

Correlating the clinical assessment of impacted mandibular third molars with panoramic radiograph and intraoral periapical radiograph

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Abstract

Aims and Objectives: This study was conducted to compare the clinical assessment of impacted third molars of mandible with panoramic radiograph (OPG) and intraoral periapical radiograph (IOPA) and to assess the efficacy of IOPA and. Moreover, we corroborated the OPG and IOPA findings of impacted mandibular third molar root apex to inferior alveolar canal. **Materials and Methods:** A total of 200 patients with pericoronitis were examined who were indicated for surgical extraction, among which 50 patients were selected for the study. All the patients underwent a radiographic survey with a digital OPG and IOPA of impacted mandibular third molars, along with clinical survey for anatomic relationship, type of impaction, space available, position in relation to second molar, number of roots, root curvature, and proximity of nerve canal. The data was subjected to statistical analysis. The Statistical Package for Social Sciences version 4.0.1 software was used for analyzing the collected data. **Results:** The study revealed that IOPA was more accurate in determining a majority of the factors affecting the third molar surgery, including relationship of the external oblique ridge (IOPA vs OPG = 96%:90%), anteroposterior relation with ramus (IOPA vs OPG = 70%:66%), vertical depth of impaction (IOPA vs OPG = 72%:68%), number of roots ($P = 0.013$), morphology of roots (IOPA vs OPG = 96%:90%); however, OPG was found to be accurate in evaluating the type of impaction (IOPA vs OPG = 88%:94%), canal relation, along with root of impacted molar (IOPA vs OPG = 74%:86%). **Conclusion:** To conclude, although IOPA has a marginal angle over OPG in assessing various parameters, only the number of roots have a greater accuracy ($P < 0.0013$) in IOPA than with OPG. However, the OPG is the better choice to be considered when the patient is associated with trismus.

Key words: Cone beam computed tomography (CBCT), external oblique ridge, impacted mandibular third molar, inferior alveolar nerve canal, intraoral periapical radiograph (IOPA), panoramic radiograph (OPG), ramus

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INTRODUCTION

Radiographic diagnosis of impacted third molars precedes their surgical removal. The factors such as the position of tooth, the number, and morphology of roots, in particular, the relationship between the roots and mandibular canal, require assessment for an atraumatic untoward transalveolar extraction of these impacted mandibular molars. A conventional radiographic examination may consist of panoramic and/or intraoral radiography. A series of three intraoral projections has been recommended for full evaluation.^[1-4] The bucco-lingual relation between the tooth and other anatomical structures, is better assessed by the tube shift or buccal object rule which is traditionally employed.^[3,4]

Orthopantomograph has diversified use in both general diagnosis and varied specialized clinical diagnosis, and is commonly used to assess third molars prior to transalveolar extraction.^[5] During the last decade, different techniques have been developed for digital, and in recent years, the solid-state digital X-ray units and photostimulable phosphor plate systems which are used with conventional OPG units are available in the market. The diagnostic outcome of panoramic images is the same as that of intraoral periapical radiograph (IOPA), however, they have been evaluated only sporadically; such comparison should be done until a new diagnostic procedure is introduced for better diagnosis.

The third molar follicle first becomes apparent at an age of 6–7 years and can be diagnosed by 8–9 years. At the age of 14–16 years, the third molar follicle is apparent in radiographs. If the follicle is not present at this age, agenesis should be considered. Girls appear to be slightly ahead of boys up to the age of root formation, however, this difference disappears in the final stage of root development. Third molar agenesis is very common and is considered to have an incidence of 5–33%. When the cervical part of the root complex is formed, the tooth germ starts to move away from the mandibular canal, assuming a distally curved eruption pathway. If resistance is met during eruption, intrusive growth occurs in the proximity of the mandibular canal, resulting in indentations in the apical part of the root, apical deflections, or circumferential growth around the mandibular canal, resulting in curving of the roots and a change in the eruption pathway. These changes that occur during the developmental and the eruption stage of the mandibular third molar make meticulous preoperative radiographic evaluation an important step. This would facilitate comprehensive evaluation of the

anatomic disposition of the tooth in relation to the vital structures in the surrounding.

