

ORIGINAL RESEARCH ARTICLE

PROXIMITY OF MANDIBULAR THIRD MOLAR ROOTS WITH INFERIOR ALVEOLAR CANAL: A RADIOGRAPHIC STUDY

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ABSTRACT

Background: Mandibular third molar's roots have close proximity to the inferior alveolar canal (IAC) and nerve. Inferior alveolar nerve injuries have been observed to occur more frequently when there is radiographic evidence of close contact of third molar roots to the IAC. Orthopantomogram is one of the commonly used diagnostic tools for evaluating the relationship between these two structures. There is lack of data regarding prevalence of these radiographic signs in Nepalese population. It was required to assess the reliability on the radiographic signs of relationship between the IAC and the third molar roots, to establish IAC as risk indicators for IAC exposure during extraction.

Methods: A single centre cross-sectional descriptive study was designed where demographic data and radiographic signs of third molar roots proximity to IAC were obtained from imaging software records and descriptive analysis was performed with SPSS version 20.

Results: One or more radiographic signs were observed in 49.6% of mandibular third molars. Interruption of white line followed by narrowing of canal and darkening of roots was observed in decreasing order of frequency and no statistically significant association between sex, age and side of impacted third molar with presence of radiographic signs.

Conclusions: Presence of one or more radiographic signs of proximity of mandibular third molar roots with IAC in nearly half of the cases. Clinicians should be aware of risk of nerve injury on presence of these signs. Further investigation with cone beam computed tomography to rule out any nerve injury risk should be adopted into practice.

INTRODUCTION

Mandibular third molars are the most variable tooth in anatomy, root morphology and position of root with close proximity to inferior alveolar canal. This proximity, alongside the surgical techniques to remove these teeth have significant effect on the inferior alveolar nerve.^{1,2} Inferior alveolar nerve injuries are seen in 0.2 to 4% of surgically removed third molars with incidence dependent on multiple factors like age, sex, concomitant use of socket medications, experience and level of the surgeon, technique and instruments used for removal of the tooth.^{3,4} Preoperatively assessing the surgical difficulty with an Orthopantomogram (OPG), allow the surgeon to observe the morphology of the tooth, number of roots, angulation of tooth, its depth in the bone and the anterior ramus, which are factors affecting treatment plan. Several signs indicating the close relationship of third molar roots to the IAC has been proposed by Rood and Shebab and later by Poyton.^{5,6} Studies shows that OPG have nearly as good sensitivity and specificity of detecting close relationship between third molar roots and IAC as compared to a cone beam computed tomography and can be used for pre-assessment of third molars.^{7,8} OPG's are inexpensive, low radiation and easily available in smaller dental

units and hospitals also however, a real three-dimensional picture and buccolingual relationship is unknown. Dearth of studies on third molar roots and inferior alveolar canal in Nepalese population persuaded us to carry out this study to describe the proximity of mandibular third molar roots to the inferior alveolar canal and nerve.

METHODS

A single centre cross-sectional study was designed with sample size of 475 patients collected from July 2017 to July 2019, at the department of Oral and maxillofacial surgery of College of Medical Sciences and Teaching Hospital (COMS-TH), Bharatpur, Nepal.

Ethical approval was obtained from institutional review committee of COMS-TH. All the patients who reported the signs and symptoms of third molar pain and difficulty were included. Pregnant patients and those who didn't provide consent were excluded. Orthopantomogram (OPG) of patients were retrieved from imaging software records. Baseline demographic data was obtained from patient's entry in OPG imaging software program (Orthoralix Vixwin software) and signs of proximity of mandibular third molar roots to inferior alveolar canal as

described by Rood and Shebab were ascertained.⁷ The seven radiographic signs were observed on digitally magnified OPG's using Orthoralix Vixwin software (Gendex, USA) and presence or absence of signs were entered. Presence of simultaneous multiple signs were entered. Explicit prior criteria have been used to designate each of the seven panoramic radiographic signs as "positive" when present or "negative" when absent (Table 1). All observations and demographic datas were entered in Microsoft excel and descriptive analysis was performed with SPSS Version 20. Frequency was used to describe presence of radiographic signs and means were used to describe demographic variables. Cross tabulation was done to analyse the pattern of combination of signs.

