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Research Article

Evaluation of Relationship Between Mandibular Third Molars and Mandibular Canal: Comparison of Findings Obtained by Panoramic Radiography and Cone-Beam Computed Tomography

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Evaluation of Relationship Between Mandibular Third Molars and Mandibular Canal: Comparison of Findings Obtained by Panoramic Radiography and Cone-Beam Computed Tomography

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Abstract

Statement of the problem: It is important for oral surgeons to determine the precise location of mandibular third molar before extraction. The close relationship of mandibular canal and mandibular third molar is a risk factor for alveolar nerve damage.

Objective: The purpose of this study is to assess the relationship between mandibular canal and the mandibular third molar which has already been seen in close relationship on panoramic radiograph (PR) by the comparison of findings of the cone-beam computed tomography (CBCT) and the PR.

Materials & Methods: Close relationship between the mandibular third molar and mandibular canal was scanned in 180 patients by the PR. Images were also obtained by CBCT from patients among which a close-relationship was detected between mandibular canal and mandibular third molar.

Results: Close relationship was detected between mandibular third molar and mandibular canal on 26 of 180 PR and evaluated 46 mandibular third molars. In 41 cases, both the findings in PR and in CBCT images showed compliance with each other. As a result it was clearly seen that the mandibular third molars which were detected to be in close relationship on PR were mostly also in close relationship with mandibular canal on CBCT-images.

Conclusions: If the close relationship is not seen on the panoramic images then there is no need to get CBCT for extracting the mandibular third molars. By this way complication risks are eliminated with less radiation. However CBCT should be definitely used in cases which complete assessment cannot be made in no way due to artifacts such as superposition in PR.

Keywords: Inferior Alveolar Nerve, Cone-Beam Computed Tomography, Panoramic Radiography, Third Molars, Mandibular Canal

Introduction

It is crucial to determine the certain location of impacted teeth before an operation for extraction for oral surgeons. Panoramic radiography was conventionally used to detect impacted teeth. This technic is widely used due to its advantage of providing the image of both jaws in a single film, with a relatively low radiation dose, in a short time and at low cost.¹ The assessment of the position, depth and type of impaction, the texture of investing bone will be beneficial. However, with this technic it may not be always possible to assess the relationship between third molar tooth and the mandibular canal and from a bucco-lingual perspective. Sometimes images need to be evaluated in 3-Dimensional but this is not possible with conventional methods such as panoramic radiography. At this point the surgeon should obtain the images with cone-beam computed tomography (CBCT).² CBCT provides cross-sectional imaging of an object by data, which collected with irradiating the object from many different directions. CBCT was started to be used frequently before the surgery of oral and maxillofacial region, supplies a better assessment of the anatomical structures, which is essential to prevent the complications and to improve the prognosis.³

The mandibular canal and apices of impacted teeth can have a close relationship. An important vascular-nerve package contains nervus alveolaris inferior inside mandibular canal. Therefore, one of the main complications of lower third molar teeth surgery is the damage of the inferior alveolar nerve.⁴ Dysestia could be seen after the extraction of lower third molar that is an unpleasant complication. However nervus alveolaris inferior couldn't be monitored by imaging method in dentistry. Therefore, physicians protect nervus alveolaris inferior based on mandibular canal during surgery. When the mandibular canal was expressed in this article, nervus alveolaris inferior should also be considered.⁵

The aim of this study is to evaluate the relation between the mandibular canal and third molar teeth that is close relationship on panoramic radiographs by the comparison of findings of the CBCT and the panoramic radiography via using statistical methods.

Materials & Methods

The present study was approved by The Ethical Committee of University of Health Sciences (2021/279), and executed in accordance with the Helsinki Declaration of 1975, as revised in 2008.

Before the operation, panoramic radiography was taken from all patients to have a 3rd molar tooth extracted who were referred to the Department of Dentomaxillofacial Radiology. Within the date range of the study, all panoramic radiographs taken before the third molar tooth extraction was evaluated. 180 panoramic radiographs (180 patients) were evaluated for this study. No criteria was taken as basis for these radiographs evaluated. Those with a close relationship between third molar teeth and mandibular canal in panoramic radiographs were evaluated in the study. All of the patients who agreed to participate were included in the study.

The images were captured using the Planmeca ProMax 2D S3 dental panoramic x-ray machine (with exposure settings of 65-90 kVp, 15 mA, and 13 s) and the images were evaluated using the MicroDicom Dicom Viewer (version 3.8.1) program on a computer under consistent conditions.

