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Prevalence of mandibular third molar impaction roots position towards mandibular canal based on rood and shehab classification (studies on panoramic radiographs)

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ABSTRACT

Objectives: This study aims to determine the prevalence of the position of the impacted mandibular third molar roots in relation to the mandibular canal using a classification by Rood and Shehab.

Materials and Methods: This study is a descriptive study with a cross-sectional approach. The samples were 210 left and right third molar impaction tooth mandibular on 105 digital panoramic radiographs at the Radiology Installation, RSGM FKG Usakti, and categorized according to the seven classifications by Rood and Shehab. The interobserver reliability test was conducted using Cohen's Kappa test. The data is presented as frequency and percentages for each type of root position classification.

Results: Radiolucent tooth type on the root was the most prevalent at 104 (50%), white line interruption in 28 (13%), narrowing of the mandibular canal in 27 (13%), deflection of the tooth root in 26 (12%), deflection of mandibular canal in 11 (5%), narrowing of the root in 8 (4%), and bifid apex in 6 (3%).

Conclusion: The highest prevalence of third molar impaction tooth root position was the radiolucent type at the root, and the lowest was the bifid apex type.

Keywords: *Panoramic radiography, impacted third molar roots, mandibular canal*
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INTRODUCTION

Dental panoramic radiography is the most frequently used extraoral examination to assess the risk of inferior alveolar nerve injury in lower third molar surgery.[1] Panoramic radiography is commonly used to evaluate the prevalence of third molars, impaction status, and the proximity of impacted mandibular third molars to the mandibular canal. Panoramic radiography is also performed to evaluate the position and anatomy of the roots of third molars and their relationship to surrounding vital structures. The position of the third molar root is the most important factor related to inferior alveolar nerve injury. The mandibular third molar is the most frequently impacted tooth of all types of teeth, followed by the maxillary third molar, maxillary canine, mandibular premolar, maxillary premolar, and second molar. The potential for tooth impaction exists in all individuals, and the incidence of impaction may vary based on different studies. One of the complications of mandibular third molar extraction is nerve complications during surgery due to improper diagnosis or surgical technique. Nerve injury can be temporary or permanent. According to a study by Yunus et al., the incidence of inferior alveolar nerve injury increases by 30% due to the proximity of the third molar root to the mandibular canal. Therefore, evaluation of the position and relationship of the third molar tooth to the mandibular canal before extraction is very important to reduce the possibility of nerve damage.[2]

The close root position to determine the involvement of the inferior alveolar nerve in the impacted tooth root can be seen radiographically and assessed using the Rood and Shehab classification.[3] The Rood and Shehab classification consists of seven signs on panoramic radiography, namely, radiolucency in the root, deflection of the tooth root around the canal, narrowing of the tooth root and passing through the canal, bifid apex, interruption of the white line of the mandibular canal, diversion of the canal, and narrowing of the mandibular canal. Evaluation of these seven signs

results in better surgical planning, which ultimately helps dentists to avoid injury to the inferior alveolar nerve.[4,5] Based on the above, identification of the location of the mandibular canal to the position of the impacted root of the third molar tooth has an important role in avoiding the risk of complications of inferior alveolar nerve injury during tooth extraction procedures. Therefore, the aim of this study was to determine the prevalence of impacted mandibular third molar root position in relation to the mandibular canal based on the Rood and Shehab classification on panoramic radiographs.

MATERIALS AND METHODS

The type of research that will be carried out in this study is descriptive observational using a cross-sectional study design. The study was conducted at the Dental Radiology Installation of the Dental and Oral Hospital, Faculty of Dentistry, Universitas Trisakti, West Jakarta, to collect digital panoramic radiography data. The digital panoramic radiograph samples were obtained from the radiology database for the period January 2021-March 2023. This study used a categorical descriptive rule; the samples consisted of 210 left and right third molar impacted mandibular teeth on 105 digital panoramic radiographs at the Radiology Installation, RSGM FKG Usakti. Data measurement in this study used the Rood and Shehab classification to evaluate the proximity and positional relationship of the mandibular canal to the apical region of the mandibular third molar. Evaluation of 7 signs of Rood and Shehab classification, namely root radiolucency, root deflection, root narrowing, bifid apex, interruption of the white line of the mandibular canal, deflection of the mandibular canal, and narrowing of the mandibular canal (**Figure 1**).

