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Interprocessus distances based on gender using panoramic radiographs

Eha Renwi Astuti[1] iD, Otty Ratna Wahyuni[1], Dina Karimah Putri[1*], Nastiti Faradilla Ramadhani[1,2], Ramadhan Hardani Putra[1], Azifah Shafa Izdihar[3], Khusnul Rahmawati[3]

ABSTRACT

Objectives: This research is aimed to find out the differences of interprocessus distances between males and females using panoramic radiographs.

Materials and Methods: This research is using observational analytic with cross sectional study design. Secondary data was taken from 96 panoramic radiographs consisting of 48 males and 48 females, from RSKGM-P Universitas Airlangga. Measurements were carried out using ImageJ Software by 3 observers. The measurement results were then analyzed by independent t-test and the inter-measuring reliability was tested using the

Intraclass Correlation Coefficient (ICC) on IBM SPSS software.

Results: The result showed that the significance value (2-tailed) of interprocessus distances measurement on males and females was <0.05 in both regions. Reliability test of inter-observer using ICC obtained the overall measurement results was more than 0.75 which means excellent reliability.

Conclusion: There was a significant difference between the interprocessus distances on males and females as measured by panoramic radiographs.

INTRODUCTION

Human identification is a process of identifying individual characteristics through distinctive physical characteristics and is very important in the field of forensics and anthropology.[1,2] When skeletal remains are found, it is necessary to reconstruct the biological profile with the aim of understanding the demographics of the population and the individuals involved. This biological profile includes estimates of age, gender, race and height.[2,3] Determination of gender is the first step of the identification process because the next step in estimating age and height depends on gender. [4]

Determining gender by skeleton can use the metrical method, which involves a series of bone measurements that show sexual dimorphism to various forms of metric analysis.[2] Sexual dimorphism is a change based on bone that can help predict sex-determining characteristics of the remaining bone.[1]

Based on previous studies, it has been proven that the skull is the most dimorphic part of the skeleton after the pelvis, giving an accuracy of up to 92%.[4–6] In cases where there is no intact skull bone, the mandible plays an important role because it is part of the skull bone, the most dimorphic, the largest, and the strongest.[4–8]

In the mandible, the condyle and ramus are the two areas that show the highest sexual

dimorphism.[3] One of the variables that shows sexual dimorphism in the mandible is through the interprocessus. It is stated that the interprocessus or the distance between the condyloid process and the coronoid process in males is longer than in females.[9]

In this digital era, dentomaxillofacial radiography has become one of the procedures that are often performed in dental hospitals.[3] Panoramic radiography has a broad function in dentistry. Panoramic radiography is the most widely used extra-oral radiograph. Panoramic radiographs can show the maxilla, mandible and temporomandibular joints in one image, so that panoramic radiographs are widely used to obtain a full maxillofacial image.[10] The lower cost and wide area coverage and ease of preparation make panoramic radiographs the best choice.[8]

Based on existing studies, the accuracy of panoramic radiographs in the anatomical measurement of the mandible has been demonstrated and shows that the mandible has a high sexual dimorphism.[2] Research to measure the distance between interprocessus has never been done before, therefore it is important to do this research. In addition, it is also important to prove the existing theory that the interprocessus distance in males is longer than in females.

[1]Department of Dentomaxillofacial Radiology, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia 60132

[2]Postgraduate Program, Master of Dental Health Science, Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia 60132

[3]Faculty of Dental Medicine, Universitas Airlangga, Surabaya, Indonesia 60132

*Correspondence to:
Dina Karimah Putri
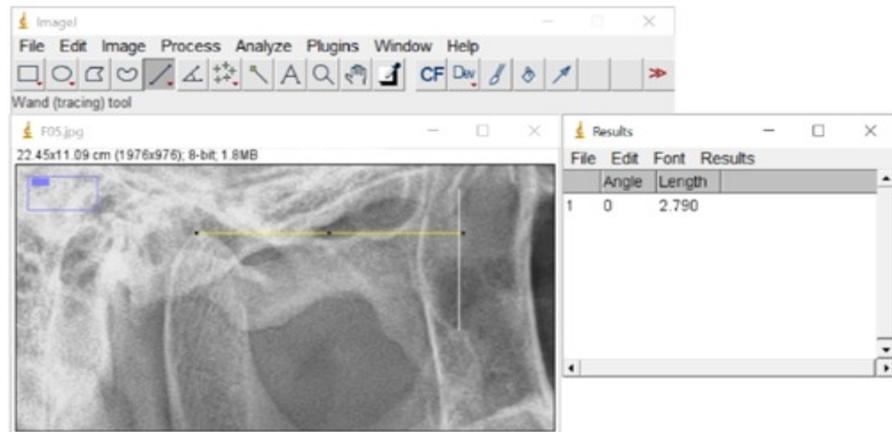✉ dina.karimah.p@fkg.unair.ac.id

