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Original Article

# Assessment of Impacted Third Molar in Relation to Inferior Alveolar Canal: A Cross-Sectional Study to Compare Radiographic Precision of Intraoral Periapical Radiograph and Panoramic Radiograph in Relation to Cone Beam Computed Tomography

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## Abstract

**Introduction:** Extraction of impacted third molar is a routine procedure in oral and maxillofacial surgery, either for prophylactic or for symptomatic reasons.

**Objective:** To compare the accuracy of intraoral periapical radiograph (IOPAR) and panoramic radiograph with that of cone beam computed tomography (CBCT) for determining the proximity of impacted lower third molar with mandibular canal.

**Materials and Methods:** The present study consisted of 20 participants, in age group of 20 years and above with impacted mandibular third molar visiting the department of Oral surgery, D.J. College of Dental Science and Research (DJCDSR), Modinagar, Uttar Pradesh. Relationship of impacted mandibular third molar with the mandibular canal was assessed using IOPAR and panoramic radiographic signs and CBCT findings. The seven radiographic signs, i.e., darkening of root, deflection of root, narrowing of root, dark and bifid root, interruption of white line of canal, diversion of canal, narrowing of canal on both IOPAR, and PANORAMIC Radiographic, were correlated for the proximity and involvement with CBCT findings for the same.

**Results:** After evaluation of seven radiographic signs seen in IOPARs with CBCT result states that darkening of root ($P = 0.025$), diversion of canal ($P = 0.022$), and interruption of white line of canal ($P = 0.021$) have significant value ($P < 0.05$) according to Pearson's chi-squared whereas only two panoramic radiographic signs, i.e., darkening of root ($P = 0.022$) and interruption of white line of canal ($P = 0.026$) have significant value.

**Conclusion:** This study showed the poor reliability of panoramic radiographic signs than IOPAR in predicting the proximity of mandibular third molar root with mandibular canal related to CBCT finding. Radiographic signs of IOPAR reliability with CBCT findings are found to be more precise and accurate as per for future prospects.

**Key words:** Cone beam computed tomography, Intra oral periapical radiograph, Orthopantomogram

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## INTRODUCTION

Extraction of impacted third molar is a routine procedure in oral and maxillofacial surgery, either for prophylactic or for symptomatic reasons. Damage to the inferior alveolar nerve during mandibular third molar extraction surgery is a significant and one of the complications, which can result in postoperative paresthesia in patients. The incidence

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of inferior alveolar nerve paresthesia following surgery is reported to be between 0.4% and 8%. Permanent paresthesia may lead to functional deficits and a decreased quality of life.[1,2] The inferior alveolar nerve can be injured directly by surgical instruments such as burs that are used for guttering, during unfavorable movements of the third molar roots during luxation of the tooth in apical, buccal, or lingual directions.[3-5] To optimize surgical planning and avoid complications, precise identification of the mandibular canal is important. Both intraoral periapical radiograph (IOPAR) and panoramic radiograph are widely used techniques. Various radiographic markers are present in IOPAR and panoramic radiographs indicating close relationship between the third molar with the mandibular canal, for example, darkening of root, deflection of root, narrowing of root, bifid root apex, diversion of canal, narrowing of canal, and interruption of white line.[6,7] IOPAR is a cost-effective and an easy technique to perform. However, there are some artifact problems such as elongation, shortening, and cone cut of lower third molar due to faulty angulation.[8] Advancement of dental radiology includes the addition of panoramic radiology along with IOPAR. However, the buccolingual relationship between the inferior alveolar canal (IAC) and the third molar cannot be evaluated.[9] It has certain disadvantages such as higher radiation dose, greater cost, image magnification, and reduced image resolution.[8] Recently, cone beam computed tomography (CBCT) has been introduced as a valuable diagnostic method. It has been suggested for examination of the mandibular third molars as it provides detailed information about the position and course of the mandibular canal.[5] As CBCT is a relatively new imaging technique and also various literature is available concerning its diagnostic value. Hence, CBCT is used as a gold standard concerning with its diagnostic value. Hence, the study aimed to compare the radiographic diagnostic resemblance in between IOPAR and panoramic radiograph considering CBCT as "gold standard" which predicts inferior alveolar nerve exposure and the buccolingual position of the third molar in relation to the mandibular canal.

## MATERIALS AND METHODS

### Source of Data

The study group consisted of 20 patients of either sex in the age group of 20 years or above with impacted mandibular third molar. The study participants were selected from out patients attending the Department of Oral and Maxillofacial Surgery, D.J. College of Dental Science and Research (DJCDSR), Niwari road, Modinagar, Uttar Pradesh from December 2013 to August 2015. Inclusion criteria include -Individuals with impacted mandibular third molar, good quality IOPAR showing close relationship between root apices of an impacted mandibular third molars and mandibular canal. Whereas patients are not willing to undergo panoramic radiograph or CBCT imaging, radiograph showing displacement of the root due to pathology, such as cyst or tumor, patient with systemic diseases, and pregnant lady patients were the exclusion criteria.