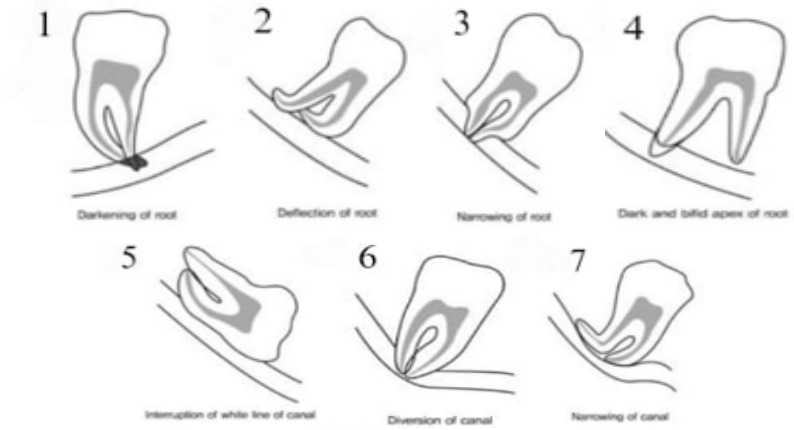

Figure 1. Rood and Shehab classification.[8]

Radiographic assessment of the position of the impacted third molar mandibular tooth root to the mandibular canal was carried out on panoramic radiographic images by a researcher and supervised by a dentist specializing in dental radiology using software i-Dixel (Morita, Japan) to evaluate the radiographic images to determine the appropriate classification for each sample.

The researcher collected and analyzed the research data and then processed it to determine the position of the impacted third molar mandibular tooth root to the mandibular canal. In this study, an interobserver reliability test analysis was carried out with one of the dentists specializing in Dental Radiology. The results of the analysis were carried out using Cohen's Kappa method, and then the data were processed using SPSS (Statistical Package for the Social Sciences) software. The results of the research data analysis will be presented in the form of a distribution Table. This research was conducted in accordance with research ethics. Ethical Clearance was obtained by submitting an approval sheet to the Health Research Ethics Commission of the Faculty of Dentistry, Trisakti University. The approval letter was issued by the Health Research Ethics Commission with the number 744/S1/KEPK/FKG/1/2024.

RESULTS

The results of the Cohen's Kappa coefficient test based on the interobserver reliability test are presented in **Table 1**.

Table 1. Coefficient Cohen's Kappa test results

	Coefficient Kappa	*P value*
M3 Right	0,663	0,000
M3 Left	0,600	0,000

In Table 1, the results of the Cohen's Kappa Coefficient test showed no significant difference (p value <0.005). After that, the results of the Cohen's Kappa test and the kappa coefficient of the right third molar were 0.663, and the left third molar was 0.600; each kappa coefficient value was in the moderate category.

From 105 panoramic radiographs consisting of

210 teeth, including the left and right third molars that had been tested for interobserver reliability, an overall prevalence calculation was carried out on the position of the third molar root in the mandible against the mandibular canal, and categorized according to seven Rood and Shehab classifications, as shown in **Table 2**.

Table 2. Prevalence of mandibular third molar root position in relation to the mandibular canal as a whole

Rood and Shehab Classification	n	%
1. Radiolucency on the root	104	50
2. Deflection of the tooth root	26	12
3. Narrowing of the root	8	4
4. Bifid apex	6	3
5. Interruption of the white line of the mandibular canal	28	13
6. Deflection of the mandibular canal	11	5
7. Narrowing of the mandibular canal	27	13
Total	**210**	**100**

Based on Table 2, the most common classifications were radiolucent roots with 104 (50%), followed by interruption of the white line of the mandibular canal with 28 (13%), narrowing of the mandibular canal with 27 (13%), deflection of the tooth root with 26 (12%), deflection of the mandibular canal with 11 (5%), narrowing of the root with 8 (4%) and bifid apex with 6 (3%).