Table 1: Criteria for presence or absence of radiographic signs on OPG

Radiographic sign	Criteria for positive sign
Diversion of the canal	Change in direction of inferior alveolar canal when it comes on contact with root of third molar
Interruption of white line of canal	Disappearance of one or both cortical white line of inferior alveolar canal
Narrowing of the canal	Reduction in diameter of the inferior alveolar canal when it meets roots of third molar
Darkening of root	Increased radiolucency because of overlapping of the canal and roots of third molar
Deflection of root	Abrupt deviation of third molar roots when it reaches the canal
Narrowing of the root	Abrupt narrowing of the third molar root when it overlaps with the inferior alveolar canal
Dark and bifid apex of the root	Double shadow of periodontal membrane when roots cross the inferior alveolar canal

RESULTS

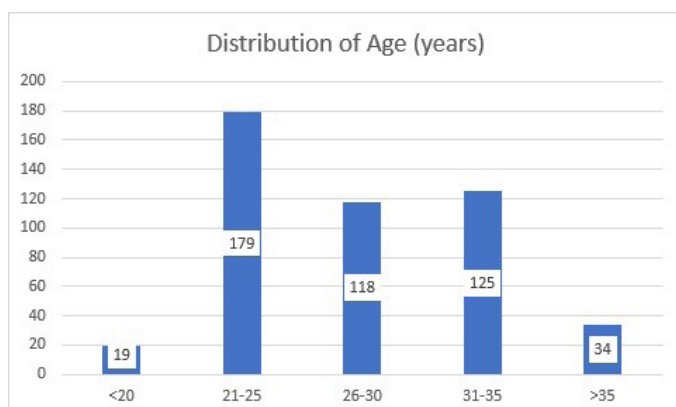


Figure 1: Distribution of age in the study population

gender distribution

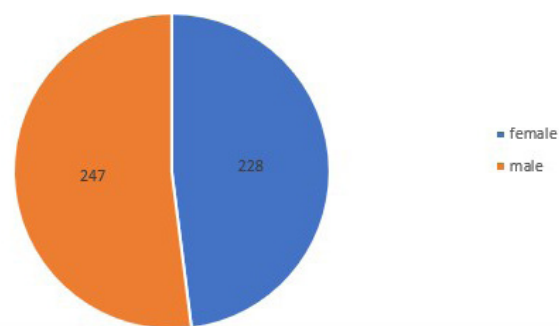


Figure 2: Distribution of gender in the study population

The distribution of age group is shown in Figure 1, and the distribution of gender in Figure 2, in the study population.

Most common age group in our study were 21-25 years age (n=179) followed by 31-35 years of age (n=125). There were almost equal number of male (n=247) and female (n=228) in this study (Figure 2).

The most common radiographic sign was interruption of white line of Inferior alveolar canal (n=196) followed by narrowing of canal (n=113) and darkening of roots(n=110) as shown in Table 2.

Table 2: Prevalence of individual radiographic signs in the population.

Radiographic Signs	Yes n (%)	No n (%)
Darkening of root	110 (23.16)	365 (76.84)
Deflection of root	49 (10.32)	426 (89.68)
Interrupted white line	196 (41.26)	279 (58.74)
Narrowing of IAC	113 (23.79)	362 (76.21)
Diversion of IAC	30 (6.32)	445 (93.68)
Dark and bifid root	20 (4.21)	455 (95.79)
Narrowing of root	32 (6.74)	443 (93.26)

Absence of any radiographic sign was observed in 245 cases (51.6%). When only one sign was observed (n=71), the most common sign was, interruption of white line of canal followed by deflection of roots. The next most common pattern of combination was 3 signs (n=60) followed by two signs together (n=55).

The common pattern of two signs seen together were interruption of white line and darkening of roots. The common pattern when three signs were seen together was interruption of white line of canal, narrowing of canal and darkening of roots (Table 3).

