Reliability of Orthopantamogram in Lower Third Molar Surgery: Inter- and Intra-observer Agreement

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INTRODUCTION

Surgical removal of impacted lower third molar (IL3M) is one of the common dentoalveolar procedures performed in any dental setup. Traditionally, orthopantamogram (OPG) is a standard evaluation tool to assess and plan this surgical removal.1-7 Risk of inferior alveolar nerve injury (IAN) due to IL3M removal is reported to be 0.35%-9.4% and permanent nerve damage less than 1%.8-12

Many radiological investigations such as a periapical radiograph, OPG, computed tomography (CT) scan, cone bean (CBCT) scan, and magnetic resonance imaging (MRI) are proposed to examine the anatomic relationship of IL3M to IAN.2,14-17 Among these, only MRI can give the exact anatomical position of the IAN bundle.2 However, it is not practical to do MRI for IL3M removal, considering the cost and time. Hence, CBCT is gaining popularity for assessment of IAN injury in IL3M surgery. On the contrary, there are studies mentioning that CBCT is not superior to OPG in terms of reducing the IAN injury during IL3M surgery.18-20

ABSTRACT

Context: The evaluation of relationship between the roots of impacted lower third molar (IL3M) and inferior alveolar nerve injury (IAN) with orthopantamogram (OPG) is mandatory before performing de-impaction surgery. An investigation is considered reliable if it can be reproduced by various examiners. Assessment of OPG is subjective and varies among examiners. OPG is reliable to clinicians if the interpretation is not a product of guess work. Aim: The aim of this study was to evaluate the magnitude of agreement among oral surgeons and oral radiologist in observing intimate relationship between IL3M and mandibular canal. Materials and Methods: OPGs were evaluated by two oral surgeons and one oral radiologist for nerve root relationship. All the three were from different institutions with 10–15 years of experience. The three observers were blinded from each other’s findings. A total of 127 OPGs were evaluated for inter-observer agreement. Fifty OPGs were evaluated after 60 days for intra-observer agreement. The agreement was evaluated based on Cohen’s κ statistics. Results: Our results denote that the interpretation of OPG among specialists is not in good agreement. We suggest development of methods to standardize evaluation of OPG and the exposure technique to improve inter-observer agreement among the dental specialists.

KEYWORDS: Impacted tooth, inferior alveolar nerve injury, nerve injury, OPG reliability, panoramic radiograph, third molar surgery

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Considering the above fact, OPG is still a standard investigation to examine relationship of impacted tooth to the mandibular canal. Studies have shown that OPG is still one of the efficient diagnostic tools for assessing IL3M \cite{21-24} Rood and Shehab\cite{25} criteria, which rely on conventional radiography, are still widely used to assess the risk of nerve injuries following IL3M surgery especially when CBCT is not an available option.

Preoperative evaluation of OPG helps the dentist and the surgeon to explain the patient about possible complications and alternative options. But the interpretation of OPG is subjected to variation among the surgeons and other specialists. The magnitude of variations directly affects the reliability of OPG in predicting IAN injury.

The purpose of the study was to find the agreement between oral surgeons and oral radiologist in examining the intimate nerve root relationship in OPG, which are considered as danger signs.

**Materials and Methods**

The study was initiated after approval from the institutional review board and obtaining the necessary ethical approval. Study subjects were those who reported to the oral surgery department in Raja Muthiah Dental College during the time period 2016–2018 for surgical removal of IL3M. The subjects were screened for nerve root relationship with OPG. All the participants were given detailed information about the study and their participation and informed consent obtained.

In OPGs, the inferior alveolar canal and roots with intimate relationship as per Rood and Shehab criteria were included. The radiographs were then evaluated by three different examiners for the following:

1. Interruption of white line (IWL)
2. Deviation of the canal (DC)
3. Radiolucency across the roots (RARs)
4. Narrowing of the canal (NC)
5. Deflection of the roots (DRs)
6. Narrowing of the roots by canal (NR)
7. Bifid apex (BA)

Only IL3Ms with complete root formation were included. Those with periapical pathology, associated tumor, cyst, fracture localized bone pathology, or altered the bone morphology were excluded.

The sample size was calculated according to results of Zandi \textit{et al.}\cite{26} Considering the minimum acceptable reliability as 0.2 and expected reliability as 0.3 with the level of significance at 5% and power of study as 20% and the number of interrupters as three, the sample size would be 109. Taking into account 10% as dropout rate, the study sample size is 120.

File number was allotted to all OPGs by a third person not involved in study. OPGs were evaluated by two oral surgeons with 15 years’ experience and oral radiologist with 10 years’ experience. All the three were trained in different institutes and work in different institutes. One third of the OPG selected randomly from the total sample where reinterpreted by all the examiners after 60 days’ time interval for evaluation of intra-observer reliability. Examiners were blinded on the OPG findings from each other and their first and second evaluation.

Inter- and intra-observer agreement was calculated using Cohen’s $\kappa$ value. The interpretation of the $\kappa$ statistics was done based on Altman’s classification.\cite{26}

Altman’s classification for $\kappa$ statistics is as follows:

- Less than 0.2—poor agreement
- 0.21 to 0.40—fair agreement
- 0.41 to 0.60—good agreement
- 0.81 to 1.00—very good agreement

**Results**

A total of 127 OPGs were examined by three examiners. The assessment for each and every sign was analyzed statistically for agreement between the examiners and for the same examiners in 2 months’ time interval. Two of the signs NR and BA could not be evaluated statistically as there was uniform agreement among the examiners that they are present in only very few radiographs. The intra-observer agreement could not be analyzed for three signs DR, NR, and BA as the readings were statistically insignificant. The agreement between Examiners 1 and 2 (both surgeons) is fair for the signs IWL (0.35), DC (0.45), and RAR (0.32). Examiners 1 and 3 (surgeon 1 and radiologist) have fair agreement for IWL (0.20) and moderate agreement for DR (0.51). Examiners 2 and 3 (surgeon 2 and radiologist) had fair agreement for RAR (0.32). The agreement for all the other radiographic signs between the examiners is poor.

