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Inferior Alveolar Nerve Injuries after Surgical Extraction of Mandibular Third Molar: A Combined Radiological and Surgical Approach

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ABSTRACT

Background: Inferior alveolar nerve (IAN) passes through the mandibular canal, a significant structure seen in an Orthopantomogram. IAN damage is one of the frequent complications associated with surgical removal of mandibular third molar. The present study was undertaken to assess the relationship between the apices of mandibular third molar and inferior alveolar canal radiographically and clinically in mandibular impacted teeth.

Materials and method- Preoperative orthopantomograph and intraoral periapical radiographs were taken for 150 patients. These findings were correlated with findings in surgery, i.e., seven radiographic indicators of a close relationship between the mandibular third molar and inferior alveolar canal and assessment of post-operative IAN damage.

Results- 105(70%) were bony impactions and 45(30%) soft tissue impactions. IAN damage was seen in 4 of 94 patients with mesioangular impaction, 3 of 14 patients with distoangular impaction, 2 of 23 patients with vertical impaction and none with horizontal impaction. Nerve injury with deflection of root showed a statistically significant value.

Conclusion- 6% damage to the IAN after the removal of mandibular third molar was observed. 5 out of 7 radiographic signs of mandibular canal association with third molar were found. More incidence of damage to the IAN was observed during deflection of root.

Keywords: Inferior Alveolar Nerve; Orthopantomogram; Paraesthesia; Third molar.

INTRODUCTION

The inferior alveolar nerve (IAN) runs in a canal within the mandible near the apices of the lower third molar. Sometimes during the surgical removal of mandibular third molar, IAN is damaged. This is an unusual complication but an important one.[1] Damage to the IAN manifests itself as a sensory disturbance of the lower lip and chin upto the midline. It is therefore important to predict and assess the risk of nerve damage.[2]

The reported incidence of the IAN injury after the surgical removal of impacted lower third molar ranges from 0.4 to 8.4%.[3] A close anatomic relationship between the roots of the third molar and the mandibular canal places the IAN at risk for damage.[4] Surgical technique used for the removal of the impacted third molar also exerts a definite influence on the incidence on the IAN damage. The major risk factors associated are advanced patient age, depth of impaction, tooth angulation, need for

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tooth sectioning and bone removal, surgeon experience and radiographic predictors.[1-2]

Considering the above background, the aims and objectives of the study was to assess the relationship between the apices of mandibular third molar and inferior alveolar canal radiographically and clinically in mandibular impacted teeth; and to avoid neurovascular bundle damage during lower third molar surgery.

MATERIAL AND METHODS

A prospective study with a total of 150 consecutive patients requiring surgical extraction of mandibular third molars reporting to the department of oral and maxillofacial surgery were selected for the study. Research was initiated after approval from departmental research committee. After assessing clinically and radiologically with panoramic and intraoral periapical radiographs diagnosis was obtained and only impacted mandibular third molars were included in the study.

Patients with systemic diseases such as bleeding disorders, cardiovascular diseases, gastrointestinal lesions, diabetes mellitus and patients not willing for extraction of the impacted tooth were excluded from the study. All the patients were explained the importance of the study and a written informed consent obtained. The relevant findings were recorded using a proforma specially designed for the study. The following details were recorded pre-operatively:

1. The tooth to be removed.

2. The type of impaction.

3. The radiological evaluation of the mandibular third molar to the inferior alveolar canal which included [1]

- Darkening of the root – Type A
- Deflection of the root - Type B
- Narrowing of the root - Type C
- Dark and bifid apex of the root - Type D
- Interruption of the white line of the canal - Type E
- Diversion of the canal - Type F
- Narrowing of the canal - Type G

SURGICAL PROCEDURE: Transalveolar extraction was performed under the local anaesthesia. After routine blood and radiographic investigations, local anaesthesia was obtained through IAN block, lingual nerve block and long buccal nerve block. A standard Terrance Ward's incision was placed, flap was elevated and bone exposed. Bone was guttered using a round and 701 straight fissure burs by standard technique on the buccal and distal side, depending on the type of impaction. Sectioning of tooth was performed wherever required. After adequate amount of bone removal, the tooth was delivered out of the socket by using an elevator. Copious irrigation was done and wound closed with 3-0 black silk suture material using interrupted sutures. A standard antibiotic (amoxycillin 500mg + clavulanic acid 125mg), analgesic (aceclofenac 100mg + paracetamol 325 mg + serratiopeptidase 10 mg) along with a multivitamin containing zinc was prescribed to all the patients for 5 days.

