

## Diagnostic accuracy of panoramic radiograph vs cone beam computed tomography in assessing the relationship with the inferior alveolar nerve.

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### ABSTRACT:

**Aim:** To evaluate whether the use of CBCT, with its additional information, alters the preoperative assessment for lower third molar extraction compared to OPG, and subsequently leads to a different surgical approach. **Objectives:** To identify radiographic indicators of the proximity of the third molar to the inferior alveolar nerve using OPG, and to evaluate and compare the relationship between the lower third molar and the inferior alveolar nerve as assessed by CBCT and OPG. **Materials and methods:** This study involved 100 participants. CBCT images were used to assess the relationship between the inferior alveolar canal (IAC) and impacted mandibular third molars (IMTM), the IMTM's position relative to the IAC, mandibular morphology, IMTM type, and the number of roots. OPG images were used to measure IMTM roots and evaluate radiographic findings (root darkening, IMTM diversion, narrowing, and interruption of the white line). A chi-square test was used for data analysis. **Results:** A significant relationship was observed between the position of the IAC-IMTM, where 27% of the IAC was having a lingual contact with the IMTM as compared to 1% of the cases where it was separately placed. **Conclusion:** The number of roots could not be accurately determined by panoramic radiography images. There is a benefit to using CBCT for the detection of multiple roots of IMTM. It was more likely that the IMTM and IAC would be in contact when the roots darkened and the white line was interrupted on panoramic images.

**Keywords:** *IMTM (Impacted mandibular third molar), IAC (inferior alveolar canal), OPG (Orthopantomogram), CBCT (Cone beam computed tomography), CT (conventional Computed tomography)*

### INTRODUCTION:

An impacted mandibular third molar extraction (IMTM) is a common oral surgery procedure with possible postoperative complications(1). It is mostly associated with injury to the “inferior alveolar nerve” (IAN) or with dysesthesia, as well as mandibular lingual fractures(2-4). IAN injuries are relatively rare, with less than 1% resulting in permanent disabilities(5). There are some factors that increase the “risk of nerve damage”, “including proximity between the third molars and the inferior alveolar canal (IAC)” and direct contact between tooth roots and IAN(6-8). There have been reports that

the anatomical relationship between the IAC and the impacted third molar is the most important factor for IAN injury(9,10). Additionally, “anatomical, and radiographic factors can influence the likelihood of IAC damage, such as surgical experience, operative procedures, and institutional settings”.(11)

The relationship between the Impacted Mandibular Third molar and the Inferior Alveolar Canal must be accurately assessed before surgery to avoid injury to the Inferior Alveolar Nerve(12). The most common diagnostic imaging method used for this purpose is panoramic radiography(13). Most of the time, panoramic

images are sufficient to assess Impacted Mandibular Third Molar preoperatively; however, such images do not indicate buccolingual direction(14). In cases where the IMTM and IAC are near each other, determining buccolingual direction is crucial. The precise relationship in these cases can be determined via “three-dimensional (3D) imaging” with “cone-beam computed tomography (CBCT) and conventional computed tomography (CT)”.

As an alternative to conventional computed tomography, In addition to producing a lower radiation dose with a higher spatial resolution, CBCT is also more affordable, occupies less space, and is more reliable. The CBCT can determine the relationship between the impacted third molars and the inferior alveolar nerve more accurately than conventional methods, such as OPG(13).

The results of this study provide clinicians with information about when CBCT is required for pre-operative examinations of Impacted Mandibular Third Molar. The study aims to determine whether the use of CBCT and the additional information provided modifies the preoperative assessment of lower third molar removal when compared to OPG and consequently results in a different surgical approach.

**MATERIALS AND METHODS:**

**Patients:**

100 study participants who visited the Oral and Maxillofacial Surgery department were included. Radiographic evaluations were performed on the patients before surgery to determine whether IMTM might be associated with the IAC. The study excluded IMTM associated with pathology such as tumors or cysts.

**Image Evaluation:**

CBCT images and panoramic radiographs were independently analyzed by two oral radiologists using a computer monitor (21-inch LCD monitor with 1280 x 1024 resolution).With the software's zoom tool, observers were able to adjust contrast and brightness settings. An evaluation of all images was performed.

Based on CBCT and OPG images, the number of root positions in each tooth was determined (1, 2, 3 or 4). An individual root is considered separate if its furcation is located in the middle or cervical third of the root(17). According to Rood and Shehab, the IAC and the IMTM are related on panoramic images. Various radiographic examinations were performed to evaluate the following findings: diminished roots, diverted mandibular canal, narrowed mandibular canal, and interrupted white line.

According to cross-sectional images of CBCT images, IMTMs can be classified into three groups: vertical (impacted teeth aligned 90° towards the mandible); horizontal (impacted teeth parallel to the mandible); and angular (teeth angled forward or backward or 90° to the mandible). Buccal, lingual, interradiolar, and inferior buccolingual relationships exist between the Impacted Mandibular Third Molar and the Inferior Alveolar Canal(18). In the results, the IAC was classified as either in contact with the third molar (a lack of bone between the third molar and IAC) or in no contact with the third molar at all (a bone between IAC and the third molar).