A close relationship between third molar teeth and mandibular canal was determined in 26 of 180 images on panoramic radiography. These 26 patients agreed to participate in the study. 46 third molar teeth in 26 panoramic radiographs (15 women and 11 men; 18-39 years of age ; mean 25.26) were found in close relationship with the inferior alveolar canal on the panoramic radiograph. These 26 patients were also imaged by CBCT to confirm the close relationship seen on panoramic radiography. All of the patients were informed of the advantages and disadvantages of CBCT by oral radiologists and oral surgeons and signed an informed consent. After computed tomographic examination, all of the patients were treated surgically, and a total of 46 teeth were extracted with no complications such as dysesthesia.

For the purpose of CBCT evaluations, we utilized proprietary manufacturer software (i-Dixel 2.0/One Data Viewer/One Volume Viewer; J Morita Mfg. Corp.). The images were observed on a 30-inch Dell 3008WFP Flat Panel Monitor (Dell Inc., Round Rock, TX, USA) in a dimly lit room, with a screen resolution of 1920x1200 pixels and 32-bit color depth.

The relationship between the inferior alveolar canal and mandibular third molar root on the panoramic radiograph was assessed by determining the position and if it is not erupted; the dept of the impacted. The relationship between the alveolar inferior canal and the 3rd molar teeth as bucco-lingual in terms of position was examined in 3 categories in CBCT: buccal, inferior and lingual (Figure 1, 2, 3, and 4).

Figure 1. A right lower third molar root is located in the upper half of the alveolar inferior canal. The left third molar root is located over the inferior wall of the alveolar inferior canal.



Figure 2. Axial slice of tomographic image and its panoramic views.

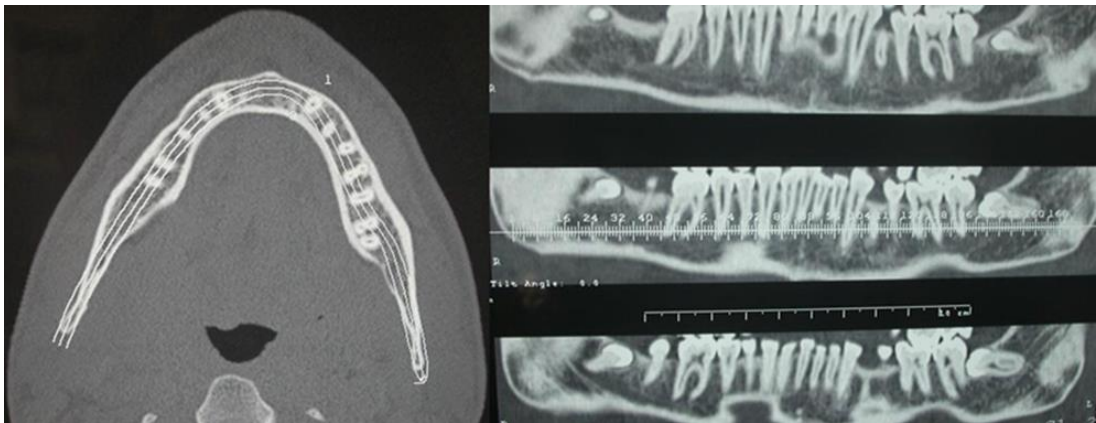


Figure 3. Right side of the mandible. Alveolar inferior canal was placed inferior of the mandibular third molar.



Figure 4. It was clearly seen on the tomographic coronal slice that mandibular canal is placed lingual side of the mandibular third molar roots.



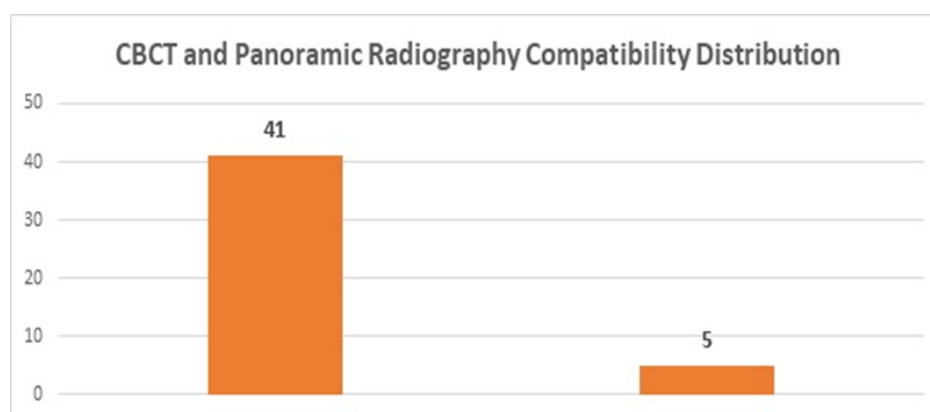
The data analyzed with descriptive statistics. Statistical analyses were performed using the SPSS software (version 22.0; SPSS Inc, Chicago, IL, USA).