Examiner 1 has good intra-examiner agreement for IWL (0.71), moderate for DC (0.46) and RAR (0.55), and poor for NC (0.15). Examiner 2 had fair agreement for IWL (0.29), DC (0.30), RAR (0.38), and moderate for NC (0.48). Examiner 3 had poor agreement for IWL (0.07), DC (0.04), and fair agreement for RAR (0.37) and NC (0.40).

**Discussion**

The presurgical assessment of IL3M is important step, which includes detailed clinical history and appropriate
investigations. Radiographic interpretation of the IL3M and its adjacent structures help the surgeon to predict the difficulty of surgery and identify various risk factors including IAN injury. Intraoral periapical (IOPA) radiograph, OPG, stereoscanningography (SCAN), and CBCT scan are recommended by various studies. As per the guidelines of current clinical practice of Royal College of Surgeons (England), OPG is sufficient for assessment of IL3M. As per the European guidelines, CBCT is recommended only when conventional imaging reveals intimate contact between mandibular canal and IL3M roots. Hence, assessment of OPG is mandatory for all lower third molar impaction cases.

Many studies have evaluated the sensitivity and specificity of OPG to predict IAN injury in IL3M de-impaction surgery. Radiographic signs such as IWL, deviation of canal, darkening of the roots, and NC are high-risk factors for IAN injury. In our study, both the surgeons had fair inter-observer agreement and fair-to-good intra-observer agreement for the aforementioned signs in OPG. The evaluation of the OPG for above signs is fairly agreeable between the surgeons and helps to identify the possible risk of nerve injuries preoperatively.

Some studies suggest that OPG is not reliable to assess the risk of nerve injuries. This can be attributed to the difference in observation of nerve root relationship made by the individual examiner, the quality of OPG, and other risk factors such as age, gender, and root curvature. The inter-observer agreement and the diagnostic quality of OPG can be improved by improving the standardization of observation among surgeons, operator skill in patient positioning, exposure, and processing conditions.

Muglali et al. observed that the agreement between two senior surgeons of different institutes for examining the relationship of IL3M roots to IAN canal was less when compared to the agreement between senior surgeon and residents of the same institute. This may be due to the fact that residents trained by the same surgeon are interpreting the same way.

In our study, we had only fair agreement among the surgeons for three of the signs (IWL, DC, and RAR) and poor for the other two signs. When compared to the surgeons and the radiologist, the agreement was poor in general for most of the signs. The intra-observer agreement is not good for all the three examiners. This indicates that standardization in the observation of OPG for signs of intimate nerve root relationship is required to improve inter- and intra-observer agreement. The development of technology such as combined use of deep learning (segmentation of third molar and IAN in OPG) with OPG may improve the assessment of nerve root relationship and risk of nerve injury in a reproducible way.

**CONCLUSION**

This study shows that the evaluation of nerve root relationship in OPG between the surgeons and radiologist is not consistent with each other. Considering the fact that OPG is still the preliminary investigation of choice for many centers where there is no access for advanced investigations such as CBCT, further studies to standardize the interpretation of nerve root relationship are recommended. We also insist that the radiology technician should be well educated on the patient positioning, exposure, and processing techniques to increase the diagnostic accuracy of OPG.

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**Conflicts of interest**

There are no conflicts of interest.

**REFERENCES**

1. Ghaemnia H, Gerlach NL, Hoppenreis TJ, Kicken M, Dings JP, Borstlap WA, et al. Clinical relevance of cone beam computed tomography in mandibular third molar removal: a multicentre, randomised, controlled trial. J Cranio maxillofac Surg 2015;43:2158-67.
2. Huang CK, Lui MT, Cheng DH. Use of panoramic radiography to predict postsurgical sensory impairment following extraction of impacted mandibular third molars. J Chin Med Assoc 2015;78:617-22.
3. Liu W, Yin W, Zhang R, Li J, Zheng Y. Diagnostic value of panoramic radiography in predicting inferior alveolar nerve injury after mandibular third molar extraction: a meta-analysis. Aust Dent J 2015;60:233-9.
4. Leung YY, Cheung LK. Correlation of radiographic signs, inferior dental nerve exposure, and deficit in third molar surgery. J Oral Maxillofac Surg 2011;69:1873-9.
5. Flygare L, Ohman A. Preoperative imaging procedures for lower wisdom teeth removal. Clin Oral Investig 2008;12: 291-302.
6. Ghaemnia H, Meijer GJ, Soehardi A, Borstlap WA, Mulder J, Bergé SJ. Position of the impacted third molar in relation to the mandibular canal. Diagnostic accuracy of cone beam computed tomography compared with panoramic radiography. Int J Oral Maxillofac Surg 2009;38:964-71.
7. Koong B, Pharoah MJ, Bulsara M, Tennant M. Methods of determining the relationship of the mandibular canal and third molars: a survey of Australian oral and maxillofacial surgeons. Aust Dent J 2006;51:64-8.
8. Juddzalys G, Daugela P. Mandibular third molar impaction: review of literature and a proposal of a classification. J Oral Maxillofac Surg 2015;73:417-21.
9. Kim JW, Cha HI, Kim SJ, Kim MR. Which risk factors are associated with neurosensory deficits of inferior alveolar nerve after mandibular third molar extraction? J Oral Maxillofac Surg 2012;70:2508-14.