Figure 1. An example of how to measure interprocessus distances using ImageJ software

MATERIALS AND METHODS

This research has received approval from the Health Research Ethics Commission (KKEPK) of the Faculty of Dental Medicine, Universitas Airlangga. This research is an observational analytic study with a cross sectional study design. The sample in this study used 96 panoramic radiographs with 48 male samples and 48 female samples obtained from the Radiology Installation of the Dental Hospital, Universitas Airlangga, Surabaya. Sampling was carried out using purposive sampling method, namely taking samples by determining certain criteria Inclusion criteria included samples were male and female, aged more than 20 years, the evaluation of the quality of the panoramic radiograph was good, the condyloid process and the coronoid process were clearly visible and the shape of the condyle head had normal variations. Exclusion kriteria included missing posterior teeth, and if there was trauma to the jaw and has anatomical, morphological and pathological abnormalities in the jaw.

This study is located at the Radiology Installation of the Dental Hospital, Universitas Airlangga, Surabaya and was held in August 2021 – October 2021. The tools and materials used in this study were ImageJ software version 1.53e, IBM SPSS version 25, laptop and panoramic radiographs.

Measurements were carried out by 3 observers. The way this research works is a modification of the research of Saini et al. (2011), namely by projecting a point to assist in the measurement. The projection of the highest point on the coronoid process which is parallel to the condyloid process is drawn a line and the distance is measured in centimeters (cm). Interprocessus distance measurements were carried out based on gender in

both the right and left sides of the interprocessus. Data analysis used Intraclass Correlation Coefficient to determine inter-observer reliability then data was tested using Independent t-test.

RESULTS

The table 1 shows the results of the inter-observer reliability test using the Intraclass Correlation Coefficient (ICC). In the table, it can be seen that the total of ICC value obtained was ≥0.75, which means that the reliability of all measurements is close to perfect (excellent reliability). Table 2 describes the reference number to conclude the interpretation of the ICC value.[11]

Based on Table 3, the value of Sig.(2-tailed) obtained was <0.05 in both regions, which means that there is a significant difference between the interprocessus distances on males and females in both the right and left regions.

DISCUSSION

Many studies using mandibular parameters on panoramic radiographs to determine gender have been carried out and have shown that the mandible is a bone with high sexual dimorphism. However, no research has been found that uses interprocessus distances variables. In this study, the interprocessus distances was measured by gender and in both right and left regions using panoramic radiographs. Panoramic radiographs can show the maxilla, mandible, temporomandibular joints in one image, so it is in accordance with the purpose of this study which is necessary to see the

Table 1. ICC value and mean of interprocessus distances between males and females in both regions

Interprocessus Distances	Intraclass Correlation Coefficient	*Mean*
Female right side	0.996	2.569
Female left side	0.996	2.634
Male right side	0.993	2.729
Male left side	0.996	2.778

Table 2. Interpretation of Intraclass Correlation Coefficient

ICC value	Interpretation
<0.4	Poor reliability
0.4 ≤ICC ≤0.75	Fair to good reliability
≥0.75	Excellent reliability

Table 3. Independent t-test result

Interprocesses Distances	Sig.(2-tailed)
Right side	0.000
Left side	0.000

interprocessus distances. According to Sambhana et al. (2016), panoramic radiographs has proven its accuracy in anatomical measurements. Several studies have proven that panoramic radiographs is accurate for linear and angular measurements of the mandible.

The sample in this study was 96 panoramic radiographs that met the criteria, where one of the criteria for the sample of this study was the evaluation of good quality panoramic radiographs. The initial amount of data that the researchers got from the Radiology Installation of Dental Hospital, Universitas Airlangga, Surabaya was around 600 panoramic radiographs that had met the age criteria and had no posterior tooth loss. After the quality evaluation was carried out, only 96 samples had a good quality evaluation. Mandibular measurements on panoramic radiographs are strongly influenced by good quality evaluation. Panoramic images will certainly produce distortions that can cause linear or angular measurements to be unreliable, therefore horizontal and vertical distortions must be minimal in order to produce reliable measurements. Distortion of the panoramic image is affected by several factors, such as the angulation of the x-ray beam, the distance from the x-ray source to the object, the path of the center of rotation and the position of the object in the focal trough. These factors depend on the anatomy of the patient and the position of the patient when the panoramic photo is taken. When the patient's head is too far back from its optimal position in the focal trough, the anatomical structures of the anterior teeth will appear to be elongated horizontally and appear wider. When the patient's head is positioned too forward from the focal trough, thinner anterior teeth and superimposed condyles and coronoid with vertebrae or maxilla are seen.[12–14] In this study, many panoramic radiographs were found where the coronoid process was not clearly visible because it was superimposed with the maxillary tuberosity so that it could not meet the sample criteria. If the patient's sagittal plane is rotated in the focal trough, horizontally large images of the molars and mandibular ramus and premolars overlap on one side, and the smaller molars and mandibular ramus on the other side horizontally. For example, when the patient's head is turned to the right, it will produce a small/narrow image of the right mandibular region, while the left region appears wide/large and the posterior teeth overlap.[13,14] In this study, if this happens which will then affect the size of the condyle, it will also affect the results of research measurements causing the measurement results to be unreliable with the actual size.

