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Research Article

Diagnostic Accuracy of Orthopantogram in Identifying the Proximity of Inferior Alveolar Nerve Canal to the Roots of Mandibular Third Molar as Compared to Cone Beam Computed Tomography

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Abstract: Background: Third molar extraction is the most frequent surgical treatment performed in a dental office. For initial risk evaluation of IAN damage, traditional radiographic examinations like orthopantomography (OPG) are indicated. To gather local evidence, we did this research.

Objective: The aim of this research is to compare orthopantomography with cone beam computed tomography in identifying whether an impacted mandibular third molar (IM3M) is near the inferior alveolar nerve canal.

Materials and Methods: This cross sectional (validation) study was conducted at the Department of Oral & Maxillofacial Surgery, Faisalabad Medical University, Faisalabad from 30-5-2022 to 30-11-2022 after obtaining the permission from ethical review committee (F.No.48-ERC/2020-21/PHRC/FMU/103). 280 candidates fulfilled selection criteria were selected from the OPD. Patients then underwent OPG and findings were recorded and patient was labeled as positive or negative. Later on, patients underwent CBCT and findings were recorded. All the data was recorded on proforma while analyzed in SPSS ver 20.0.

Result: The mean age of patients was 34.76±9.27 years. Out of 280 patients, there were 131 (46.8%) males and 149 (53.2%) females. Out of 280 patients, 135 (48.2%) had left side IM3M extraction while 145 (51.8%) had right side IM3M extraction. On OPG, 65 (23.2%) had superimposition, 71 (25.4%) had interruption, 64 (22.9%) had darkening of roots and 80 (28.6%) had narrowing. The sensitivity of OPG was calculated as 79.8%, specificity was 97.2%, while PPV and NPV were calculated as 97.9% and 74.8% and diagnostic accuracy of OPG was 86.4%, taking CBCT as gold standard.

Conclusion: Thus, OPG can be somewhat reliable method for IAN position before Im3M extraction.

Keywords: Orthopantogram, Proximity of inferior alveolar nerve canal, Impacted roots, Mandibular third molar, Cone beam computed tomography, Maxillofacial trauma.

INTRODUCTION

Oral and maxillofacial surgeons often remove third molars during procedures for preventative, restorative, and orthodontic purposes. After surgery, IAN paresthesia has been documented with a frequency of 0.4% to 8.4%. Loss of function and a worse quality of life are possible consequences of permanent paresthesia. Since orthopantomography (OPG) is simple to conduct and has minimal biological and economic costs, it is suggested as the first choice conventional radiography examination for preliminary risk assessment of LAN damage. Due to its two-dimensional nature, OPG cannot accurately portray the true anatomical connection between the third molar and the IAN. Third molars were found to be superimposed in 67.4% of instances, narrowed in 23.3% of cases, deviated from their normal position in 18.6% of cases, interrupted in 30.2% of cases, and had darkened roots in 11.6% of cases. Close proximity refers to the intimate contact or minimal distance between the inferior alveolar nerve (IAN) canal and the roots of the impacted mandibular third molar (IM3M) [1-9].

Conversely, cone-beam computed tomography (CBCT) allows for the accurate acquisition of all anatomical and topographical variables pertaining to the third molar, which is crucial for adequate pre-operative planning with the goal of reducing the likelihood of surgical accidents and complications while also informing the patient clearly of the potential dangers involved [10, 11]. Akash Kadam conducted research on the diagnosis accuracy of OPG in 2018 and found that it had a sensitivity of 70% and a specificity of 63.3% [12]. According to the research of Patel *et al.*, a panoramic radiograph has a sensitivity of 98.55% and a specificity of 48.39% when used for diagnosis [13].

This study aims to evaluate the diagnostic accuracy of OPG in assessing the proximity of the inferior alveolar nerve (IAN) to the roots of impacted mandibular third molars, using CBCT as the reference standard. By comparing the findings from both imaging techniques, we seek to determine the reliability of OPG as a preliminary assessment tool in clinical decision-making.

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The purpose of this research is to examine the usefulness of OPG in IAN exposure prediction and to assess OPG's accuracy. We want to use the results of this research to convince more dentists to use OPG during the extraction of impacted third molars in the mandible.

The aim of this research is to compare orthopantomography with cone beam computed tomography in identifying whether an impacted mandibular third molar (IM3M) is near the inferior alveolar nerve canal.