Suture removal was performed after 7 days and the surgeon explored the wound for closure and registered any complications such as trismus, swelling, postoperative bleeding, infection and nerve injury. All patients were specifically asked about altered labial sensation. Any nerve injury detected was followed up after 15 days and 1 month. The affected areas were assessed using 2-point discrimination test, pinprick test and light touch test. Statistical analysis was done in SPSS version 16.01 with the help of Chi-square test and p-value calculated. Result was considered significant if p-value was <0.05.

RESULTS

The age of the patients involved in the study ranged from 18-49 years with mean age of 25.5 years. A total of 150 impactions were considered for the study - 105(70%) were bony impactions and 45(30%) soft tissue impactions. IAN damage was seen in 9 patients and all were bony impactions. [Table 1]

Mesioangular impactions were seen in 94(64%) cases, distoangular impactions in 15(10%) cases, horizontal impactions in 18(12%) of cases and vertical impactions in 23(14%) of cases. IAN damage was seen in 4 patients with mesioangular impaction, 3 patients with distoangular impaction and 2 with vertical impaction. [Table 2]

Table 1: Distribution of the type of impactions.

	Total	Normal	Nerve injury	p-value
Impaction	150	141	9	
Soft tissue	42	41	1	0.244467
Bony	108	100	8	

Table 2: Distribution of the different angulations of the impacted teeth.

	Total	Normal	Nerve injury
Angulation	150	141	9
Distoangular	14	12	2
Mesioangular	93	86	7
Horizontal	19	19	0
Vertical	24	24	0

Table 3: Appearance of radiological signs in mandibular canal.

Radiographical signs	Total	Normal	Nerve Injury	
	133	124	9	
A	72	72	0	Chi square test - 16.524, degree of freedom (df) = 4, p = 0.002
B	4	2	2	
C	0	0	0	
D	23	18	5	
E	11	11	0	
F	22	20	2	
G	1	1	0	
No Sign	17	17	0	

Darkening of root was seen in 72 cases, narrowing of root in 4 cases, dark and bifid apex of root was not seen in any of the cases, deflection of root was seen in 23 cases, interruption of white lines of canal in 11 cases, narrowing of canal in 22 cases and diversion of canal was seen in 1 case. IAN damage was seen in narrowing of the root in 1 case, deflection of the root in 2 cases and deflection of root sign along with narrowing of canal seen in 2 cases. Nerve injury with deflection of root showed a statistically significant value with a p value of 0.002. [Table 3]

DISCUSSION

The term impaction is of latin origin coming from the word “impactus” meaning ‘on strike’. Archer defined an impacted tooth as a tooth which is completely or partially unerupted and positioned against another tooth, bone or soft tissue, so that its further eruption is unlikely. Surgical removal of impacted teeth is one of the most common procedures performed by maxillofacial and oral surgeons.[5] The incidence of lower third molar impaction is 14% compared with other teeth which include maxillary cuspids (1.3%), mandibular first premolars (0.22%) and second premolars (0.11%). However, any tooth may be impacted in both the arches.[6] In a study, it was found that the mean distance between the mandibular third molar and IAC was 2.2 mm with a maximum distance of 12 mm and minimum distance of 0.5 mm.[7] In majority of population, the mandibular third molar is situated behind the second molar tooth at the end of the body of the mandible where it meets a relatively thin ramus; in the ramus it is present on the medial side of the bony shelf and distal to the anterior border of ramus. Facial artery runs upwards between the groove at medial surface of mandible and lateral surface of submandibular gland, it then