Results

Close relationship was detected between mandibular third molar and inferior alveolar canal on 26 of 180 panoramic radiographs and evaluated 46 mandibular third molars on 26 radiographs.

In 41 cases, both the findings in panoramic radiographs and in CBCT images showed compliance with each other. The findings of the panoramic radiographs and the computed tomographic images did not match in 5 cases. In 5 cases were clearly seen close relationship on the panoramic radiographs, however there were no relationship on the computed tomographic images of those cases (Figure 5).

Figure 5. The compatibility of CBCT and Panoramic Radiography on the evaluation of relation between the third molar teeth and alveolar inferior canal.

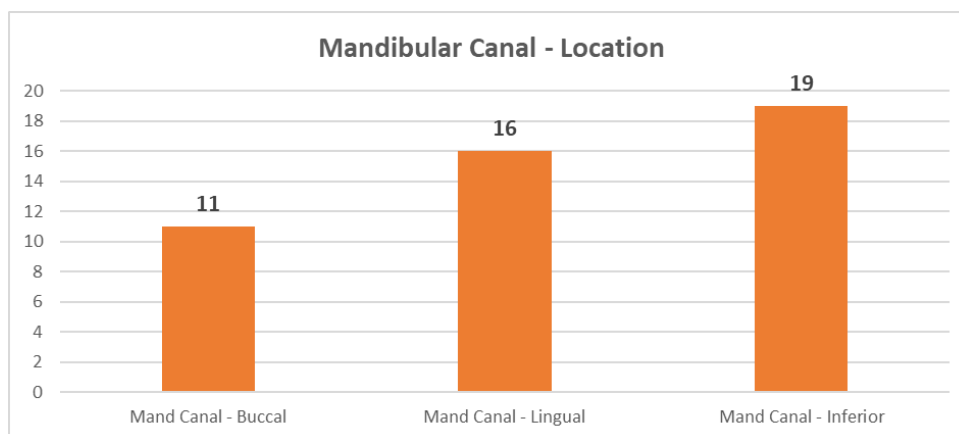


Of these 5 images which could not be found compliance between two imaging techniques, 4 belonged to a male and 1 to a female. Inferior alveolar canal was located in the buccal of the mandibular third molar in 3, in the lingual in 1 and inferior in 1 of the images where there was no consistency between the technics. Positionally, 3 of them were mesioangular, 1 of them was vertical and 1 of them was erupted. The consistency between panoramic radiography and CBCT was 89.13% in the images of the study.

The data analyzed with descriptive statistics. Of the 46 teeth examined with the aid of CBCT, 11 (23.91%) inferior alveolar canals were in the buccal side, 16 (34.78%) were lingual and 19 (41.3%) were in the inferior position (Figure 6). All the images in which the inferior alveolar canal was in the buccal position belonged to male patients, 94% of the images in the

lingual position to female patients, and 53% of the images in the inferior position to male patients.

Figure 6. The location of inferior alveolar canal according to mandibular third molar.



46 cases were classified into 5 categories, according to the angulation of the teeth and whether they were erupted or impacted. 15 (32.6%) of 46 were erupted, 11 (23.91%) were mesioangular impactions, 1 (2.17%) distoangular impaction, 10 (21.73%) were horizontal impactions and 9 (19.56%) were vertical impactions. As the statistical results indicate 67.4% of teeth were not erupted and shows significantly high ratio to analyze the data.

Discussion

To determine the position and shape of roots before third molar extraction, the first option of imaging method naturally should be 2D radiography. However, 2D radiography is not always adequate.⁶ Ericson and Kurol reported that 2D radiography alone was not enough to detect an impacted tooth.⁷ Traxler evaluated the results of CBCT and orthopantomography for 55 patients with unerupted teeth, and they put forth that CBCT is more favorable in point of determining the position of the tooth.⁸

Damage of inferior alveolar nerve after third molar surgery is a well-known and rare complication with a reported prevalence ranging from 0.5% to 5%.^{9,10} Inferior alveolar injury induced dysesthesia usually occurs within a few months. The most important factor contributing to inferior alveolar nerve damage may be the anatomic proximity to the third molar root. Therefore, radiographic assessment before the surgery is necessary for planning the operation. Usually, a panoramic radiograph may provide the determination of the location of inferior alveolar canal; but accurate anatomical data is sometimes insufficient with this method. Since this method gives 2D image, the information it can give is limited.