MATERIALS AND METHODS

This Cross sectional (validation) study was conducted at the Department of Oral & Maxillofacial Surgery, Faisalabad Medical University, Faisalabad from 30-5-2022 to 30-11-2022 after obtaining the permission from ethical review committee (F.No.48-ERC/2020-21/PHRC/FMU/103). Sample size of 280 cases is calculated with 95% confidence level, expected percentage of superimposition of IAN 1.e. 67.4% with 5.5% absolute precision required. By using the non-probability, consecutive sampling technique, candidates of both gender from 18 to 50 years of age, coming for IM3M extraction and willing to undergo CBCT Scan were enrolled in our study.

Patients with bifid & trifid mandibular canals, pregnant patients, diabetics, with maxillofacial trauma all previous history of surgery or lesion in the same region, with intraosseous pathologies (e.g., dentigerous cysts or ameloblastoma or space infections) associated with mandibular 3rd molar and smokers were excluded from the sample.

280 candidates fulfilled selection criteria were selected from the OPD. Informed consent was taken. Demographic details (name, age, gender, lateral side) were noted. Then patients underwent OPG. Findings were recorded and patient was labeled as positive if there was presence of interruption, darkening of roots, diversion / narrowing of IAN. Later on, patients underwent CBCT by using plancema Dental X-ray Machine. All scans were performed by a single consultant radiologists having at least 4 years' experience in radiology. The CBCT findings were also interpreted by same radiologist. To reduce bias, blinding was ensured by anonymizing patient data before analysis. Findings were recorded and patient were confirmed as positive if there was presence of intimate contact of IAN with IM3M roots due to lack of cortication of bone. Close proximity refers to the intimate contact or minimal distance between the inferior alveolar nerve (IAN) canal and the roots of the impacted mandibular third molar (IM3M). The proximity was assessed based on the presence of cortical bone separation between the IAN canal and the root apex. If the cortication is absent or there is direct contact between the IAN and the root, it was considered close proximity. All the data was recorded on proforma.

STATISTICAL ANALYSIS

All the data was analyzed in SPSS ver. 20.0. 2x2 table was developed to calculate the "sensitivity, specificity, PPV, NPV and" overall diagnostic accuracy of OPG taking CBCT as gold standard. To assess inter-rater agreement between OPG and CBCT, Cohen's Kappa statistic was calculated.

RESULT

The mean age of patients was 34.76±9.27 years. Out of 280 patients, there were 131 (46.8%) males and 149 (53.2%) females. The male-to-female ratio was 1: 1.1. Out of 280 patients, 136 (48.6%) were living in rural areas while 144 (51.4%) were living in urban areas. Out of 280 patients, 135 (48.2%) had left side IM3M extraction while 145 (51.8%) had right side IM3M extraction. On OPG, 65 (23.2%) had superimposition, 71 (25.4%) had interruption, 64 (22.9%) had darkening of roots and 80 (28.6%) had narrowing (Table **1**).

Table 1. Basic Demographics at Presentation.

n	**280**
Age (years)	34.76 ± 9.27
Gender	
Male	131 (46.8%)
Female	149 (53.2%)
Residence	
Rural	136 (48.6%)
Urban	144 (51.4%)
Lateral Side Tnvolved	
Left	135 (49.2%)
Right	145 (51.8%)
On OPG IAN Relation to IM3M Roots	
Superimposition	65 (23.2%)
Interruption	71 (25.4%)
Darkening of roots	64 (22.9%)
Narrowing	80 (288.6%)

On OPG, 141 had positive IAN, out of which 138 were positive on CBCT while 3 were negative. And 139 had negative IAN, out of which 35 were positive on CBCT while 104 were negative on CBCT. The sensitivity of OPG was calculated as 79.8%, specificity was 97.2%, while PPV and NPV were calculated as 97.9% and 74.8% and diagnostic accuracy of OPG was 86.4%, taking CBCT as gold standard (Table **2**).

Table 2. Accuracy of OPG taking CBCT as Gold Standard.

		CBCT		**Total**
		Positive	**Negative**	
OPG	Positive	138	3	141
	Negative	35	104	139
	Total	173	107	280

Data was stratified for age of patients. Out of 280 patients, there were 146 (52.1%) patients of age 18-35 years and 134 (47.9%) were of age 36-50 years. To assess inter-rater agreement between OPG and CBCT, Cohen's Kappa statistic was calculated. The observed agreement was 86.4% while the expected agreement by change was 50.2% resulting in a Kappa vale of 0.727. This indicates a substantial agreement between the two modalities. Sensitivity = 79.8%, Specificity = 97.2%, PPV = 97.9%, NPV = 74.8%, Diagnostic accuracy = 86.4%.