These types of studies have been conducted in the past comparing computed tomography and panoramic radiographs by Pecker *et al.* in Turkey. Though various diagnostic modalities have come up in the recent past including the use of computed tomography, IOPA and panoramic radiographs (OPG) ought to be considered the gold standards for planning transalveolar extraction of impacted third molar of mandible. However, there is sparse literature on comparison between IOPA and OPG. The aim of our study is to correlate the clinical findings with these standard radiographs and compare the efficacy of IOPA with OPG for determining the status of the anatomical factors that dictate the third molar surgery.

Aims

The aims of our study are

- To confirm the clinical parameters of impacted mandibular third molars with OPG and IOPA and to assess the efficacy between the two.
- To corroborate the OPG and IOPA findings of the root apex of the impacted mandibular third to the inferior alveolar nerve canal.

MATERIALS AND METHODS

The study was conducted for a period of 1 year. Two hundred patients diagnosed with moderate-to-severe pericoronitis electing to undergo surgical extraction were chosen, out of which 50 patients were selected for the study by simple random sampling. The sample size of 50 was selected based on similar comparative studies done previously by Ishak *et al.*^[6] We enrolled individuals who voluntarily signed an informed consent after obtaining institutional ethical committee clearance. All the patients were referred to the Department of Oral Medicine and Radiology for digital OPG and IOPA. The digital OPG was obtained using SIRONA ORTHO PHOS XG5 unit along with automatic processing of the film. IOPA was obtained using Villa India and Blue X unit in a paralleling cone technique, and manual processing was done.

The clinical and radiographic assessments were done under standard conditions by a trained oral surgeon experienced in interpreting IOPA and OPG, as well as one observer beginning his training in Oral and Maxillofacial Surgery. Clinically, the anteroposterior width and depth of the crown exposed was measured

with a divider and a scale [Figures 1 and 2]. A trace paper was attached to the OPG [Figure 3] and IOPA [Figure 4], and then the ramus, second, third

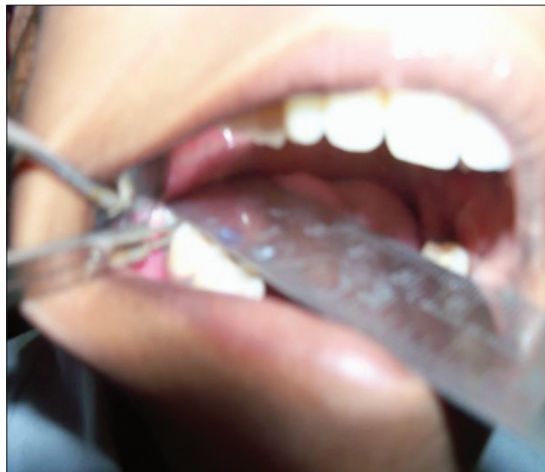


Figure 1: Vertical position in relation to occlusal surface of second molar



Figure 2: Antero-posterior width of crown exposure

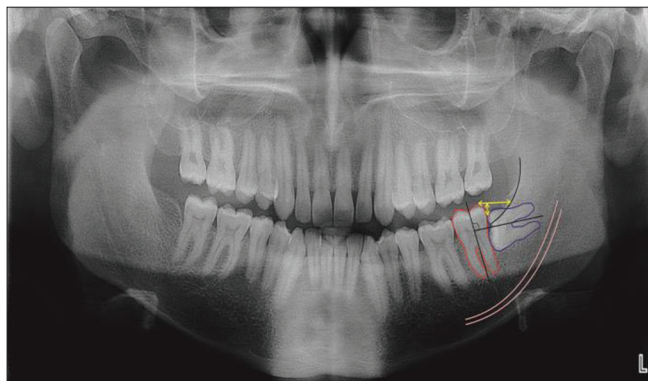


Figure 3: Radiological evaluation of panoramic radiograph and intraoral periapical radiograph

