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Analysis of height and width of mandibular condyle and shape of the articular eminence with and without clicking using TMJ radiography

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Abstract

The temporomandibular joint (TMJ) is the joint of the mandibular condyle with the glenoid fossa of the temporal bone and is the only joint in the head that is responsible for opening and closing movements of the jaw. Cliking is the most frequent symptom indicating temporomandibular joint dysfunction. Several radiographic techniques are used to establish the diagnosis in the examination of the temporomandibular joint. This research was carried out using closed mouth TMJ radiography. The purpose of this study was to determine the height and width of the mandibular condyle and the form of eminence with and without clicking using TMJ radiographs. This research is a descriptive analytic study. The results showed that the average height of the mandibular condyle with clicking was 18,796 mm and without clicking was 22,812 mm. The average width of the mandibular condyle with cliking is 11673mm and without cliking is 11,181mm. The average form of articular eminence with clicking is 36.754 ° and without cliking is 41.081 °. The conclusion of the study was that using the Independent t test there were significant differences in the height of the mandibular condyle and the shape of the articular eminence but there was no significant difference in the width of the mandibular condyle with and without clicking using TMJ radiographs.

Keywords: Temporomandibular joint, Clicking, Mandibular condyle, TMJ radiography.

INTRODUCTION

The temporomandibular joint (TMJ) is one of the most important and unique parts found in the body. The temporomandibular joint is the joint of the mandibular condyle with the glenoid fossa of the temporal bone and is the only joint in the head that is responsible for opening and closing movements of the jaw, chewing and speaking and located behind the ear [1].

Mandibular condyle is shaped like a roll, besides functioning as a joint, the mandible condyle is a growth area even though it is still in the cartilage. Under normal circumstances, the head of the condyle must be convex and symmetrical in shape with the contralater [2]. The condyle is one of the most active parts of the human body that can move more than 200 times a day. The condyle undergoes complex movements during the opening and closing of the mandible. Part of the anterosuperior mandibular condyle is assumed to bear the greatest burden during mandibular function. Functional and parafunctional loads can cause adaptive and degenerative changes in the recipient load including the condyle bone [3]. Pontual *et al* research shows that when compared with other bone anatomy of the temporomandibular joint, the condyle is the most frequently changing anatomy of 91%, whereas the articular eminence is 1 %, condyle and articular eminence by 7%, and condyle, articular eminence and glenoid fossa by 1% [4].

The articular eminence is part of the temporal bone through which the condylar process glides during mandible movement. The tendency for articular excellence varies between individuals and this determines the path of movement of the condyle and the rate of rotation of the disk above the condyle. The depth of the fossa varies, and articular development depends on the functional stimulus of the condyle. Excessive pressure on the movement of the temporomandibular joint can cause wear on the area of the articular eminence. Through radiography, the flattening conditions in eminence will be apparent [4].

According to the National Institute of Dental and Craniofacial Research, temporomandibular joint dysfunction is the most common cause of facial pain from the temporomandibular joint and muscle disorders. This disorder causes pain and recurrent or chronic dysfunction of the jaw joints and related

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muscles and their supporting tissues. TMD is the second most common musculoskeletal condition that results in pain and disability (after chronic back pain), affecting around 5% to 12% of the population. About 15% will become chronic TMD. At present there are no data on TMD based on large national samples. Some large data has been collected from studies with smaller samples from limited population groups [5].

According to U.S. Department of Health and Human Services, researchers generally agree that there are three main categories of TMD patient conditions namely, myofacial pain involving discomfort or pain in the muscles that control the function of the jaw, internal disturbances involving replaced disc joints, dislocation of the jaw, or condyle injury and arthritis referring to in a group of degenerative or inflammatory joint disorders that can affect temporomandibular [6].

Various symptoms may be related to temporomandibular joint disorders. Jaw muscle or joint pain, especially when chewing, is the most common symptom. Other symptoms include radiating pain in the face, jaw, or neck, painful 'clicks' or lattices appear and changes in the way the maxillary and mandibular teeth coalesce [6]. The most common clinical diagnosis applied to TMD patients is sometimes clicking - sometimes accompanied by pain and occasional stiffness, especially in the morning and evening [7].

