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Approximation length of the mandibular first molar tooth of Bataknese based on gender analyzed using parallel techniques

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ABSTRACT

Objectives: The purpose of this study is to use the parallel technique to approximate the tooth, root, and furcation length of the mandibular first molar in the Bataknese population while accounting for gender differences.

Materials and Methods: The research employs an analytic observational design with a cross-sectional approach. It utilizes secondary data from 90 parallel technique radiographs of patients aged 19-25 years who meet the specific inclusion and exclusion criteria. The radiographs are analyzed to assess tooth length, roots, and furcation of the mandibular first molar. Measurements are conducted using Cliniview software, and the results are processed and analyzed utilizing an independent t-test.

Results: The result showed that the average tooth length in males was 21.60 mm, with the mesial root measuring 13.64 mm, the distal root measuring 12.78 mm, and the furcation measuring 4.25 mm. In females, the average tooth length was 19.50 mm, with the mesial root measuring 12.13 mm, the distal root measuring 11.24 mm, and the furcation measuring 3.56 mm. Males have a greater average length than females.

Conclusion: Male teeth, roots, and furcations are longer than female teeth, according to the study's findings, which were derived via an analysis using the parallel technique. There was a discernible gender difference.

INTRODUCTION

One of the aspects of dentistry that has evolved is radiographic examination. At the moment, it serves as the primary diagnostic method for figuring out how bad oral illness is. Both intraoral (such as periapical bisecting, bitewing, and parallel radiography) and extraoral (such as cephalometry and panoramic radiography) radiographic procedures are used as evaluation techniques. Dental radiography is widely utilized because it generates images that may be used more quickly and accurately to identify abnormalities. This aids in assessing the oral cavity's general health and avoiding unnecessary operations.[1]

In dentistry, periapical radiography is a commonly utilized intraoral projection technique, particularly for endodontic treatment.[2] Periapical radiography is used to display the anatomy of each tooth, from the root to the crown, as well as the surrounding supporting tissues. The quality of the radiograph must be determined before any analysis or interpretation can begin, as low quality will limit the amount of important information that can be extracted from the diagnostic imaging, such as whether the radiograph shows distortion or elongation.[3] In periapical radiography, there are two primary methods: the parallel technique and the bisecting technique. These are a few of the most widely chosen methods for starting case management.[4] The parallel technique can yield more accurate radiographs than the bisecting technique because it minimizes geometric distortion in the orientation of the film, tooth, and central ray.[5] In dental care, the bisecting technique is more frequently used due to better patient adaptability, even if the parallel technique can produce more accurate radiographs.[6] Tooth size diversity across individuals is influenced by a multitude of factors, including hormonal differences between males and females, gender, environment, racial variations, and genetic or hereditary characteristics.[7] Root canal therapy is one of the procedures that ordinary dentists and dental conservation specialists typically perform, depending on its level of difficulty.[8] The gender of an individual affects the size of their teeth. Many teeth in the mouths of males and females are different in size. A person's tooth size is influenced by their race. The morphological traits unique to

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each race influence the variation in tooth size within that race.[9]

The three main races in the globe are Caucasoid, Negroid, and Mongoloid. Mongoloids make up the main race in Indonesia and are divided into two groups: Proto-Malay (Old Malay) which contains the Batak, Toraja, and Dayak tribes, and Deutero-Malay (Young Malay) which includes the Javanese, Banjar, and Balinese tribes.[10] Indonesia is home to a wide variety of ethnic groups and civilizations. One of the ethnic groups of Indonesia is the Bataknese, who live in North Sumatra. According to the 2010 Badan Pusat Statistik census, one of the largest ethnic groups in Indonesia is the Bataknese. This name refers to a group of ethnic groups that reside on and originate from the west and east beaches of North Sumatra Province. There is a sizable Bataknese population in North Sumatra.[11] The mandibular first molar is the most caries-prone tooth in humans, and even in young patients, it usually requires a root canal. Therefore, it is crucial to comprehend the length and curve of the root during root canal therapy to prevent any harm.[12] The average length of the mandibular first molar teeth, root, and furcation in the Bataknese population varies with gender, however, this information is currently unclear. The data that is currently accessible includes a study by Soraya et al. that indicates the average length of the maxillary permanent central incisor in Acehnese students, which is 25.86 mm.[13] The average length of the mandibular first molar in the Bangladeshi population was found to be 20.28 mm in the study by Alam et al.[14] According to Gu et al.'s research, the average length of the Chinese population's first mandibular molar root with two roots, measured vertically from the tip of the root to the CEJ boundary, is 13.16 ± 1.24 mm.[15]