molars, and inferior alveolar canal was traced on it. A horizontal line was drawn from the anterior border of the ramus to the posterior extremity of the distal cusp of second molar to determine the amount of bone that has to be removed anteroposteriorly; a vertical line was drawn from the tip of the distal cusp of mandibular second molar to the crown of the impacted mandibular third molar to determine the depth of impaction. These measurements were compared with the clinical measurements. The proximity of the nerve canal to the root apex of mandibular third molar appreciated in the radiographs was compared clinically by visualizing the socket after the extraction for nerve exposure. The clinical assessment was done to have following information

Anatomic relationship

- I. Partial bony impaction
- II. Complete bony impaction

External oblique ridge

- a. Anterior to third molar
- b. Posterior to third molar

Type of impaction or space relationship (Pell and Gregory classification):

- a. Mesioangular ($\geq 10-70$ degrees)
- b. Distoangular ($\leq 10-70$ degrees)
- c. Vertical (± 10 degrees)
- d. Horizontal (>70 degrees)

Space available or Ramus relationship (Pell and Gregory classification):

- I. Sufficient space (Class I)
- II. Reduced space (Class II)
- III. No space (Class III)

Depth of impaction or position in relation to second molar (Pell and Gregory classification):

- I. High occlusal (Level A)
- II. Medium occlusal (Level B)
- III. Deep occlusal (Level C)

Before the operation, the IOPA and OPG were assessed for the following factors:

- Type of impaction
- External oblique ridge
- Vertical relationship in relation to second molar
- Space available or Ramus relationship
- Number of roots
- Root curvature
- Proximity of nerve canal

RESULTS

The results were subjected to statistical analysis. Multiple logistic corrections were done to identify the independent risk factors. Association of categorical variables was assessed by Pearson hi-square. The study revealed that IOPA was more accurate in determining majority of the factors affecting the third molar surgery, which includes the relationship of the external oblique ridge to the third molars, where 96% showed that the IOPA was superior to the OPG. (IOPA vs OPG = 96%:90%); $P = 0.436$ (two-sided significance by Chi-square test [Table 1]. The anteroposterior relation of the impacted tooth with the Ramus was best determined by IOPA with 70% justifying the decision (IOPA vs. OPG = 70%:66%); $P = 0.265$ (two-sided significance by Chi-square test) [Table 1; Graph 1]. The vertical depth of impaction in relation to the occlusal aspect of the second molar was better visualized with an IOPA. (IOPA vs. OPG = 72%:68%); $P = 0.828$ (two-sided significance by Chi-square test) [Table 1; Graph 1]. Number of roots was better confirmed with an IOPA. This was statistically significant with $P = 0.013$ (two-sided significance by Chi-square test) [Table 1; Graph 2]. Morphology of roots was also better visualized with an IOPA (IOPA vs. OPG = 96%:90%); $P = 0.436$ (two-sided significance by Chi-square test) [Table 1; Graph 2].

However, panoramic radiograph was found to be more accurate in evaluating the type of impaction (IOPA vs. OPG = 88%:94%) [$P = 0.487$ (two-sided significance by Chi-square test)] [Table 1; Graph 1], as well as the canal relationship to the apex of the root of the impacted molar (IOPA vs. OPG = 74%:86%); $P = 0.211$ (two-sided significance by Chi-square test) [Table 1; Graph 3]. Though in most cases panoramic was more accurate in determining the exact type of impaction and the canal relationship to the tip of the impacted molar, these values were not statistically significant on analysis.