DISCUSSION

This study refers to the Rood and Shehab classification because of the seven radiological diagnostic signs that have been mentioned; these signs are important in clinically diagnosing the prediction of possible inferior alveolar nerve injury. In this study, the interobserver reliability test used the Cohen's Kappa method to assess the consistency of the measurement results carried out by two people, namely, the raters, on a measuring instrument.[6] The Cohen's Kappa coefficient value data obtained on the roots of the left and right impacted molar teeth produced a kappa coefficient for the right M3 of 0.663 or 66.3% and the left M3 of 0.600 or 60.0% which can be seen in Table 1. The coefficient figures obtained showed a good level of consistency (level of agreement) in each observer and had the same perception results in identifying the position of the roots of the mandibular third molar impaction teeth against the mandibular canal with the Rood and Shehab classification. In addition, there is a correlation between observer 1 and observer 2 with a p-value of $p < 0.005$.[6]

The results of the classification of the position of the mandibular third molar impacted root to the mandibular canal as a whole obtained the highest prevalence, namely the radiolucent type on the root of 104 teeth (50%), then the white line interruption of 28 teeth (13%), and narrowing of the mandibular canal of 27 (13%) and the lowest prevalence of bifid apex of 6 teeth (3%) from a total of 210 teeth consisting of 105 radiographs.

This is in line with research conducted by Pandey et al., in 2018 which reported that, radiolucent tooth conditions on the roots were 14 teeth, then white canal line interruptions were 11 teeth and root deflections were 9 teeth out of a total of 47 teeth, this study stated that root narrowing and bifid apex conditions were the least and rarest types of tooth conditions found, with a prevalence of 0 teeth (0.0%) each.[7]

The results of research by Kamadjaja on the prevalence of third molar root classification against the mandibular canal obtained the most classification, namely radiolucent on the roots as many as 58 (55%) followed by root deflection as many as 15 (14%), and white canal line interruptions as many as 13 (12%) Then the lowest prevalence was in the type of root narrowing 2 (2%) found in this study.[8]

The results of research from Al-Dajani et al., showed that the third molar root type of radiolucent on the roots was consistently the most common and did not differ in the degree and distribution of impact from different races in each country.[9] In different radiological techniques, it was also reported that root radiolucency was found to be the most common, while white line interruption was the second most common classification. But with the cases found, there was a different prevalence. The previous different findings could be due to sample variation, differences in researcher experience, use of different methodologies, and radiographic techniques.[10] Cases of impacted third molars increase with age. This is because the impacted mandibular third molars are difficult to remove.[11]

In a study by Lacerdas et al., in 2020, of the 7 radiographic signs, the most frequently observed in this study were radiolucent tooth roots and interruption of the white line of the mandibular canal, which confirms the results found in the literature.[12] Several studies have verified that these signs are among the most important radiographic parameters to indicate the risk of damage to the mandibular alveolar nerve during mandibular third molar extraction (risk 8% -22%).[12]

The appearance of radiolucency in the tooth root varies according to the position of the mandibular canal with the tooth root. The location of the mandibular canal is close to the lingual cortex in the retromolar space. In the retromolar space, the distance from the mandibular canal to the buccal cortex is approximately twice that observed to the lingual cortex, while the distance to the base of the mandible is approximately four times that to the lingual cortex.[13]

Radiolucency of the root and mandibular canal on panoramic radiographs is an important indicator of the position of the tooth root within the mandibular canal. Contact between the mandibular canal and the impacted third molar root causes loss of density of the third molar root, so that on panoramic radiographs, the tooth appears more radiolucent.[14] Radiolucency of the third molar root and interruption of the mandibular canal indicate thinning of the bone in the lingual area.[15] The appearance of the third molar root that is getting darker and the disconnection of the mandibular canal indicate thinning of the bone in the lingual area because the impaction of the mandibular third molar exceeds the pressure on the mandibular bone in the lingual area, which causes the lingual area to become thinner than the buccal area.[14]

The root of the third molar is an important marker that needs to be considered because it is one of the factors causing injury to the inferior alveolar nerve. The level of impaction of the mandibular third molar is relatively high, so it requires accurate radiographic interpretation and high-level preparation by the dentist to perform the extraction procedure without causing injury to the inferior alveolar nerve.