The inter-observer reliability test in this study was carried out using the Intraclass Correlation Coefficient (ICC) through IBM SPSS version 25. The total ICC value was more than 0.75. Therefore, it can be said that the reliability of all measurements is close to perfect (excellent reliability). This is because the three observers use the same measuring method, starting from equalizing perceptions of the measured parameters, using the same measuring instrument, namely Image J Software version 1.53e, and using the same calibration technique. In addition, the most important factor is that the sample used has a good evaluation of the quality of panoramic radiographs, where the horizontal and vertical distortions are minimal so that the measurement results are reliable.

The results of the measurement of the interprocessus distances based on gender showed a significant difference, namely the independent t-test results gave a Sig. (2-tailed) value of 0.000 in both regions. Based on the mean, it was found that the male interprocessus distances was 0.16 cm longer in the right region and 0.14 cm longer in the left region than female. These differences can be influenced by the effect of gender on the potential for mandibular growth. The acceleration of adolescent growth in males is longer than that of females, so the growth potential in males is greater.[15] The peak of growth in females occurs earlier than in males. The pattern of bone growth in females is fast and in a short time, while the pattern of bone growth in males is slow and over a longer time.[16] Mandibular growth follows the direction of growth of the condyle to maintain constant contact with the cranial base. Mandibular growth ends at around 15 years of age in females and around 17 years of age in males. However, there is other literature which states that mandibular growth can last up to around the age of 20 years. At puberty, the average condyle growth will increase, which is around the age of 12-14 years and stop at around the age of 20 years. This is what underlies the age of this study sample was more than 20 years so that there is no large bias in the measurements caused by mandibular growth and condyle growth that still continues when performed under the age of 20 years.

Differences in size in the right and left regions can be influenced by genetic factors or environmental factors. Genetic factors plays an important role in controlling craniofacial differentiation. Genetics plays a role in the process of bone formation and plays an important role in determining the dominance of the active side of the body. This will affect craniofacial size, so that there are differences in craniofacial size between right and left.[17,18] Environmental factors such as muscle

activity or normal function plays a role in skeletal growth. In masticatory activity, masticatory muscles are an important factor to maintain occlusion. The attachment of the major muscles to the maxilla and mandible causes the size of the maxilla and mandible to differ between the right and left sides.[18] Decreased function can be affected by tooth loss, which affects orofacial structures such as bones, muscles and nerves.[19]

If there is loss of posterior teeth, it will cause changes in the vertical dimensions of the occlusion and changes in the relationship between the mandibular condyle and the glenoid fossa. Loss of the vertical dimension of the occlusion causes the disc to dislocate anteriorly so that there will be a change in the functional movement pattern of the jaw. This increases the biomechanical stress on the glenoid fossa and the articular eminence that the condyle passes through when the temporomandibular joint functions. Increased biomechanical stress that occurs over a long period of time will cause adaptive changes and degenerative changes so that the joint structure will change shape, namely at the head of the condyle.[20] This is the basis why loss of posterior teeth is an exclusion criterion for the study sample.

Based on the explanation above, the results of this study are in accordance with the theory, namely that the interprocessus distances in males is longer than in females. However, due to the absence of a flat shape in condyle shape variation in the sample of this study, this study could only be implemented on the interprocessus with the condyle heads in the shape of round, angled, crooked finger and pointed. The advantage of this study is that the prevalence of fractures in the condyle and coronoid is lower at 14.8% in the condyle and 3.3% in the coronoid, compared to the mandibular symphysis which has a prevalence of 19.2% and the mandibular body 18.1%.[21] By therefore, if the rest of the mandible is fractured and both processes are intact, measurement of the interprocessus distances may be an option.

CONCLUSION

Based on the results of this study, there is a significant difference between the interprocessus distances on males and females in both the right and left regions as measured by panoramic radiographs.

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FOOTNOTES

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