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# SEXUAL DIMORPHISM OF MINANGKABAUNES' MAXILLARY CENTRAL INCISOR'S WIDTH

(DISMORFISME SEKSUAL DARI LEBAR  
INSISIVUS SENTRAL MAKSILA PADA SUKU MINANGKABAU)

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## Abstract

Teeth are known as organs made up of the hardest mineral tissue that is resistant to decay and physical, thermal, mechanical, chemical or biological damage. Tooth crown dimensions are reasonably accurate predictors of genders especially to young individuals whose secondary skeletal characteristics are yet developed. This research aims to analyse the influence of genders to the width of maxillary central incisor Minangkabau. The study was conducted using cross-sectional method in Luhak Agam, Luhak Tanah Datar and Luhak Lima Puluh Kota, West Sumatra using simple random sampling technique to a total of 120 samples. Teeth width was measured in mesiodistal dimension with 0.01 mm calibrated sliding digital caliper. The measurement was done on a tooth mould at  $\frac{1}{3}$  incisal as the position of mesial and biggest distal. T-test independent statistic test was done to determine the relationship between the 2 variables. Sexual dimorphism was determined with Garn formula. The research shows significant difference ( $p=0.001$ ) between the width of left and right central incisor in males and females. The average width of the male and female right maxillary incisor is 8.545 mm and 8.370 mm, while the left central incisor width is 8.877 mm in male and 8.283 mm in females. Sexual dimorphism on the right central incisor is 2.09% and 3.43% on the left side. The conclusion of the study is that maxillary central incisor width can distinguish different genders in the identification process.

**Keywords:** odontometric, sexual dimorphism, Minangkabau, forensic, identification

## Abstrak

Gigi dikenal sebagai organ yang terbuat dari jaringan mineral yang paling keras dan resisten terhadap pembusukan dan kerusakan fisik, termal, mekanik, kimia atau biologi. Dimensi mahkota gigi adalah prediktor jenis kelamin yang cukup akurat khususnya bagi individu muda di mana karakter sekunder rangka belum berkembang. Penelitian ini bertujuan untuk menganalisa pengaruh faktor gender terhadap lebar mesiodistal gigi insisivus sentral maksila pada suku Minangkabau. Penelitian ini dilakukan dengan metode crosssectional. Pengambilan sampel berdasarkan simple random sampling dengan jumlah sampel 120 orang. Penelitian dilakukan di Luhak Agam, Luhak Tanah Datar dan Luhak Lima Puluh Kota, Sumatera Barat. Diameter mesiodistal gigi insisivus sentral dan diukur dengan menggunakan sliding digital caliper kalibrasi 0,01 mm. Pengukuran dilakukan di cetakan gigi pada  $\frac{1}{3}$  insisal sebagai posisi mesial dan distal yang terbesar. Uji statistik independent T-test dilakukan untuk menentukan hubungan antara 2 variabel. Seksual dimorfisme ditentukan dengan rumus Garn. Hasil penelitian ini adalah terdapat perbedaan yang signifikan ( $p=0,001$ ) antara ukuran lebar mesiodistal gigi insisivus sentral kiri dan kanan pada laki-laki dan perempuan. Lebar rata-rata gigi insisivus sentral maksila kanan ditentukan menjadi 8.545 mm untuk laki-laki dan 8.370 mm untuk perempuan dan untuk insisivus sentral maksila kiri adalah 8,877 mm pada laki-laki dan 8,283 mm pada perempuan. Seksual dimorfisme pada ukuran lebar mesiodistal gigi insisivus kanan adalah 2,09% dan sebelah kiri adalah 3,43%. Kesimpulan penelitian ini adalah ukuran mesiodistal insisivus sentral maksila dapat membedakan jenis kelamin dalam proses identifikasi.

**Kata kunci :** odontometrik, seksual dimorfisme, Minangkabau, forensic, identifikasi

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## INTRODUCTION

Minangkabau is the largest ethnic in the world and the only one in Southeast Asia that embraced matrilineal descent system, in which the lineage follows the descent group of the biological mother.<sup>1</sup> West Sumatra, one of the provinces in Indonesia prone to natural disaster such as earthquake, landslide, tsunami and volcanoes, is highly populated by Minangkabau ethnic.<sup>2</sup>

Post-disaster victims' identification may be hindered due to the damaged of soft tissue. Therefore identification of hard tissue like bones and teeth must be done in order to know corpse' identity<sup>3</sup>. The determination of genders is very important because it divides the total matches' characteristic that might be found. Skeletal, pelvis and skull are the traditional indicators of genders and the accuracy of morphology and osteometric evaluation in determining genders have reached 100%.<sup>4</sup>