DISCUSSION

Conventional IOPA has diversified use in both general diagnosis and specialized clinical diagnosis, especially to assess third molars prior to transalveolar extraction. With the invention of digital OPG during the last decade, many clinicians have opted for this modality of investigation to assess third molars prior to surgical removal. Though several comparative studies focusing on the image quality between the conventional and

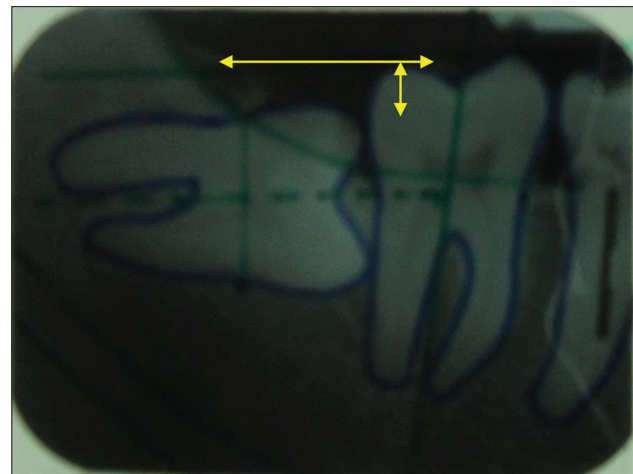


Figure 4: Yellow line in Fig 3 and 4 indicate vertical and antero posterior relation of impacted tooth with ramus of mandible (Horizontal) and second molar (Vertical)

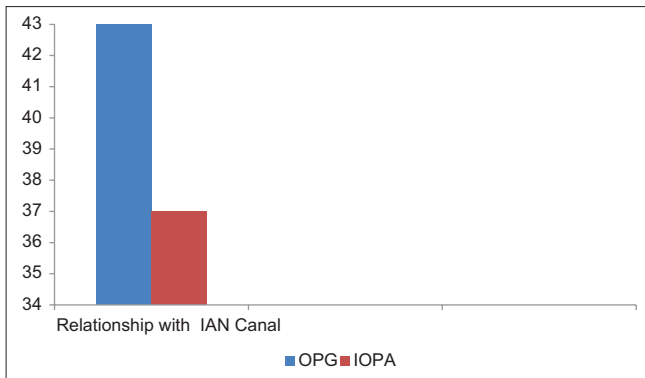
Table 1: The Comparison of IOPA radiograph with OPG in evaluating the various parameters of third molar impaction, with clinical correlation

Parameter	IOPA	OPG	Total	P
External Oblique Ridge	48 (96%)	45 (90%)	93 (93%)	0.436
Type of Impaction	44 (88%)	47 (94%)	91 (91%)	0.487
Tooth position				
Vertical	36 (72%)	34 (68%)	70 (70%)	0.828
Anteroposterior	39 (78%)	33 (66%)	28 (72%)	0.265
Number of roots	45 (90%)	34 (68%)	79 (79%)	0.013
Morphology of roots	48 (96%)	45 (90%)	93 (93%)	0.436
Relation with IAN Canal	37 (74%)	43 (86%)	20 (80%)	0.211

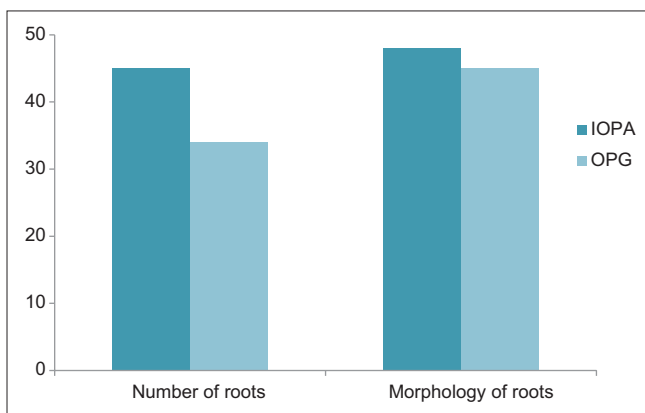
digital OPG have been conducted with a significant difference in quality between the two,^[7] there had been no study so far comparing the efficacy of IOPA and digital OPG, which are most popular among the practitioners.