Table 3: Prevalence of multiple signs and their combinations

Radio-graphic sign	Preva-lence	Percent-age	Darken-ing of root	Deflec-tion of root	Interrupt-ed white line	Narrow-ing of IAC	Diversion of IAC	Dark and bifid root	Narrow-ing of root
0	245	51.6							
1	71	14.9	7	24	37	0	2	0	1
2	55	11.6	26	8	55	19	1	1	0
3	60	12.6	38	6	60	51	9	3	13
4	31	6.5	26	7	31	30	10	8	12
5	13	2.7	13	4	13	13	8	8	6
Total	475		110	49	196	113	30	20	32

No significant correlation was found between demographic variables of age, sex and side of impaction and presence or absence of radiographic signs of proximity of third molar roots to inferior alveolar canal with significance level fixed at $p < 0.05$ at 95% confidence level.

DISCUSSION

Radiographic signs showing proximity of third molar roots to inferior alveolar canal has been used to correlate the neuro-sensory injury to inferior alveolar nerve when third molar roots are anatomically close to the inferior alveolar canal as evident by radiographic signs. Rood and Shehab found a significant relation between diversion of the canal, narrowing of the root, interruption of the white line by the nerve, and injury to the nerve.⁹ Some studies show that the bone line of the mandibular canal is more likely to be interrupted by the impacted tooth if panoramic radiography shows the impacted tooth intersecting the mandibular canal, and it is also more likely to come into contact with the canal if the root of the impacted tooth is narrowing.^{10,11} Other study too have reported that the impacted tooth is more likely to come into contact with the canal if the white line cannot be identified on panoramic radiography.¹² With positive panoramic radiographic signs of diversion of the canal, interruption of white line of the canal or darkening of the root, the risk of inferior alveolar nerve injury after third molar surgery was shown to increase between 8- 22%.^{7,8,12} Hence, the presence of the panoramic radiographic signs of diversion of the canal, interruption of white line of the canal or darkening of the root had sufficient added value for ruling in the IAN injury during mandibular third molar surgery and these signs were similarly observed most frequently in this study. The other four signs were not observed frequently which was similar to the observation in this study and, studies have shown that these four signs do not have adequate predictive value to support further investigations with a CBCT.^{13,14} In the prospective study by Rood and Shehab, with signs suggesting an increased risk of nerve involvement, nerve injury was observed in 14% of cases.⁵ The Howe and Poyton study also used radiological predictors as stated above, nerve injury incidence was observed in 35.64%.⁶ Hence, using radiographic predictors during pre-operative planning, can be a useful tool to reduce the incidence of nerve injuries associated with surgical removal of third molars. Further investigations with a CBCT can be performed to confirm the three dimensional association of third molar roots to

the inferior alveolar canal and surgery can be modified to minimize risk of injury.¹⁵⁻¹⁷ Intentional and partial coronectomy can be performed for roots which show radiographic signs most associated with nerve injuries.^{18,19} In our clinical experience, if there is presence of radiographic signs that suggest anatomical proximity of inferior alveolar canal with third molar roots, it is always prudent to make sure that the tooth is elevated gently from the socket and root apex visualized, before complete removal from the socket. Orthodontic extrusion and extraction can be an alternative in high risk cases.²⁰ Multi rooted third molars with proximity to inferior alveolar canal should be removed after division of roots to minimise traction injury to the inferior alveolar nerve if the roots are hooked around the nerve. By following these simple rules, we have observed minimal incidence of inferior alveolar nerve injuries during surgical removal of mandibular third molars in our own unit.²¹

This study is not devoid of limitations. First of all, this is a simple cross-sectional study where radiographic signs were observed on an OPG. Newer studies in developed countries and health systems use CBCT to confirm the proximity of third molar roots to the inferior alveolar nerve in three dimensions. Because of relative unavailability of CBCT in our country and relatively higher expense of CBCT, precludes its use in our patient population. We recommend CBCT only if there is high possibility of post-operative nerve damage and use OPG as a predicative tool routinely before surgical removal of third molars. This is a single centre study so the outcomes of this study cannot be generalized. A cross sectional prevalence study is the first step towards clinical studies where complications of nerve injury and should be correlated with the radiographic signs on OPG and comparative study between diagnostic accuracy of OPG and CBCT should be planned in the future.

CONCLUSION

Radiographic signs indicating proximity of mandibular third molars with inferior alveolar canal are seen very frequently on OPG and OPG can be used as a predictive tool to anticipate risk of inferior alveolar nerve injury. When interruption of white line of canal, diversion of canal and darkening of roots of mandibular third molar is seen on OPG, a high suspicion of nerve injury should be made and a CBCT should be advised in such cases.

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