Cliking as one of the sounds in the temporomandibular joint, is the most common complaint in the temporomandibular joint. Clicking can occur at any time during the opening and closing movements of the mandible. Clicking is one of the earliest symptoms of temporomandibular joint abnormalities. This sound is heard when the condyle moves from the intermediate disc zone to the posterior border. The sound can be a slow thud, faint to cracking sound sharp and loud [8].

There are several radiographic techniques used to confirm the diagnosis of the temporomandibular joint examination such as transcranial radiography, transpharyngeal radiography, dental panoramic tomograph radiography, Reverse Towne radiography and tomography radiography. On radiographic images of the temporomandibular joint, it can be seen in the position of the mouth open and closed. On examination of the closed mouth, the condyle will lie in the mandibular fossa. On examination of an open mouth, the condyle will lie in the articular eminence if the patient opens his mouth wide [7].

Research Pramanik *et al* (2017) conducted a study by measuring differences in the morphology of the condyle with and without clicking using panoramic radiography. The results showed there was a difference in the height of the Head of Condyle (HOC) in which there was a click sound of 6.31mm and without a click sound of 7.63 mm. In the width of the HOC with a click sound of 10.38mm and 10.22mm without a click. The height of the condylar process in those with a clicking sound of 19.70mm and without a clicking noise of 20.04mm [3].

In addition, research by Valladeres *et al* (2010) regarding changes in the dimensions of the mandibular condyle at the age of 3 to 20 years using cone-beam computed tomography shows the linear dimensions of the mandibular condyle in the lateral region have changed due to condyle growth and were established earlier and the frontal dimensions increased. However, this study has an error method which is to determine the reliability of intra-operator measurements for the condilar dimensions, this is measured twice at two-week intervals by the same radiologist. Significance testing for linear measument differences was achieved using the Student T-Test pair [2].

Based on some of the studies described above, researchers are interested in conducting research to find out whether there are differences in height and width of the mandibular condyle and the shape of the articular eminence with and without clicking using radiographs of the temporomandibular joint.

METHOD

In this study, an examination of prospective research samples included hearing 'clicks during opening and closing the mouth. Samples that met the inclusion criteria were selected and informed consent included the importance of these actions and sought approval that the medical data be used as research material.

Perform TMJ radiographs with closed mouth position on samples at the Dental Radiology Installation at USU Dental and Oral Hospital. Open the CliniView software and press search to open the TMJ photo you want to check. After that, pressing the image and create copy to produce a radiograph of the same temporomandibular joint as the original photo. Adjust the contrast brightness and zoom to enlarge the photo and make the photo look clearer.

Using the drawing toolbar, to calculate:

a. Height of the mandibular condyle: press the line and draw a perpendicular linear line from the superior mandibular condyle (SCo) and the second line that is built from the lowest point of the sigmoid notch (InfSig). Press measurement (length) and paint the perpendicular line from the superior mandibular condyle to the second line drawn (Figure 1).

b. Width of the mandibular condyle: press the line and draw a parallel line extending from the outermost point of the mesial condyle to the distal outermost point of the condyle. Press measurement (length) and draw straight lines from the two parallel lines (Figure 1).

c. Form of articular eminence: Determine the angle of inclination of the articular eminence (∟e) through a reference point namely:

    i. Press the line and paint from the most superior point on the roof of the glenoid fossa ie point g is identified geometrically as the thinnest part at the base of the fossa and the innermost part of the glenoidalis fossa.

    ii. Press measurement (length) and make the horizontal axis (h) determined as Frankfort Horizontal Plane, identified by connecting the most inferior points of the glenoid fossa.

    iii. Press measurement (angle) and make the inflection point ie point e is the point where the glenoid fossa basin and the articular eminence slopes meet and form a sigmoid curve. (Figure 1) [25].