The primary outcome of the study is that the IOPA is more accurate in determining the external oblique ridge relation, space availability, number of roots, and morphology of roots, whereas the type of impaction and the relationship of inferior alveolar canal to the root apex of impacted mandibular third molars are more obvious in OPG.

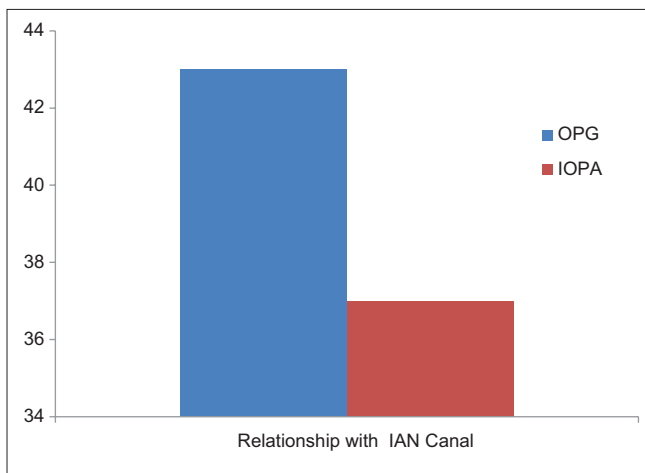
The transalveolar extraction of mandibular third molar necessitate thorough radiographic evaluation of tooth and its related structures to facilitate its removal and eliminate or reduce the risk of nerve damage. Therefore, the most important factor to be considered for surgeons to recognize may be the proximity of the mandibular canal, the number and configuration of the roots, and the degree of mechanical impediment



Graph 1: Graph comparing the accuracy between IOPA and OPG in the type of impaction, vertical position of impacted molar and antero posterior position of impacted molar



Graph 2: Graph comparing the accuracy between IOPA and OPG in the number and morphology of roots of impacted third molar



Graph 3: Graph comparing the accuracy between IOPA and OPG in showing the relationship of impacted mandibular third molar root tip with inferior alveolar nerve canal

caused by the overlying bone. Hence, the difference in diagnostic accuracy between the conventional IOPA and the digital OPG were evaluated to assess the efficacy between the two in the study.

Several studies have been performed earlier to correlate the different radiographic modalities used in the diagnosis of impacted mandibular third molar. Flygare *et al.* suggested that OPG and/or IOPA suffice the presurgical imaging needs in the majority of cases where there is no overlapping between the mandibular canal and the impacted molars of mandible.^[8] A posteroanterior open mouth projection is a supplementary imaging technique in most of the remaining cases. In cases where the mandibular canal and the wisdom tooth are intimately placed, volume tomographic techniques such as CBCT or low-dose CT is indicated.^[8] Hassan concluded that, in clinical dentistry setup, the conventional radiographs which are used mainly include IOPA and to a lesser extent OPG.^[9] According to their study, IOPA is virtually a primary tool of radiographic examination in the dental clinic. In contrast, a survey shows that up to 95% of dental surgeons want their patients to undergo only OPG before implant placement and relatively small number of patients are referred to CT scan. Though the basic investigation preferred by many practitioners are OPG and IOPA, no study been conducted to compare the efficacy between the two, especially with the most frequent minor oral surgical pathosis of impacted mandibular third molar.