### Methodology - Imaging Modality

1. For IOPAR: The patient was prepared under all radiographic safety precautions. For paralleling technique, intraoral periapical Kodak ekta speed film was used. The film was centered over the impacted mandibular third molar. An X-ray exposure was made with 70 kvp, 10 mA, and 0.7 s parameters.
2. For Panoramic Radiographs: Following the IOPAR, patient was prepared for panoramic radiographic procedure under all radiographic safety precautions. The panoramic radiograph was taken using a Proline XC unit (Planmeca, Helsinki, Finland) with a 15 cm ×30 cm photostimulable phosphor receptor. An X-ray exposure parameter of 73 kv, 12 mA, and 13.9 s. was used.
3. For CBCT: The CBCT mandibular scans were acquired using Planmeca Romexis® device (Planmeca system, Finland) operated at 90 kV and 10mA; scans were completed within 15 s, after scanning contiguous sectional images in three directions, cross section, and horizontal section were reconstructed with a slice width of 400 μm.

### Evaluation of IOPAR and Panoramic Radiographic Images

Both radiographs were evaluated with adequate light. The presence or absence of the seven radiographic signs was evaluated in the IOPAR and panoramic radiograph. The evaluations of both images were done for the presence and absence of seven radiographic signs accordingly.

### Evaluation of CBCT Images

CBCT images were evaluated in the sagittal sections to establish if the cortical layer of the mandibular canal between the third molar and inferior alveolar nerve was still intact. The position of the mandibular canal with respect to the mandibular third molar root apex at the point of closet contact was also evaluated as buccal, lingual, between the roots and inferior. The evaluation of the CBCT images was done for the absence and presence of above-mentioned parameters.

After brief evaluation of IOPAR and panoramic radiograph images of impacted mandibular third molar and mandibular canal, seven radiographic signs were correlated and confirmed by CBCT radiographic interpretation which was used as "Gold Standard" in this study. Final data provided

confirmness about presence or absence of seven radiographic signs in between IOPAR and panoramic radiograph.

### Statistical Analysis

Statistical analysis of data was done using "Pearson's Chi-squared test" to determine whether there is a significant association between the two variables.

## RESULT

In the present study, out of 20 patients 12 were male (60.0%) and 8 patients were female (40.00%).

### Result of the Seven Radiological Signs as Seen in IOPAR and CBCT

- IOPAR findings shows that darkening of root was present in 12 cases (60%), deflected root in 08 (40%), narrowing of the root in 8 (40%), dark and bifid root in 11 (55%), diversion of the IAC in 10 (50%), narrowing of the IAC in 12 (60%), and interruption of the white line in 11 (55%) cases.
- CBCT findings shows that darkening of root was present in 18 cases (90%), deflected root in 7 (35%), narrowing of the root in 7 (35%), dark and bifid root in 13 (65%), diversion of the IAC in 17 (85%), narrowing of the IAC in 13 (65%), interruption of the white line in 17 (85%) cases.

Statistical data show that out of seven radiographic signs, three signs, i.e., darkening of root ($P = 0.025$), diversion of canal ($P = 0.022$), and interruption of white lines ($P = 0.021$) were significant.

### Result of the Seven Radiological Signs as Seen in Panoramic Radiographs and Cone CBCT

- Panoramic radiographic finding shows that darkening of root was present in 11 cases (55%), deflected root in 3 (15%), narrowing of the root in 3 (15%), dark and bifid root in 10 (50%), diversion of the IAC in 12 (60%), narrowing of the IAC in 11 (55%), interruption of the white line in 10 (50%) cases.
- CBCT findings shows that darkening of root was present in 18 cases (90%), deflected root in 7 (35%), narrowing of the root in 7 (35%), dark and bifid root in 13 (65%), diversion of the IAC in 17 (85%), narrowing of the IAC in 13 (65%), interruption of the white line in 17 (85%) cases.

Statistical data show that out of seven radiographic signs, two signs, i.e., darkening of root ($P = 0.022$) and interruption of white lines ($P = 0.026$) were significant.

Additional CBCT findings shows that mandibular canal was present on buccal side in five cases (25%), on lingual 8 (40%), on inferior 16 (80%), in between roots 2 (10%) cases. In addition, found presence of cortication in 9 (45%) and absence of cortication in 14 (70%) cases (Figure 1-3) and (Graphs 1, 2).