A third molar's morphologic shape can be divided into three types: “type 1, round (rounded on both buccal and lingual sides); type 2, lingual extended (slightly straight on the buccal side with bony extension on the lingual side); and “type 3, lingual concave (lingual concave on the lingual side and round on the buccal side)”.

**RESULTS:**

The study examined the relationship between the positions of the impacted mandibular third molars (IMTM) and the inferior alveolar canal (IAC) as observed on panoramic radiographs and cone-beam computed tomography (CBCT).

**1. Participants :** The study included 65 women and 35 men, aged between 19 and 28.

**2. Radiographic Findings:** No significant associations were found between specific radiographic signs (such as darkening of roots, nerve deflection, hourglass appearance of nerves, or interruption of white lines on panoramic radiographs) and the presence of contact between IMTM and IAC on CBCT (Tables 1 and 2).

**3. Positioning of IAC Relative to IMTM:**

- The IAC was most often found on the lingual side of the IMTM.
- There was frequent contact between the IMTM and the IAC.

**4. Correlation Between Position and Contact:**

A significant correlation was found between the positions of the IAC and IMTM. When the IAC was in contact with the IMTM, this occurred in 27% of cases, while it was separated in only 1% of cases. For IACs positioned buccally, a higher proportion (19%) were separated from the IMTM, compared to 10% that were in contact. This difference was statistically significant, with a p-value of less than 0.001.(Table 3)

**TABLE 1: A correlation between the variables in OPG and CBCT images is shown**

OPG findings		Anatomical Location of Nerve-CBCT	Total
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		Buccal	Inferior	interradicular	Lingual	
darkening of roots	Count	9	9	2	13	33
	%	9.0%	9.0%	2.0%	13.0%	33.0%
Deflection of Nerve	Count	1	5	1	2	9
	%	1.0%	5.0%	1.0%	2.0%	9.0%
hourglass appearance of nerve	Count	0	1	1	0	2
	%	0.0%	1.0%	1.0%	0.0%	2.0%
IWL	Count	19	23	1	13	56
	%	19.0%	23.0%	1.0%	13.0%	56.0%
Total	Count	29	38	5	28	100
	%	29.0%	38.0%	5.0%	28.0%	100.0%
Chi-square value- 16.67						
p value- 0.054						

**TABLE 2: Radiographic signs**

OPG findings		Roots-Canal- CBCT		Total
		In Contact	Separate	
darkening of roots	Count	19	14	33
	%	19.0%	14.0%	33.0%
Deflection of Nerve	Count	6	3	9
	%	6.0%	3.0%	9.0%
hourglass appearance of nerve	Count	1	1	2
	%	1.0%	1.0%	2.0%
IWL	Count	32	24	56
	%	32.0%	24.0%	56.0%
Total	Count	58	42	100
	%	58.0%	42.0%	100.0%
Chi-square value- 0.34				
p value- 0.95				

**TABLE 3: Relationship between the position of the IAC-IMTM and the buccolingual position of the IAC-IMTM on CBCT images**

Anatomical Location of Nerve-CBCT		Roots-Canal- CBCT		Total
		In Contact	Separate	
Buccal	Count	10	19	29
	%	10.0%	19.0%	29.0%
Inferior	Count	16	22	38
	%	16.0%	22.0%	38.0%
interradicular	Count	5	0	5
	%	5.0%	0.0%	5.0%
Lingual	Count	27	1	28
	%	27.0%	1.0%	28.0%
Total	Count	58	42	100
	%	58.0%	42.0%	100.0%
Chi-square value- 31.12				
p value- 0.00*				

\*significant

**DISCUSSION:**

A severe complication of mandibular third molar extractions is IAN injury. Various factors can contribute to injury, including the surgeon's experience, the patient's age and gender, tissue damage during surgery, postoperative edema, and the surgical procedure(6). It is believed that IAN injury is primarily caused by the anatomical relationship between the third molar and the IAC(9,10). Nevertheless, other authors have pointed out that an increased risk of IAC damage is associated with various factors, such as the surgeon's experience, surgical technique, institutional setting, and anatomical and radiographic characteristics(19).

The impacted third molar must be assessed thoroughly by an oral surgeon as a prerequisite for successful surgery. Choosing the correct procedure is crucial to prevent injuries to the IAN, fractured mandibles, and mandibular perforations. Radiography first assesses the relationship between the IMTM and the IAC(6). Due to the fact that it produces two-dimensional images, it cannot provide information on axially, coronally, or sagittally. Preoperative assessment of mandibular third molars with CBCT is more reliable than with conventional radiography.