Teeth are known as organs made up of the hardest mineral tissue in human body. That is why, teeth are very resistant to decay and undergo physical, thermal, mechanical, chemical or biological damages<sup>5</sup>. Although not as accurate as the pelvis and the cranium bones, tooth crown dimensions are a reasonably accurate predictor in determining sexes. Furthermore, this is very accurate to young individuals whose secondary skeletal characteristics are yet developed.<sup>6</sup>

Odontometric has been acknowledged as the method to determine genders in forensic literature for the last 25 years<sup>7</sup>. Through teeth analysis, it is possible to study sexual dimorphism of an individual from the development pattern and teeth eruption, protein expression known as amelogenin, then teeth morphology and dimensions. The standard of 8teeth size based on odontometric study is specific to the population and showing a different level of sexual dimorphism<sup>3</sup>. Odontometric provides very useful information to determine types in a population as it is easy, reliable, and affordable and measurable<sup>9</sup>.

The difference between genders in teeth size has been explored in the last half century by odontologists and anthropologists who focus on the width measurement of mesiodistal. In the study done by Priyambadha (2016) in Java ethnic in Surabaya, Indonesia, shows that teeth can be used to determine gender in human. There are differences of mesio-buccal, buccolingual and diagonal of crown diameters between Javanese males and females<sup>10</sup>. One of the teeth that is able to show gender difference is central incisor teeth. Research by Srivastava et al in 2004 in India shows that central incisor teeth show a significant sexual dimorphism and it can be used as

an additional determination of genders for individuals or groups in mass disaster or archaeological sites<sup>11</sup>.

This research aims to analyse the influence of genders to the width of mesiodistal central incisor maxillary teeth in men or women. The study emphasises on mesiodistal incisor and caninus permanent teeth dimensions can specify genders identity in Minangkabau population.

## MATERIALS AND METHODOLOGY

The study was done using cross sectional approach with simple random sampling technique. Total samples were calculated using samples unpaired categorical analysis formula, with a total samples of 120 people. Ethical test has been done in Universitas Andalas with a test number of 073/KEP /FK/ 2017. The study was conducted in 3 areas where Minangkabau ethnic is from, Luhak Nan Tigo which is an area in Guguk sub-district, Situjuh and Tanjung Luhak Limapuluh Kota. To represent Luhak Tanah Datar, Tanjung Baru sub-district was chosen as the study location while Baso, Banuhampu and Tanjung Raya districts were chosen as the location used in Luhak Agam. The research was done by home visit in every research locations. Measurement was done by trained dentists to do accurate measurements.

Research subjects have to meet inclusion and exclusion criteria such as healthy teeth and periodontal condition, caries free teeth, normal overjet and overbite, no diastema in anterior teeth, normal molar and canine relationship for inclusion criteria while the exclusion criteria are teeth with dental filling, dental attrition and any other defects.

Maxillary dental tray of a right size with irreversible hydrocolloid alginate was used to mould respondents' maxillary. The ratio of powder and water used is according to the instruction in the packaging. The tray was being flown with flowing water and then drilled by a dental stone type III, water and powder ratio is 1:3 and setting time of 8-16 minutes. Mesiodistal central incisor teeth diameter was measured using a sliding digital caliper of 0.01 mm calibration. The width of mesiodistal measured by beak caliper from incisal parallel to tooth axis. The measurement was done on  $\frac{1}{3}$  incisal which is the biggest mesial and distal position. If teeth are rotated or misaligned, teeth are measured on between two surface points that are adjacent to the neighbouring tooth.

Mesiodistal width measurement was done to central incisor maxillary teeth. The measurement was repeated 3 times for each tooth for accuracy purpose.

Data was tabulated using Microsoft Excel software. Sexual dimorphism was calculated with the following formula:

$$\frac{\text{Average mesiodistal width of male teeth}}{\text{Average mesiodistal width of female teeth}} - 1 \times 100$$

Statistically, data were analyzed by statistic software SPSS 20. The relationship between variables was tested by independent T-test.

Parameters	Males (n=60)		Females (n=60)		P value
	Mean $\pm$ SD	Min-Max	Mean $\pm$ SD	Min-Max	
The width of right mesiodistal central incisor maxillary	8.545 $\pm$ 0.559	7.00 - 9.70	8.370 $\pm$ 0.630	7.00 - 10.00	0.001
The width of left mesiodistal central incisor maxillary	8.877 $\pm$ 0.663	6.00 - 9.20	8.583 $\pm$ 0.658	7.00 - 9.50	0.001

Table 1 shows a significant difference between right and left mesiodistal width of incisor maxillary.