## DISCUSSION

Injury to inferior alveolar nerve during mandibular third molar removal is a serious complication. The reported incidence of inferior alveolar nerve injuries is range from 3.3% to 13% for temporary damage and 0.2-1% for permanent damage during third molar removal.[3] Therefore to protect the nerve from damage during surgery, it is important to evaluate the topographic relationship between the mandibular canal and impacted third molar teeth. The IOPAR and panoramic radiograph are the most common imaging modality used to view impacted mandibular third molars and to assess the risk of inferior alveolar nerve injury. According to those studies, darkening of the root, interruption of the canal wall, diversion of the canal, narrowing of the root, deflected root, narrowing of the canal, and dark and bifid root were reported to indicate a close relationship between the third molar root and inferior alveolar nerve.

According to Nagaraj and Chitre, darkening of the root (65.5%) and interruption of the white line (58.0%) of the mandibular canal were observed with maximum number of percentage. Both radiographic signs were found to be most significant related to inferior alveolar nerve damage.[10] According to Sinha and Pai, darkening of root and interruption of white lines on IOPAR strongly related with the absence of corticalization on CBCT findings. On contrary, patients presented with the diversion and narrowing of the canal on IOPAR showed the presence of corticalization on CBCT.[8]

In our study, we observed that darkning of the root (60%), interruption of the white line (55%) and diversion of mandibular canal (50%) are present on IOPAR with their maximum number of percentage. They are found to be significant with CBCT radiographic signs. In addition, strong relation between presence (45%) and absence (70%) of corticalization are found.

Bell reported that panoramic radiography has relatively poor diagnostic accuracy when used to examine anatomical forms and structures. There was an intimate relation between the mandibular third molar and the inferior alveolar nerve in 51% of the cases when darkening of root was observed and in only 11% of the cases when interruption of the radiopaque outline of the inferior alveolar neurovascular bundle was observed. Only 25%

surgeons consider panoramic radiographs adequate for surgery, whereas 61% of the surgeons considered CBCT scan as the ideal imaging modality.[9]

Total 20 impacted mandibular third molar teeth were included in this study, and the incidences of the signs were studied. Darkening of root and narrowing of canal were seen in 55%, interruption of white line and dark–bifid root were seen in 50% of the cases, divergence of mandibular canal was present in 60% of the cases, narrowing of the root, and deflection of root were seen with lowest incidence of 15% of the cases. In our study, darkening of root and interruption of white line were most significant which is similar to Rood and Nyssen criteria.[11] Deflected root, narrowing of root, dark and bifid root, divergent of canal, narrowing of canal, dark and bifid root were non-significant signs in our study. According to Bell,[9] the incidence of darkening of root and interruption of white line were most common which is similar finding in our study in addition with diversion of canal. Other signs were very few in number.

**Figure 1: Shows darkening, deflection of root, interruption of white line, narrowing, and diversion of canal**

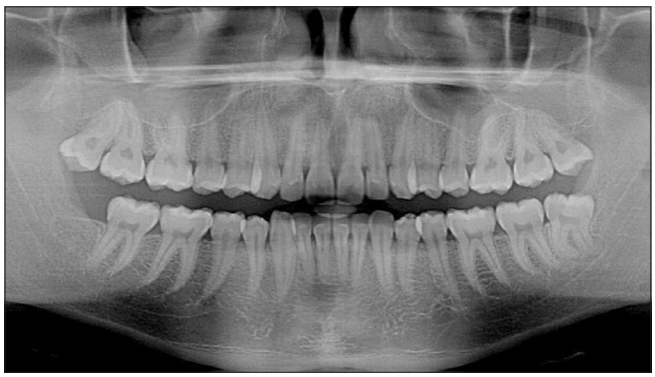


**Figure 2: Shows darkening, deflection of root, and interruption of white line and narrowing of canal**

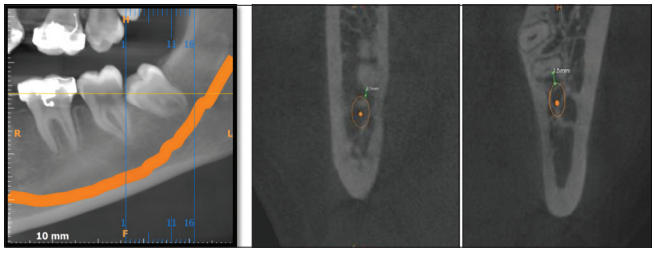
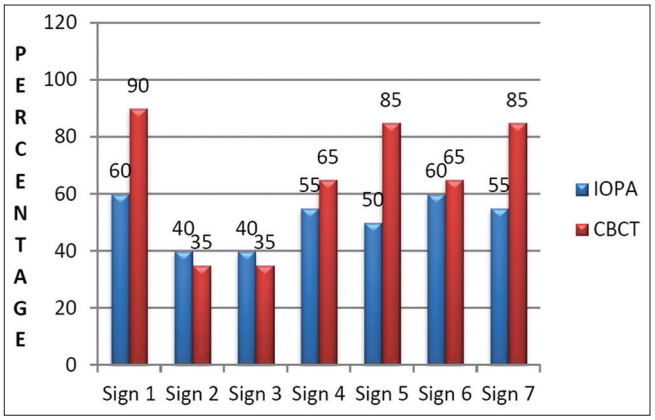