According to Miller of 31 teeth examined by CBCT, inferior alveolar canal was placed on the buccal side of the mandibular third molar in 14 teeth (45.2%), inferior of the root in 5 teeth (16.1%) and lingual side of the root in 12 teeth (38.7%).¹¹ Maegawa reported that the inferior alveolar canal is most often located on buccal side.¹² In this study 11 (23.91%) mandibular canals were on the buccal side, 16 (34.78%) were lingual and 19 (41.3%) were in the inferior position. According to Miloro 165 of 541 teeth examined manually and 45% of the third molars were erupted, 8% were horizontal, 12% were distoangular, 10% were vertical and 25% were mesioangular impactions.¹³ In this study 15 (32.6%) of 46 were erupted, 11 (23.91%) were mesioangular positioned, 1 (2.17%) distoangular positioned, 10 (21.73%) were horizontal positioned and 9 (19.56%) were vertical positioned. There does not exist a significant relation between these positions.

Öhman reported that mandibular third molar and the inferior alveolar canal were in contact in %94 of the cases.¹⁴ In many previous studies the course of the inferior alveolar canal was mostly seen on the buccal of the roots, determined to be at least 50%.^{12,15,16} However, Öhman found this ratio to be only 31% and concluded that the mandibular canal mostly runs through lingual of the roots.¹⁴ In this study it was found that 11 (23.91%) mandibular canals were on the buccal side, 16 (34.78%) were on lingual side.

Liqun evaluated 1296 mandibular third molars on CBCT. 7.1% Of cases was in close relation with inferior alveolar canal. In the 88% of cases mandibular canal was on the apical (inferior) side of third molar.¹⁷ Liqun suggests that in cases where the roots are in close contact with the canal, the canal is usually positioned in the lingual of the roots.¹⁷ In this study statistical results significantly indicate that the third molars which are in close relation with mandibular canal were mostly in the inferior position (41.3%).

Pawelzik reported that 90% of CBCT images the relationship between the inferior alveolar canal and the third molar clearly seen but the exact anatomy could not be seen on the conventional panoramic images.¹⁸ In this study 5 cases were clearly seen in close relationship on the panoramic radiographs but no relationship was detected on CBCT images. According to this, it had been concluded that there is 89.13% consistency between the two techniques, similar to the Pawelzik, in terms of the relation of these two structures. It is not possible to draw a meaningful conclusion via statistics in terms of the status of the mandibular third molar and its position relative to inferior alveolar canal in images with incompatibility.

Tantanapornkul¹⁶ studied the accuracy of panoramic radiographs about detecting the relation between third molar and mandibular canal. Only interruption of inferior alveolar canal wall either isolated or in association with darkening of third molar root, showed a statistically significant association with the direct contact between the canal and the roots on 3D images. They were defined as panoramic criteria. When these findings were encountered, panoramic radiography has been evaluated as reliable in determining the relationship between the third mandibular molar and inferior alveolar canal. Elkhateeb had been reached similar results in their study.⁴

The studies show that regarding the close relationship between the two structures, a certain parameter could not be reached in terms of how the inferior alveolar canal is positioned relative to 3rd molar tooth, it's variable. No majority can be mentioned as a percentage. However, some parameters can be reached in terms of the images given by the close relationship on panoramic radiography. Tantanapornkul and Elkhateeb have revealed these parameters with their studies.⁴ They reached these parameters by verifying panoramic radiography images with 3D imaging techniques.

The results in this study show that with accurate and careful evaluation of panoramic radiography is effective for determination of inferior alveolar canal and mandibular third molar tooth relation. Only 5 of the 46 third molar teeth were incompatible with the panoramic radiography and CBCT images in relation to the inferior alveolar canal. However in studies to be carried out by increasing the number of data, meaningful results can be obtained in terms of positioning of mandibular canal in images without consistency. And at this point, when evaluating the relation between the mandibular canal and the mandibular third molar, it can be evaluated more effectively in which cases CBCT imaging is required.

The limitation of this study; since the panoramic radiography gives 2D image, the information it can give is limited. Therefore, accurate anatomical data is sometimes insufficient with this method.

Conclusion

Pre-surgical imaging is essential to prevent any occurrence of perforation or damage to the mandibular canal during mandibular third molar tooth extractions. Panoramic radiographic evaluation with a complete knowledge of anatomy will be sufficient. In addition to existing

studies, by increasing the number of samples in new studies, more detailed and precise parameters can be reached on the panoramic radiography, showing the close relationship between the two structures. By this way, complication risks were eliminated with less radiation.

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