Table 2. Sexual dimorphism of incisor maxillary teeth

Parameter	Dimorphism
Dimorphism I right central maxillary	2.09 %
Dimorphism I left central maxillary	3.43 %

Table 2 shows sexual dimorphism percentage in Minangkabau population calculated using Garn S.M formula (1967). Sexual dimorphism by the size of right and left central incisor maxillary is 2.09% and 3.43% respectively.

## DISCUSSION

Teeth are organs that made up of minerals suitable to anthropological, genetical, odontological and forensic investigations. The width of mesiodistal teeth crown is the base on morphological integration<sup>12</sup>. Odontometric is able to show sexual dimorphism to determine genders on cases in which identity can only be confirmed using craniofacial. As an instrument to determine genders, odontometric has become research subject for a long time.

## RESULT

The width range of right and left central incisor maxillary teeth for Minangkabau population is shown in Table 1. The average width for the right side is 8.545 mm for males and 8.370 mm for females while for the left side the average width was measured as 8.877 mm and 8.283 mm for males and females respectively.

Table 1. The distribution of central incisor maxillary jaw size based on genders.

Ditch and Rose are the first to prove that teeth diameter can successfully show genders from the skeletal in archaeology<sup>13</sup>. Measuring the diameter of crown tooth has been done for years in every population in the world. The teeth provide reliable information with lower level of errors. Maxillary and mandibular permanent teeth of Minangkabau people can be used to determine genders. There is a significant difference in central incisor maxillary between men and women<sup>10</sup>.

In the study average width of right central incisor maxillary for male is determined as 8.545 mm and 8.370 mm for females while for the left side is determined as 8.877 mm and 8.283 mm for male and female respectively.

Several studies show males to have bigger diameter size of crown teeth than those of what females have<sup>14</sup>. On average male has bigger diameter of central incisor crown tooth than what female has although the dimorphism degree varied in every population<sup>15</sup>.

The result is consistent with this study which shows a significant difference between male and female. Mesiodistal and buccolingual size of tooth crown are often used in genders determination. This study shows that the mesiodistal size of maxillary and mandibular central incisor is bigger in male than female.

Similarly, in buccolingual diameter measurement, the average diameter is bigger in men than in wo-

men except in the first premolar and second mandibular teeth<sup>16</sup>. This is in accordance with the previous study which stated that the crown of central incisor mesiodistal teeth is consistently higher in men than in women. Another research leads to a significant difference between males and females in buccolingual measurement.

Percentage of sexual variance (sexual dimorphism) between males and females are not too big, which is ranging from 2.09% to 3.43%. The results also show that the average of crown tooth is bigger in men than in women.

90% of organic component in enamel is amelogenin. It is a protein that consists of proline, glutamine, leucine and histidine. During the maturation process, enamel mineralisation happens fast. Amelogenin in human is produced by a gene with two copies, one in chromosome X and the other one in Y (AMGX and AMGY). About 90% of amelogenin comes from AMGX. The difference between AMGX and AMGY is the amino acid brought to produce sequence of amelogenin. Amelogenin fraction and product show sexual characteristic. The protein is expressed in the genes at chromosome X and Y, with 90% comes from chromosome X.

Amelogenin in the chromosomes does not undergo homologous recombination therefore amelogenin gene is a favourable genetic markers in determining genders in forensic. Chromosome Y influences the time and speed of growth. It causes enamel maturation to slow down and be wider compare to chromosome X.

Gender determination has been observed in complex enamel, dentin and pulp volume. Sexual hormone also influences odontoblast function. Estrogen antigen receptor has been identified in odontoblast at predestine layer and pulpa blood vessel from the extracted teeth<sup>18</sup>. There is a combination of envi-

ronment and genetic factors which control the diameters of mesiobuccal and buccolingual.

Chromosome Y gives the biggest contribution to the size of teeth by controlling dentin thickness whereas chromosome X is responsible to enamel thickness. Y chromosomes give a direct effect to teeth size which might be related to a non-specific effect at cellular activities. The size difference of tooth crown between men and women has been drawn as genetic expression with men having a bigger size than women do.

Y chromosome intervenes teeth size from the thickness of enamel and dentin whereas X chromosomes only have roles in controlling enamel thickness. Permanent crown tooth is formed at the formation of teeth and the dimension does not change during the growth and development of teeth, except in the cases of functional, pathological and nutritional interferences which can lead to changes in teeth dimension.