Injury to the inferior alveolar nerve is rare, but the risk can increase from 19 to 30% if there is direct contact between the root and the nerve.[7] Therefore, in order to clearly assess the relative position of the nerve and the tip of the impacted third molar root, it is very necessary to evaluate the protection of the nerve from mechanical damage during the surgical procedure. It is done as a form of care to guide and inform patients about the possibility of nerve injury during tooth extraction. Pandey et al., 2018 reported that the panoramic radiographs obtained showed a close relationship between the third molar root and the mandibular canal such as root radiolucency, white line interruption, root narrowing, root deflection, mandibular canal narrowing, and bifid apex.[7] These results are also supported by previous research by Szalma et al., who reported that there was a correlation between radiographic markers and exposure of the inferior alveolar nerve. The inferior alveolar nerve was seen in 47 (15.2%) of 309 intraoperative extractions. Radiolucency in the third molar root is significantly associated with exposure of the inferior alveolar nerve (P value <0.001).[16]

Some things to note are that if the position of the third molar root with the mandibular canal is reviewed based on panoramic radiography techniques, then the findings have weak diagnostic accuracy because impacted third molars are often outside the center of rotation of the detector and radiological source, causing incorrect visualization interpretation.

Park et al., showed that the main weakness of panoramic radiography is the limited three-dimensional visualization of the position between the mandibular canal and the roots of the mandibular third molar. Therefore, the condition of the impacted third molar root, such as radiolucent teeth on the root, root deflection, and interruption of the white line of the mandibular canal observed on panoramic radiography, either as isolated or associated findings, requires additional evaluation, namely CBCT, in determining the risk relationship between the tooth root and the mandibular canal effectively.[16] Then CBCT is performed if there is suspicion of contact between the mandibular canal and the root of the mandibular third molar on panoramic radiography, or if the third molar is impacted. After that, the advantages of panoramic are a simple supporting examination, easy to assess, easy to find (widely distributed), and affordable compared to CBCT.[11]

Pandey et al.'s study used CBCT to evaluate panoramic findings in cases where the apex of the third molar root was close to the mandibular canal with a high possibility of inferior alveolar nerve injury. Overall, cortical disorders occurred in 63.8% of cases, indicating that the risk of nerve injury was higher in CBCT results compared to panoramic radiographic assessment. The cortical integrity of the mandibular canal is an important predictor of nerve injury.[7]

Pandeli et al.'s study showed that only three-dimensional examination can accurately determine the root of the third molar tooth to the mandibular canal with better treatment planning.[7]

Regardless of the radiographic examination technique used, if there are signs indicating proximity, the dentist should use a surgical technique that facilitates the extraction of the third molar tooth while minimizing the risk of damage to the inferior alveolar nerve, such as odontectomy.[12]

CONCLUSION

Based on the results of the study conducted from 210 impacted mandibular third molar on 105 panoramic radiographs regarding the prevalence of third molar roots to the mandibular canal based on the Rood and Shehab classification, it can be concluded that the most common classification is radiolucency in the root as many as 104 (50%), followed by interruption of the white line of the mandibular canal as many as 28 (13%), narrowing of the mandibular canal as many as 27 (13%), deflection of the tooth root as many as 26 (12%), deflection of the mandibular canal as many as 11 (5%), narrowing of the root as many as 8 (4%) and the least classification is bifid apex as many as 6 (3%).

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FOOTNOTES

All authors have no potential conflicts of interest to declare in this article. This research has received ethical approval from the Research Ethics Commission of the Faculty of Dentistry, Trisakti University, with 744/S1/KEPK/FKG/1/2024. The research has been carried out by ethical standards.

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