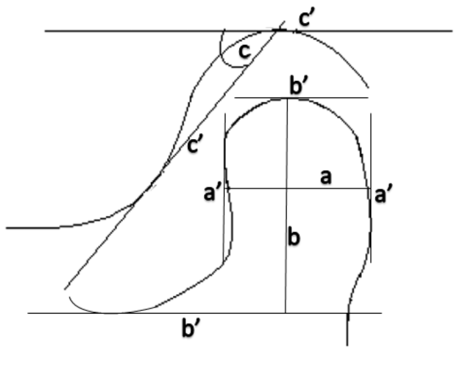

Figure 1: Schematic measurement of a. mandibular condyle width, b. mandibular condyle height, and c. eminence inclination

The measurement results will come out automatically on the computer screen and perform data processing and analysis.

RESULTS

This research was conducted at the Dental Radiology Installation, Dental and Mouth Hospital of the University of North Sumatra. This research was conducted in May - June 2019. The data for this study was conducted in January to February 2019. This research was a descriptive analytic study. The study sample consisted of 26 USU dentistry faculty students aged 18 - 30 years, consisting of 13 people without temporomandibular joint clotting and 13 people with temporomandibular joint clicking. The study was carried out on a radiograph of the temporomandibular joint to measure the height and width of the mandibular condyle and the shape of the eminence.

In Table 1, the analysis of the mean test results for the right temporomandibular joint, the average height of the mandibular condyle and the shape of the articular eminence with clicking is lower than without clicking while the width of the condyle with clicking is greater than without clicking.

Table 1: Analysis of the Right Temporomandibular Joint Test Results

Variable	Group	Average	Standard Deviation	P-Value
Height of mandibular condyle	Clicking	18.264	2.650	p = 0.740
	Without Clicking	22.285	3.573	p = 0.270
Width of mandibular condyle	Clicking	11.618	2.242	p = 0.144
	Without Clicking	10.831	1.652	p = 0.654
Shape of Articular Eminence	Clicking	36.936	5.483	p = 0.463
	Without Clicking	41.423	4.351	p = 0.998

In table 2, the analysis of the mean test results for the left temporomandibular joint, the average height of the mandibular condyle and the shape of the articular eminence with clicking is lower than without clicking while for the width of the mandibular condyle with clicking is greater than without clicking.

Table 2: Analysis of the Left Temporomandibular Joint Test Results

Variable	Group	Average	Standard Deviation	P-Value
Height of mandibular condyle	Clicking	19.525	2.408	p = 0.697
	Without Clicking	22.339	2.749	p = 0.529
Width of mandibular condyle	Clicking	11.650	1.982	p = 0.464
	Without Clicking	11.531	2.826	p = 0.002
Shape of Articular Eminence	Clicking	35.088	3.549	p = 0.248
	Without Clicking	40.739	4.911	p = 0.078

Data normality testing is performed using the Shapiro-Wilk test. If the data is normally distributed, the test is continued using the independent t test, but if the data is not normally distributed, the test is continued using the Mann-Whiteney test.

Based on the normality test results in Tables 1 and 2, it is known that the data on the left mandibular condyle height, the form of the left articular eminence, the right mandibular condyle height, the right mandibular condyle width and the right eminence shape were normally distributed with p values> 0.05, so testing uses an independent t test. However, the width of the left mandibular condyle for the group without clicking is not normally distributed with a value of p = 0.002 <0.05, so testing uses the Mann-Whitney test.

Independent t test results on the right temporomandibular joint, there was a significant difference in the height of the mandibular condyle and the shape of the clicking and without clicking articular eminence and there was no significant difference in the width of the mandibular condyle between clicking and without clicking (table 3).

