeth receiving a greater load than before, resulting in abrasion and a decrease in the occlusal plane, which can lead to pathological changes in the temporomandibular joint structure.[40] Condyle resorption occurs on the anterosuperior side, which experiences the greatest load when the mandible moves. Excessive load on the TMJ and the direction of muscle force perpendicular to the bone can increase condyle resorption.[41] Loss of posterior teeth can cause a decrease in the vertical dimension of occlusion so that the TMJ experiences excessive load, and the articular disc experiences a change in position to the anterior.[34,42] The smallest AJS value is in the Kennedy class IV classification. The anterior teeth act as guides or anterior guidance in mandibular movement. The movement pattern of the mandible will change when the anterior teeth are lost.[34] Loss of anterior teeth can increase the activity of the masticatory muscles so that the mandible experiences changes in movement patterns that tend to be anterior.[14,24,43] Bad habits such as biting lips, pencils, nails, and fingers and supporting the chin can cause muscle contractions, so the condyles tend to move anteriorly.[44,45]

The Kennedy Class III classification in this study has the largest SJS value. Large SJS values can occur due to trauma, tooth loss, and unbalanced chewing habits in the TMJ.[46] An increase in the SJS value resulting from trauma may indicate that there is fluid or blood located between the TMJ compartments.[47] Arikan et al in their research stated that the SJS value in edentulous patients was greater than in patients with teeth. This can be influenced by differences in the duration of tooth loss experienced by patients and a decrease in bone volume.[48] Unilateral tooth loss tends to chew on the side with more teeth, so dominant chewing occurs on one side.[20] The side not used for chewing has a smaller chewing muscle contraction force, so the balancing side has a greater superior joint space value.[17] The smallest superior joint space value is in the Kennedy classification class IV. A superior position of the condyles can be caused by excessive chewing loads and muscle contractions.[46] The anterior and posterior teeth carry out the masticatory function in stages. Loss of anterior teeth in the dental arch eliminates the function of breaking down and tearing food during the mastication process so that the function of the posterior teeth becomes more dominant. Larger and more complex foods result in greater muscle work and mechanical load on the TMJ.[24,49]

The largest PJS score in this study was in class II. Loss of posterior teeth on one side of the jaw can cause individuals to avoid chewing where the teeth are missing. Jiang et al. stated that the unpreferred chewing side has a greater PJS value than the preferred chewing side.[21] An imbalance in the load between the two sides of the jaw can result in changes in the form of regressive remodelling that can be seen on the posterior aspect of the condyle.[50] Regressive remodelling occurs as a decrease in the volume and number of tissues, resulting in tissue degeneration.[51] Khabadze et al in their research stated that the PJS value had a greater value, which could be caused by several factors such as density, width, and an index that shows the complexity of the trabecular bone in the TMJ. The complexity of bone trabeculae decreases in patients who experience tooth loss.[36] This study's smallest PJS average value was in the Kennedy classification class I. Salma T stated in her research that individuals who experience bilateral posterior tooth loss tend to have small PJS values.[38] Loss of posterior teeth on both sides of the jaw can reduce the effectiveness of mastication and the vertical dimension of occlusion. Changes in the position of the condyle in edentulous patients occur because the condyle tends to rotate superiorly and posteriorly when the mandible moves, resulting in a decrease in the posterior joint space of the temporomandibular joint.[52,53]

Edentulous spaces in patients with partial tooth loss can result in abnormal forces during the mastication process, resulting in an imbalance in the stomatognathic system. Repeated and persistent unequal distribution of pressure is called microtrauma. The accumulation of microtrauma in the joint structures results in abnormal mandible movement during mastication. This can result in lengthening of the ligaments and thinning of the disc, resulting in TMJ internal derangement.[7,24] Disc derangement can be divided into two, namely disc displacement with reduction (DDwR) and disc displacement without reduction (DDwoR).[24,54] Changes in the joint space of the temporomandibular joint are closely related to the occurrence of disc displacement.[12,39] Previous research conducted by Almasan et al. showed that disc displacement patients with reduction and without reduction had AJS values greater than SJS and PJS. It indicates the condyle's position is more posterior and superior in disc displacement patients.[55] The results of this study show that the position of the condyle is abnormal, with the AJS value being smaller than that of SJS and PJS. This condition indicates that the condyle tends to be located more anteriorly. The results of this study are similar to the results of research by Idan et al., which showed that disc displacement with reduction patients had the smallest AJS scores compared to SJS and PJS.[56]

Imbalanced occlusion that does not match the action of the temporomandibular muscles and joints causes muscle hyperactivity and disc displacement.[57] Giacomo et al.'s research stated that DDwR patients experienced increased temporalis muscle activity. This condition can occur due to a decrease in the vertical dimension of occlusion in patients with tooth loss and DDWR so that the temporalis muscles carry out the dominant muscle movement and the muscle force is more anterior.[58,59] Abnormal muscle forces due to functional changes in masticatory muscles can affect the structure of disc ligaments and masticatory muscle fibres. Disc ligaments are stiff and inelastic, so an abnormal force on the TMJ causes the ligament to lose its stiffness to maintain the disc's position. This causes the disc to be more susceptible to displacement. The temporalis and lateral pterygoid muscle fibres attached to the anterior disc play a role in maintaining the stability of the condyle and disc during mandibular movement. These muscle fibres work by balancing the pressure received on the TMJ with different contraction directions. An imbalance in the activity of these muscle fibres can increase the risk of disc displacement.[24,60]

CONCLUSION

Based on the research results, the linear measurement value of the condyle of edentulous patients classified as Kennedy class I, II, III, and IV in men has a greater joint space value than in women. The significant difference found in men with Kennedy Class I patients that has a smaller value than in women in Kennedy Class I patients. The results of the analysis of the average linear measurement value of the condyle in edentulous patients classified as class I, II, III, and IV showed that the condyle position was in an abnormal position and experienced disc displacement with reduction.

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FOOTNOTES

All authors have no potential conflict of interest to declare for this article. All procedures conducted were in accordance with the ethical standards.

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