It is quite possible that during root canal therapy, inadvertent incidents, often referred to as procedural blunders, will occur. One of the primary causes of these accidents is natural iatrogenic factors, such as extensive instrumentation in the pulp area. Over-instrumentation during the biomechanical preparation of endodontic therapy, especially in the danger zone of the root-dentin, leads to iatrogenic involvement of the furcation. Alghamdi et al. examined changes in furcation measurements of mandibular and maxillary molar teeth before and after root canal therapy. They found that the average furcation area of the teeth varied significantly between the pre-and post-root canal periods. Measurements of the furcation area taken both before and after root canal therapy demonstrate that endodontic treatments result in over-instrumentation.[16] The main objective of this study is to measure the tooth, root, and furcation length of the mandibular first molar in the Bataknese population using the parallel technique, considering gender variances.

MATERIALS AND METHODS

This study was an observational analytic study using a cross-sectional design. This research has received approval from the ethical commission of the Faculty of Medicine, Universitas Sumatera Utara with reference number 252/KEPK/USU//2024.

Ninety parallel technique radiographs of patients who met the inclusion and exclusion criteria, aged 19 to 25, from the Dental and Oral Hospital (RSGM) of Universitas Sumatera Utara were used as a secondary sample for this study. The samples needed to be in good visual condition, with the anatomy of the mandibular first molar teeth visible from the apex of the tooth to the tip of the highest cups, CEJ; they also needed to be free of caries at the CEJ, tilted teeth, lacerated roots, and fixed orthodontics. Cliniview 10.1.2 software was then used to measure the length of the tooth, root, and furcation from the gathered radiographs.

The tooth's length was measured along a vertical straight line from the highest cusp tip to the tip of the root (PG). The length of the root was measured along a vertical straight line from the CEJ to the tip of the mesial root (AM) and the distal root (AD). The length of the furcation was
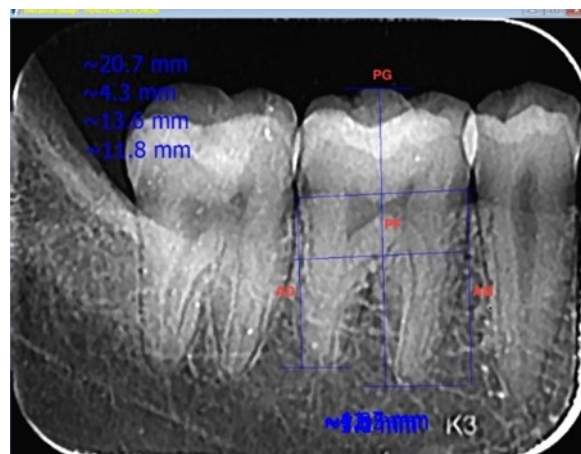

Figure 1. Measurement of the mandibular first molars' tooth length (PG), mesial root length (AM), distal root length (AD), and furcation length (PF)

measured along a vertical straight line from the CEJ to the lowest furcation surface (PF), as shown in Figure 1. Normality tests were conducted on the measurement results using the Shapiro-Wilk test, and if the data were normally distributed, the analysis proceeded with independent t-tests.

RESULTS

According to the study's findings, in the mandibular first molar, males have greater average tooth, root, and furcation lengths than females. It is also observed that the average length value of the mesial roots is greater than that of the distal roots in both males and females. The average value variations are displayed in Table 1 and Figure 2. The results of the data testing are shown in Table 2, where they are regularly distributed and homogeneous (p > 0.05). Table 3 demonstrates that, according to parametric testing using independent t-tests, there are significant differences between males and girls in the length of the tooth, root, and furcation of the mandibular first molar (p < 0.05).