Table 3: Right Temporomandibular Joint Independent Test t

Variable	Group	P-Value
Height of mandibular condyle	Clicking	p = 0,001 < 0,05 (significant)
	Without Clicking	
Width of mandibular condyle	Clicking	p = 0,375 > 0,05 (not significant)
	Without Clicking	
Shape of Articular Eminence	Clicking	p = 0,044 < 0,05 (significant)
	Without Clicking	

Independent t test results on the left temporomandibular joint, there was a significant difference in the height of the mandibular condyle and the articular eminence form between clicking and without clicking. Based on the Mann Whitney test there was no significant difference in the width of the left mandibular condyle between clicking and without clicking (table 4).

Table 4: Independent t test and Mann Whitney test of Left Temporomandibular Joint

Variable	Group	P-Value
Height of mandibular condyle	Clicking	p = 0,028 < 0,05 (significant)
	Without Clicking	
Width of mandibular condyle	Clicking	p = 0,587 > 0,05 (not significant)
	Without Clicking	
Shape of Articular Eminence	Clicking	p = 0,011 < 0,05 (significant)
	Without Clicking	

Analysis of the results of the mean per group test, the average height of the mandibular condyle, and the shape of the articular eminence with clicking is lower than without clicking while the width of the mandibular condyle with clicking is higher than without clicking (table 5).

Table 5: Analysis of Average Test Results

Variable	Group	Average	Standard Deviation	P-Value
Height of mandibular condyle	Clicking	18.796	2.580	p = 0.962
	Without Clicking	22.812	3.098	p = 0.586
Width of mandibular condyle	Clicking	11.673	2.242	p = 0.143
	Without Clicking	11.181	1.652	p = 0.057
Shape of Articular Eminence	Clicking	36.754	5.483	p = 0.567
	Without Clicking	41.081	4.412	p = 0.413

Table 6: Analysis of Independent t Test Results

Variable	Group	P-Value
Height of mandibular condyle	Clicking	p = 0,001 < 0,05 (significant)
	Without Clicking	
Width of mandibular condyle	Clicking	p = 0,530 > 0,05 (not significant)
	Without Clicking	
Shape of Articular Eminence	Clicking	p = 0,036 < 0,05 (significant)
	Without Clicking	

Overall, using an independent t test, there was a significant difference in the height of the mandibular condyle and the shape of the eminence between Clicking and without Clicking but there was no significant difference in the width of the mandibular condyle between clicking and without clicking.

DISCUSSION

According to research conducted, the average height of the right and left mandible without clicking is higher than that of clicking. According to statistical analysis on the height of the mandible shows that there is a significant difference in the height of the mandibular temporomandibular joint with and without clicking These results are in accordance with the research of Pramanik *et al*. Which also shows that there is a difference in height of the mandibular condyle with and without clicking. Remodeling is an adaptation of the shape of the joints in response to biomechanical pressure to resist the accumulative effect of functional movement of the jaw so that the remodeling process can cause changes in joint structure [25]. In addition, the mandibular condyle is assumed to bear the greatest burden during mandibular function and this causes resorption to take effect [26].

Statistical analytical results on the height of the mandibular condyle concluded that there were differences in the temporomandibular joints with and without clicking. Changes that occur in the mandibular condyle are an increase or decrease in height depending on the adaptive response that occurs in the condyle which is a renovation or resorption. According to Anuna, who also conducted studies with changes in the condyle and its relationship with age, temporomandibular joint dysfunction and tooth status showed that changes in the mandibular condyle by clicking [27]. According to Hintze, differences in significance were more common in the condyle than in articular eminence which also corresponds to the mandibular condyle by clicking. this study because the decrease in height of the mandible condyle is the first change that occurs in individuals with complaints of clicking [28].

The average width of the right and left mandibular condyle on clicking is greater than without clicking. But based on analytic results, there is no significant difference in the width of the mandible condyle. This is consistent with research conducted by Pramanik *et al*. Which is also possible because measurements were made using radiographs of two-dimensional horizontal temporomandibular joints which may be inaccurate and not used as references [29]. This is also possible because resorption in the mesial and distal regions of the mandibular condyle is less than a reduction in the height of the condyle as the largest load recipient [26]. Measurement of the mandibular condyle as one of the mandibular growth centers requires accuracy, accuracy, and compatibility of the equipment in determining the difference because condyle growth has high adaptability flexibility [3].