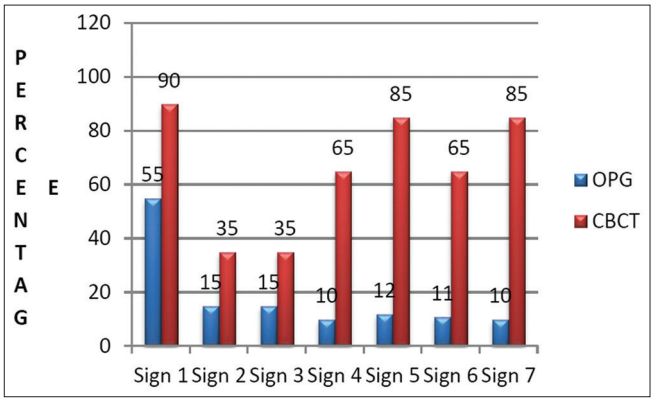
**Figure 3: Cone beam computerized tomography coronal cross-sectional view showing presence of corticalization**

Diagnostic radiology has undergone changes in the past 10 years. CBCT is an important development in the dental radiology. The advantages of CBCT-based systems include uniform magnification, a high-contrast image with a well-defined image layer free of blurring multiplanar views, three dimensional reconstructions, and the availability of software for image analysis.[12]

According to Weeraya and Ghaeminia, CBCT is significantly superior to panoramic images in predicting neurovascular exposure during extraction of impacted third molar and CBCT is significantly superior to panoramic images in both sensitivity and specificity. In a study by Maria Eugenia Guerrero, inferior alveolar nerve exposure at surgery was correctly predicted in 56% of




**Graph 1: Comparison of radiographic signs seen in intraoral periapical radiograph and cone beam computed tomography**




**Graph 2: Comparison of radiographic signs seen in panoramic radiograph and cone beam computed tomography**

cases using CBCT compared with 35% using panoramic radiography.[13]

In the present study, we used CBCT to evaluate the IOPAR and panoramic findings in cases where the third molar root apices were in proximity to mandibular canal with high probability of inferior alveolar nerve injury. The radiological signs in the IOPAR and panoramic radiograph most commonly associated with contact were darkening of root and interruption of white line. In our study, evaluation of CBCT revealed that the nerve was placed inferiorly in 80% of the cases followed by lingual in 40%, buccal in 25%, and between the roots in 10% of the cases.

Some studies have also revealed that the nerve may be positioned inferiorly, more than buccally or lingually. This result too was in agreement with other studies and also exposure of the inferior alveolar nerve at the time of surgical procedure frequently occurred under this conditions.[3] Cortical integrity is an important predictor of paresthesia after third molar paresthesia. Various studies have proven increased incidence of inferior alveolar nerve injury and post-operative paresthesia in cases with cortical disruption seen on CBCT.[14]

Out of the 20 impacted mandibular third molar teeth, about 70% of them had interruption of cortical layer of the mandibular canal in the present study. Monaco investigated the relationship between the presence of Rood's criteria (interruption of the white line of the IAC, narrowing of the canal, deflection of the roots, darkness of the roots, diversion of the IAC, narrowing of the roots, and dark and bifid apex) and CT findings, and found that absence of cortication occurred in 50-80%.[15] This is consistent with the current study.

In this study, we found that radiographic signs which are responsible for inferior alveolar nerve damage (i.e., darkening of the root, interruption of white lines, narrowing, and diversion of canal) present with higher percentage in IOPAR than panoramic radiograph.

## CONCLUSION

The results of this study show that IOPAR has better advantage than panoramic radiograph in visualizing the correct relationship of the impacted mandibular third molar with that of inferior alveolar nerve to the tooth structure. Study concluded that both IOPAR and panoramic radiograph can be used for evaluating risk of nerve damage along with closeness of impacted mandibular with that of impacted mandibular third molar. In addition, we can recommend a CBCT when a radiological evidence of nerve root relationship exists in IOPAR and panoramic radiograph to minimize injury to the inferior alveolar nerve during removal of impacted third molars.

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