The difference in genders leads to the total of primary and secondary dentin to form more in males than in females. In men's teeth, dentin area is bigger than in women's. It can be concluded that male's teeth contain more dentin than female's teeth therefore this condition affects the diameters of crown tooth in the two genders<sup>17</sup>.

## CONCLUSION

Average width of right central incisor maxillary teeth is determined as 8.545 mm and 8.370 mm for males and females respectively. Average width of left central incisor maxillary teeth is determined as 8.877 mm and 8.283 mm for males and females respectively. Sexual dimorphism by the size of right and left central incisor maxillary is 2.09% and 3.43% respectively.

## REFERENCES

1. Ariani I. Nilai filosofis budaya matrilineal di minangkabau (relevansinya bagi pengembangan hak-hak perempuan di indonesia). <<http://jurnal.ugm.ac.id/wisdom/article/view/12613>> (10 January 2018)
2. Amri MR, Yulianti G, Yunus R, Wiguna S, Adi AW, Ichwana AN, et al. Risiko bencana Indonesia. Jakarta: BNPB, 2016: 9-140
3. Acharya AB, Mainali S. Sex discrimination potential of buccolingual and mesiodistal tooth dimensions. <<http://www.ncbi.nlm.nih.gov/pubmed/18557797>> (10 January 2018)
4. Patil KR, Mody RN. Determination of sex by discriminant function analysis and stature by regression analysis: A lateral cephalometric study. <<http://www.ncbi.nlm.nih.gov/pubmed/15567623>> (10 January 2018)
5. Astete JC, San Pedro VJ, Suazo GI. Sexual dimorphism in the tooth dimensions of Spanish and Chilean peoples. <<http://pesquisa.bvsalud.org/enfermeria/resource/en/lil-549160>> (10 January 2018)
6. Joseph AP, B VKR. How reliable is sex differentiation From Teeth Measurements. *Oral and Maxillofacial Pathology J* 2013; 4(1): 289-93.
7. Işcan MY, Kedici PS. Sexual variation in buccolingual dimensions in Turkish dentition. <<http://www.ncbi.nlm.nih.gov/pubmed/14609652>> (10

- January 2018)
8. Moreno-Gómez F. Sexual dimorphism in human teeth from dental morphology and dimensions: a dental anthropology viewpoint. In: Moriyama H. Sexual dimorphism. London: IntechOpen, 2013: 98-124.
  9. Khangura R, Sircar K, Singh S, Rastogi V. Sex determination using mesiodistal dimension of permanent maxillary incisors and canines. <<http://www.ncbi.nlm.nih.gov/pubmed/22408326>> (10 January 2018)
  10. Priyambadha F, Artaria MD. Variation of dental crown dimension between javanese males and females. *J Int Dent Med Res* 2016; 9(3): 178–83.
  11. Srivastava R, Jyoti B, Jha P, Gupta M, Devi P, Jayaram R. Gender determination from the mesiodistal dimension of permanent maxillary incisors and canines: An odontometric study. *J Indian Acad Oral Med Radiol* 2014; 26(3): 287–92.
  12. Kaushal S. Maxillary central incisor morphometry in North Indians: a dimorphic study. *JPAFMAT* 2005; 5: 13–7.
  13. Gupta S, Chandra A, Gupta P, Verma Y, Srivastava S. Establishment of sexual dimorphism in North Indian Population by odontometric study of permanent maxillary canine. *J Forensic Res.* 2014; 5(2): 2–5.
  14. Hattab F. Mesiodistal crown diameters and tooth size discrepancy of permanent dentition in thalassaemic patients. *J Clin Exp Dent* 2013; 5(5): 239-44.
  15. Ayoub F, Shamseddine L, Rifai M, Cassia A, Diab R, Zaarour I, et al. Mandibular canine dimorphism in establishing sex identity in the Lebanese population 2014; 2014: 12–5.
  16. Metgud R, Surbhi, Naik S, Patel S. Odontometrics : a useful method for gender determination in Udaipur population. *J Forensic Investig.* 2015; 3(2): 5.
  17. Dinakaran J, Dineshkumar T, Nandhini G, Priyadarshini N. Gender determination using dentition. *SRM J of Research in Dental Sciences* 2015; 6(1): 29-34
  18. Jedeon K, Loiodice S, Marciano C, Vinel A. Estrogen and bisphenol a affect male rat enamel formation and promote ameloblast proliferation. 2018; 155(9): 3365–75.