The right and left articular eminence forms in clicking are flatter than without clicking and there is a significant difference in the form of articular eminence. These results are in accordance with the studies of Alexious *et al*. Showing flattening of the articular eminence associated with a decrease in the height of the mandibular condyle which is considered to be a degenerative change due to the large burden on the temporomandibular joint. Mandibular movements are coordinated by the two joints that are justified which justifies a change in the joint condyle and articular eminence as observed by Alexious and also in this study [30].

According to Malik *et al* the thinning of the articular eminence also occurs because rotational and sideways disk displacement is most often found with the mouth closed, disk rotation rotation is characterized by an anterior position, and the medial or lateral position of the disk with respect to the ideal position between the condyle and eminence. Side displacement consists of medial or lateral displacement. This results from lengthening of the capsular and disc ligaments coupled with thinning of the articular eminence which generally results from macro or microtrauma. Another cause is joint loading [21].

Anatomy of the condyle makes each individual differ in their shape and size. The profile of the condyle has many variations in age groups and sex for each individual. It is thought that both the condyle and angulation are very individual and there are often differences between right and left [31]. Other factors that affect the shape of the condyle in normal conditions are facial shape, occlusal force, and functional load insignificant differences that can also be attributed to insufficient and insufficient samples balanced [3].

The cause of clicking is excessive and sudden movement of the mandible which results in disc shifting or clenching of the teeth which prolongs so that the opening changes due to muscle fatigue. Clicking can also occur intermittently in adolescents due to adaptation movements when growth is in progress, this condition can be avoided by closing and opening on the retrusi axis [21]. Abnormalities in the temporomandibular joint can affect the joints and surrounding muscles. Most of the causes of temporomandibular joint abnormalities are a combination of muscle tension and anatomical abnormalities in the joints, sometimes accompanied by psychological factors. This disorder is most common in women aged 20-50 years [13].

Clicking mechanism occurs if the disc movement is not compatible with the movement of the condile. Disc displacement arises from several conditions, one of which is trauma to the joint so that the ligaments that work opposite to the lateral pterygoid muscle experience tension or tearing. In this situation, muscle contractions move the disc forward when the condyle moves forward when opening the mouth but the ligaments cannot maintain the disc, in the right position when the jaw is closed, resulting in clicking when opening and closing the mouth. Clicking can occur due to joint surface irregularities, for example due to osteoarthritis. Clicking has something to do with changes in the position of the condyle in the mandibular fossa [21].

Whenever there is an abnormality in the position of the jaw accompanied by excessive pressure on the joint and prolonged or continuous, it can cause the discs (meniscus) to tear and experience dislocation in front of the condyle. Under these circumstances, the movement to open the mouth causes the condyle to move forward and force the discus in front of it. If this continues, the condile can jump over the disc and collide with the bone, causing a clicking sound. This can also occur in reverse movements. Often, this sound is not accompanied by pain so the patient is not aware that the sound is a symptom of a temporomandibular joint disorder [20].

The temporomandibular joint is an area that is difficult to investigate radiographically. Research on temporomandibular joint dysfunction still gives different results, caused by many factors that affect the occurrence of temporomandibular joint dysfunction or it could also be because the research has been done only to examine one cause or symptom alone [31]. The clicking process so that there are changes in the height and width of the condyle and the shape of the eminence through a long process, starting from the change in disk morphology, the position of the disk until finally the morphology changes the condyle. In this study, it is likely that samples with temporomandibular joint clicking have not experienced major changes because they have not experienced temporomandibular joint dysfunction for a long time and are not long enough for morphological changes, so it is necessary to study more deeply about the symptoms or etiologics involved in the study of joint disorders. temporomandibular [3].

CONCLUSION

The conclusion of this study is that by using radiographic temporomandibular joints in Clicking and without Clicking there is a significant difference in the average height of the mandibular condyle and the average shape of the articular eminence but there is no significant difference in the average width of the mandibular condyle.

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