Because the anatomical structures and allignment of teeth are always not in a straight line and the tooth root and the inferior alveolar canal in a radiographic image are not in a straight line, intimate care is taken during observation and to obtain a conclusion. IOPA and OPG are the two conventional imaging techniques of choice for maxillofacial surgeons for thorough evaluation of the lower third molar position and its associated structures. Several radiographic markers in OPG are identified for their reliability in predicting the risk of inferior alveolar nerve damage or exposure. Performance of the two conventional radiographic methods (OPG and IOPA) is high for identification of the intimate relation of the mandibular third molar and the inferior alveolar canal; however, they are not accurate and do not predict the exact root apex and canal relationship in three dimensions.^[10] When the panoramic images show darkening of the roots and interruption of the white line, we should assume that there may be contact between the impacted mandibular third molar and the inferior alveolar canal in such a scenario CBCT is considered.^[11,12]

Rios-Santos in their study on the assessment of periapical status using film-based IOPA and digital panoramic images found that OPG allows the

assessment of the periapical status of 87.4% of teeth, including third molars.^[13] Digital panoramic images allow the assessment of the periapical status of only 58.0% of the teeth. Hassan suggested that there is a better correlation between CBCT scans and IOPA scores than between CBCT scans and OPG images scores. This is due to the paralleling technique used for IOPA where film holder and a beam indicating device guide the film and the long axis of the root to be parallel to each other, and the X-ray beam passes perpendicular to both root and film, but this does not occur in the case of OPG.^[14] However, in the present study OPG was found to be more accurate in evaluating the type of impaction (IOPA vs. OPG = 88%:94%) and canal relationship to the apex of the root of the impacted molar (IOPA vs. OPG = 74%:86%). Though in most cases panoramic was more accurate in determining the exact type of impaction and the canal relationship to the tip of the impacted molar, these values were not statistically significant on analysis. The clinical examination after extraction of the impacted tooth included direct visualization of the canal in the extraction socket and grooving in the roots of the extracted tooth, if any. However, in most cases this method of clinically determining the inferior alveolar canal relationship to the root tip may not be accurate and it needs further confirmation with sophisticated modalities such as CBCT. Kositbowornchai *et al.* in their study on comparisons of various radiographic modalities for determining root tip and canal relationship suggested that OPG alone does not meet the need of determining the relationship between the inferior alveolar canal and the roots of lower third molar.^[15] The visibility of number of roots is more obvious in an IOPA compared to OPG, and hence the panoramic radiographic images are inadequate to detect multiple roots of impacted third molars this result is acceptable with previous studies.^[16,17]

The major disadvantage of both IOPA and OPG is that they provide two-dimensional information of tooth and its periapical structures. Comparatively dental CBCT is highly sensitive and is significantly superior to the so called conventional radiographs for predicting local anatomy around the impacted third molar.^[18] It is an excellent method for localizing the canal, and its relationship to the lower third molar roots especially when there is interruption of white line and when superimposition is seen, because of an added advantage that reformatted images can be generated through the mandibular body in any plane with CBCT.^[19] In addition, the alveolar bone loss is better revealed in cone beam CT if the impacted mandibular third molar

is periodontally involved^[20] cases than compared to IOPA.^[21] To achieve atraumatic surgical extraction avoiding bizarre complications such as injury to inferior alveolar nerve causing paresthesia CBCT will be more helpful than OPG.^[22] It is suggested to analyze OPG more carefully and use CBCT in high risk patients.^[23,24] The identification of the presence of mandibular retromolar canal is obvious in CBCT for extraction of mandibular third molar, whereas the roots appears intimately close to the mandibular canal on OPG.^[25] In traditional radiographs, the superimposition of anatomic structures and thickness of the roots may obscure many anatomical and pathological details. CBCT is capable of eliminating this effect and the details are so clear that external root resorption can be identified even in early stages.^[26,27] Being expensive, limited availability, and increased radiation exposure makes dental CBCT to be chosen very rarely for a preoperative radiographic evaluation of impacted mandibular third molars, making IOPA and OPG as a better choice for opting.

CONCLUSION

To conclude, though IOPA has a marginal angle over OPG in assessing various parameters [Table 1], only the number of roots have a greater accuracy ($P < 0.0013$) in IOPA than OPG. However, the OPG is the radiograph of choice when the patient is associated with trismus.

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Conflicts of interest

There are no conflicts of interest.

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