Table 1. Based on gender, the mandibular first molar's tooth, root, and furcation lengths' mean and standard deviation

Gender		Tooth length	Mesial root length	Distal root length	Furcation length
Male	Mean	21.60	13.64	12.78	4.25
	N	45	45	45	45
	Std. Deviation	.826	.811	.940	.455
Female	Mean	19.50	12.13	11.24	3.56
	N	45	45	45	45
	Std. Deviation	1.333	1.172	1.182	.567
Total	Mean	20.55	12.89	12.01	3.91
	N	90	90	90	90
	Std. Deviation	1.527	1.258	1.316	.618

Table 2. Results of Shapiro Wilk normality and Leven's homogeneity test

Variable	Gender	Shapiro Wilk	Homogen Levene's
Tooth length	Male	.073	-
	Female	.067	-
	Based on mean	-	.060
Mesial root length	Male	.054	-
	Female	.051	-
	Based on mean	-	.064
Distal root length	Male	.123	-
	Female	.075	-
	Based on mean	-	.098
Furcation length	Male	.083	-
	Female	.052	-
	Based on mean	-	.065

Table 3. Result of Independent T-Test

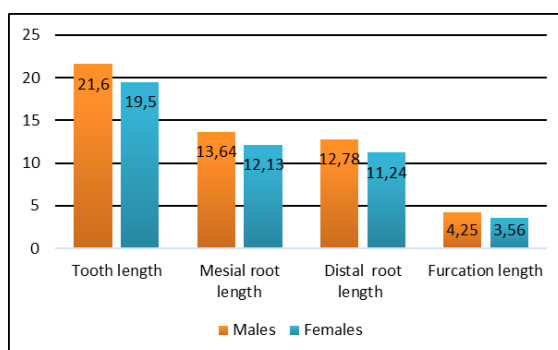| Variable	Independent T-Test (2-tailed)
Tooth length	.000
Mesial root length	.000
Distal root length	.000
Furcation length	.000

Figure 2. Diagram of the difference in mean values of the tooth, root and furcation length between males and females

DISCUSSION

When a clinician knows an estimated measure of the tooth length, it can be useful to determine the tooth length during therapy. This study used a parallel technique was used to acquire X-rays using a film holder and the periapical photo-alignment method. This method was selected because of its low distortion. This happens as a result of the film's alignment with the tooth's long axis. The length and width of the teeth can be captured in anatomically correct photographs by precisely focusing, immobilizing, and directing the beam with the use of a film holder. This method is simple to apply, comprehend, and understand. When a film holder with a beam centering mechanism is employed, the operator no longer needs to measure angles in both the horizontal and vertical axes, and dimensional corrections can be avoided.[13]

This study's average tooth length is different from that of previous research. Ethnicity or the use of various measuring tools, such as radiography and electronic measurements utilizing apex locators or other methods, maybe the cause of the variations. Using the paralleling technique, the average length of mandibular first molar teeth among all male and female samples was found to be 20.55 mm ± 1.527. Compared to the Madjapa (2018) study, which produced a value of 21.7 mm in the Tanzanian population, this finding is smaller.[17]

Out of all the male and female samples in this study, the mean mesial root length was 12.89 mm ± 1.258 and the mean distal root length was 12.01 mm ± 1.316. This result differs from that of the study by Akhlaghi et al. (2017), which used paralleling radiography to show that a selected group in Iran had an average mesial root length of 15.68 mm and a distal root length of 15.1 mm. This may be because the Aryan race, an Indo-European race, is represented in Iran. The Aryan race is more physically similar to Europeans, having a lighter complexion, higher cheekbones, and eyes that are blue, green, and light brown. In comparison to the Mongoloid race, it has similarities with the Caucasoid race, whose teeth are longer.[18] The average root length among African descendants was 9.94 mm ± 0.85, according to research by Theye et al. (2018) using micro-CT, which is less than the results of this study. There could be racial influences on this. A Negroid race of African heritage, they are characterized by physical attributes like a large or round face, dark skin, curly black hair, and a stocky, tall build. The Negroid race has tiny, rectangular mandibular first molar teeth.[19]