DISCUSSION

The most often impacted teeth are the mandibular third molars, which may occur for a variety of causes. Insufficient eruption space and a failure to rotate teeth from a horizontal to a mesio-angular and vertical position are the two most common reasons for impaction. The removal of a patient's third molar is one of the most frequent surgical operations performed [14, 15].

A majority (55.6%) of impacted mandibular third molars showed contact in the CBCT, but just a third (35.3%) showed superimposition. It was shown that the presence or absence of a radiological sign in a panoramic radiograph did not reliably indicate a close association with the third molar, hence it was recommended that patients with tooth-canal overlap be sent for CBCT evaluation [16, 17].

In our study, we observed that the OPG had moderate sensitivity (79.8%), while specificity was high (97.2%), PPV of OPG was also high (97.9%), but NPV was moderate (74.8%). The overall diagnostic accuracy of OPG was 86.4%, respectively revealing that OPD can be used as first line diagnostic tool for IAN but further studies should be done. Ebrahimifard *et al.* in 2018 studied diagnostic accuracy of OPG to predict 70% sensitivity and 63.3% specificity [12]. Patel *et al.* showed the diagnostic accuracy of panoramic radiograph as 98.55% sensitivity and 48.39% specificity [13].

The reported prevalence of IAN paresthesia after surgery ranges from 0.4% to 8% [18]. Loss of function and a worse quality of life are possible consequences of permanent paresthesia. Accurately identifying the mandibular canal helps surgeons plan their procedures more effectively and reduces risks of consequences like paresthesia [19].

Our research found that 61.8% of patients had IAN based on CBCT (the gold standard). Neves *et al.* discovered that a risk association between tooth roots and the mandibular canal might be indicated by darkening roots and discontinuity of the white line on panoramic radiographs, indicating the need for 3D examination [20].

Tantanapornkul *et al.* found that CBCT predicts neurovascular bundle exposure better than OPG by assessing the third mandibular molar root tip's location in the canal. When it comes to predicting nerve exposure, CBCT and OPG have a 93% sensitivity and 77% specificity, and 70% and 63%, respectively [21]. OPGs may help determine IM3M's proximity to the IAN and the seven radiographic criteria (darkened roots, deflected roots, constricted roots, bifid root apex, diverted canal, restricted canal, and canal white line disruption). However, if any of these particular symptoms are present on OPG, additional research using CBCT is indicated, since the 3D link between IM3M and IAN may be investigated [22]. We found that twenty-five percent (23.2%) had superimposition, twenty-one percent (25.4%) had interruption, twenty-two percent (22.9%) had darkened roots, and twenty-eight percent (28.6%) had narrowed.

Ishak *et al.* discovered that contact was present in 55.6% of impacted mandibular third molars with white line disruption and in 35.3% of impacted mandibular third molars with superimposition. It was shown that the presence or absence of a radiological sign in a panoramic radiograph did not reliably indicate a close association with the third molar, hence it was recommended that patients with tooth-canal overlap be sent for CBCT evaluation [23].

Surgeons contemplating on extracting mandibular third molars should be wary if CBCT pictures show a lack of cortication. OPG-detected canal diversion should be used as a predictor of IAN damage since it is statistically linked to a greater likelihood of absence of cortication. It is advised that 3D imaging methods be used when this particular symptom is present. In addition, the lack of cortication in the mandibular third molar joint, which is associated with an inter-radicular/lingual course of the IAN, necessitates particular caution on the part of the surgeon [24, 25].

CONCLUSION

Thus, OPG can be somewhat reliable method for IAN position before Im3M extraction. Now we can implement the evidence and the application of OPG in patients undergoing impacted mandibular third molar extractions. This will aid in the use of optical coherence tomography (OPG) for preoperative evaluation of impacted third molars, since it will allow doctors to see how close the roots of the impacted tooth are to the internal iliac (IAN) canal.

AUTHORS' CONTRIBUTION

Iqra Naeem: Conceptualization, Study design, Writing draft.

Muhammad Usman Khalid: Writing draft, Critical review and revision the manuscript.

Malik Muhammad Usama and **Muhammad Shafique Ashraf**: Study design.

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Declared none.

CONFLICT OF INTEREST

Declared none.

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