Ghaemina et al.(13) found that panoramic radiographic signs were significantly correlated with IAN exposure, a finding that was supported by several authors. It is their opinion that CBCT can be used to assess IMTM buccolingually. As shown by the current study, third molar roots regularly contact the IAC on CBCT images when the white line of the IAC is interrupted and when the roots are darker on OPG images

Previous studies have classified impacted mandibular third molars (IMTM) based on their angulation relative to the second molar. The typical classifications include vertical, mesioangular, horizontal, and distoangular. These classifications are frequently used to evaluate the complexity of extraction and the potential complications associated with impacted third molars. Tantanapornkul et al. Reported that the horizontal type was the most frequent (52%), followed by angular (32%) and vertical (16%). Momin et al. Reported similar results, with 42% horizontal, 37% angular, and 21% vertical” (20).

Coronectomy, or deliberate vital root retention, is a technique proposed to remove the crown of a tooth while leaving its roots intact when they are closely associated with the inferior alveolar nerve. This approach aims to minimize the risk of nerve damage. It is particularly considered in cases where radiographic evidence shows a close relationship between the tooth roots and the inferior alveolar nerve(26). Indicators of potential nerve

injury, as suggested by Rood and Shehab, include diversion of the inferior alveolar canal, darkening of the root, interruption of the white line of the canal, narrowing of the canal, and deflection of the root.

In the present study, The study investigated the relationship between the positions of impacted mandibular third molars (IMTM) and the inferior alveolar canal (IAC) using panoramic radiographs and cone-beam computed tomography (CBCT).

No significant associations were found between specific radiographic signs on panoramic radiographs—such as root darkening, nerve deflection, hourglass-shaped nerves, or interruption of the white lines—and the presence of contact between the IMTM and IAC on CBCT.

The IAC was most frequently located on the lingual side of the IMTM, and contact between the IMTM and the IAC was commonly observed.

A significant correlation was noted between the positions of the IAC and IMTM. When the IAC was in contact with the IMTM, this was observed in 27% of cases, while separation was noted in only 1% of cases. For IACs positioned buccally, a greater proportion (19%) were separated from the IMTM, compared to 10% that were in contact. This difference was statistically significant, with a p-value of less than 0.001.

According to Msagati's(22) study and Syed's study(23), the mesioangular type was most prevalent (76% in Msagati's study and 50.75% in Syed's study). Lübbers et al. found that mesially angulars (40.2%) and verticals (29%) made up the majority of patterns. According to the present study, the most frequent type was angular (42.28%), followed by vertical (34.24%) and horizontal (23.48%). It is possible that different study samples can lead to differences between studies. When deciding whether to use an elevator during surgery, the shape of the mandible is a major factor. The purpose of this is to prevent direct or indirect pressure on the IAN and bone perforation or fracture. Bone morphology cannot be revealed by two-dimensional images. Watanabe et al. reported that majority of mandible shapes were round (61%) rather than lingual concave or buccal concave. Lin et al.,(24) however, found that the least common type was round (21%) in the posterior mandible. For the purpose of preoperative planning, Momin et al. classified the mandible as round, lingual extended, or lingual concave by examining the bone morphology in the area of the third tooth.. The most common shape was round (49%) followed by lingual concave (32%), and lingual extended (18%). According to the authors, impaction type and mandibular shape did not have a

significant association. According to this study, mandibular shapes are classified into three categories: round, lingual extended, and lingual concave. Approximately 46 % of cases were round, 8% were lingual concave, and 8% were lingual extended. This finding is in agreement with the results of Momin et al.(21)

It is very important for the surgeon to have an understanding of the IAN's location in "preoperative evaluation of impacted third molars" in order to make the correct area for the elevator and to luxate the involved tooth. A common cause of IAN injuries is the compression and traction on the nerve caused by the removal of third molars. There is a possibility that an IAN injury may occur during the elevation of mesioangular impacted third molars. This is because the roots may move downward and compress the nerve. Third molar roots can also compress the IAN when they move buccolingually. Surgical intervention is usually initiated on the buccal side of the third molar if the surgeon is unfamiliar with the buccolingual course of the IAN before surgery. However, lingual positioning of the IAN might result in undesirable forces, which can lead to injury of the IAN. In preoperative assessment, CBCT images allow clinicians to plan comprehensive treatment methods and select surgical methods. Previously, it has been reported that the IAC is usually located on the lingual side of impacted third molars and that contact between the IAC and the impacted teeth is generally observed. According to the present study, the IAC was typically located on the lingual side of the IMTM.

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### **CONCLUSION:**

In this study, the number of roots could not be accurately determined by panoramic radiography images. There is a benefit to using CBCT for the detection of multiple roots of IMTM. It was more likely that the IMTM and IAC would be in contact when the roots darkened and the white line was interrupted on panoramic images. A significant correlation was found between the positions of the IAC and IMTM. Contact between the IAC and IMTM was observed in 27% of cases, while separation occurred in only 1%. For IACs positioned buccally, 19% were separated from the IMTM, whereas 10% were in contact, showing a statistically significant difference. A preoperative assessment of IMTM requires CBCT when the roots darken and the white line is interrupted.

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