The average furcation length for both male and female samples in this investigation was 3.91 ± 0.618. Using CBCT, Al-Zoubi et al. (2018)'s study discovered that the Saudi population's mandibular first molar teeth had an average furcation length of 4.17mm ± 1.32. This discrepancy could result from the usage of various radiograph types in addition to racial differences. The Caucasoid race known as Arabs have longer teeth than the Mongoloid race. In this work, measurements were made using Cliniview software and periapical radiographs utilizing the paralleling approach. Prior research has employed CBCT and NewTom 3G software for measurements (NNT, QR SRL); Scanora 3D for OnDemand, Cypermed Inc., Irvine, CA), which offers 3D measurements that are more precise and detailed. The size discrepancy could potentially be attributed to variations in radiography type selection.[20] This study used periapical intraoral radiographs, and the radiograph results only provided a two-dimensional image. Previous studies using micro-CT (Computed Tomography) and CBCT (Cone Beam Computed Tomography) can offer three-dimensional reconstruction. In contrast, a prior study by Preminio et al. used Micro-Tomography, which can display both sides of the buccal and lingual sections, to measure the length of the buccal mandibular first molar furcation to 2.49 mm and 3.18 mm on the lingual part. The average furcation, which can only be measured on the buccal part in this study, is 3.91 mm shorter on the buccal part, according to the results.[21]

Male and female teeth have different sizes. This is a form of sexual dimorphism caused by higher gene regulation in males. The difference in the development of the first molar teeth between males and females can be explained through biological and hormonal factors. The teeth of males undergo a longer amelogenesis process than those of females. As a result, male teeth are generally larger than female teeth. This is related to differences in the phases of growth and bone maturation influenced by hormones such as estrogen and testosterone.[22] Testosterone levels in men are also higher compared to women during the growth process. During the growth process, men experience up to three times the amount of testosterone compared to women. The permanent teeth begin to appear and the primary teeth are ready to go through each stage of tooth formation, at which time the permanent teeth also begin to develop. When the primary teeth are ready to go through each stage of tooth development, the permanent teeth begin to appear and grow. Testosterone levels peak around the 14th week of pregnancy. This increase indicates that growth is influenced by hormonal factors.[23] Dentin thickness is also influenced by the X and Y chromosomes in both sexes, as the Y chromosome affects both dentin and enamel formation, while the X chromosome is involved only in enamel production. Males tend to have thicker dentin compared to females, so males with XY chromosomes generally have larger teeth than females with XX chromosomes. The developmental differences of other teeth, such as incisors, canines and premolars also follow a similar pattern to the molars, but with certain variations.[24]

Tooth growth is also influenced by environmental factors and nutrition. A person's healthy growth and development depends on the nutrients they consume, which can lead to variations in tooth size both during pregnancy and after giving birth. Calcium and protein are two nutrients that are very crucial for the growth of bones and teeth. A mother who consumes little

calcium during her pregnancy will affect her unborn child's teeth. Another nutrient that is necessary for the growth and development of teeth is vitamin A. A shortage in vitamin A can cause the mineralization process to slow down, changing the chemical composition of dentin. The size of each person's teeth will vary based on the nutrition they take in throughout pregnancy. An environment's influence on a race's dental morphological characteristics can also be linked to a location's geographic factors.[9]

The results of this study demonstrate that, in the Bataknese utilizing the parallel technique, the mean values of mandibular first molar length, mesial root length, distal root length, and furcation length are higher in males than in females. Despite having the same dental anatomy, men's and women's teeth are not the same size because of several factors that substantially affect tooth size.[25] The theory of Fidya et al. (2016) states that variations in male and female size, height, and appearance are referred to as sex differences. Teeth have a relatively low observer error rate and can yield trustworthy information. However, because of their small size, teeth also require very accurate measurements.[26] Dimorphism is a trait shared by humans and other living creatures that is defined by variations in the size of various body tissues brought on by sex differences. Males and females differ in size, shape, color, and other dimensions as a result of these dimensional alterations.[27]

When completing root canal therapy in a location without radiography, these results may help estimate the working length by showing the length and furcation of the teeth and roots in the Bataknese. This study emphasizes how crucial it is to take ethnic and gender variations in dental morphology into account. Male and female Batak people differ significantly in their tooth, root, and furcation lengths, which emphasizes the need for a customized approach in dental practice and forensic applications. By identifying and taking these variations into account, dental professionals can enhance treatment outcomes and boost the precision of forensic identification.

CONCLUSION

Male teeth, roots, and furcations are longer than female teeth, according to the study's findings, which were derived via an analysis using the parallel technique. There was a discernible gender difference.

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None.

FOOTNOTES

All authors have no potential conflict of interest to declare for this article. This research has received approval from the ethical commission of the Faculty of Medicine, Universitas Sumatera Utara with reference number 252/KEPK/USU//2024. All procedures conducted were in accordance with the ethical standards.

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