hooks the lower border of mandible at the anteroinferior corner of masseter muscle and ascends on face and have a secure relationship with the second molar.[8] It is a possible to cut these vessels accidently with the scalpel. It is advised to always begin the incision from the depth of the sulcus and direct the blade upwards towards the teeth.[9] Below and along the apices of third molar is the mandibular canal which is an independent bony structure which protects the IAN, artery and vein, which are contained in a facial sheath called the neurovascular bundle. Calcification of the inferior alveolar canal is completed before the roots of the wisdom tooth are formed and therefore in their development the growing roots may impinge upon the canal and become deflected. Every endeavour should be made to prevent the damage to the IAN during the removal of the impacted mandibular third molar, which is closely related to it. In cases of risk of damage to the IAN, it can be minimized by removing generous amount of bone on the buccal side of the tooth and delivering the tooth through that defect.

Studies have reported the incidence of IAN injury to be in the range of 0.4–8.0%; furthermore, for teeth in a true relationship to the inferior alveolar canal, it increases to 20–35.6%. However, everlasting injury occurs only in less than 1% of patients.[10-11] It is also considered that nerve dysfunction after mandibular third molar surgery is the third most common complication after alveolar osteitis and post-operative infections. In our study, the incidence of damage to the IAN after removal of mandibular third molar was 6%, which is similar to other clinical studies. Although few authors do not report any permanent injury to the IAN, Rood had reported an incidence of 0.3% when the lingual split technique was used.[12] Very few studies have addressed the influence of age of the patient and the injury to the IAN. Some studies pointed out that the older age group of patients had higher risk of inferior alveolar nerve damage; however other studies have failed to show an association between age and damage to the IAN. Data from our study shows no statistically significant correlation between age of the patient and damage to the IAN. A higher incidence of inferior alveolar nerve injury has been reported within clinical studies after the third molar was removed under general anaesthesia as compared to those removed under local anaesthesia. Brann C.R et al. (1999) noted significantly higher risk of IAN injury with the use of general anaesthesia.[13]

The method of bone removal seems to have an effect on the IAN damage. Few studies suggest higher incidence of nerve injuries with bur technique when compared to bone removal with chisel.[14,15] Higher rates of IAN damage were reported after the removal of mandibular third molars with total bony impaction as compared to a lower incidence in soft tissue impacted mandibular third molars. There was no statistically significant difference between the soft tissue and bony impactions in the present study. The angulation of the third molar is an important cause for impaction has been assessed in several long-term studies. Blaeser et al. (2003) reported that the angulation type of the mandibular third molar was not correlated with the damage of the mandibular canal.[16] Kipp and Goldstein et al. (1980) reported that the incidence of paraesthesia is affected according to the molar angulation.[17] In our study, we found IAN damage in seven cases of mesioangular impaction and two cases of distoangular impaction which is similar to finding of study by Wofford et al. (1987) where in there were more dysesthesias seen in mesioangular impacted mandibular third molars. Statistically association of angulation with inferior alveolar nerve damage was insignificant.[18] As many as seven radiological signs are mentioned in the literature as indicative of a close relationship of the impacted mandibular third molar to the inferior alveolar canal. In our study, we found appearance of five of the seven radiological signs. Rood et al. (1990) found a significant relation between the diversion of the canal and grooved roots.[1] Howe and Poyton (1960) found that darkening of the root on X-rays was the most reliable indication of a true relationship between the third molar and the inferior alveolar canal.[19] In the present study, nerve injury associated with deflection of the root and bifid root apex was found to be 50% and 21.73% respectively. Many studies in the literature have pointed out the direct relationship between third molar impaction depth and post extraction neurological damage. The most explainable reason could be the anatomical approximation between the third molar and the neurovascular bundle, as well as the greater surgical complexity, which might lead to a higher

probability of damage. Study by Brann CR et al. (1999) found that eruption status was found to have no statistically significant relationship with the incidence of nerve damage.[13] In our study we found more incidence of damage to the IAN during deflection of root which was statistically significant (p=0.002). Kang et al. (2020) found most IAN injuries with diversion of the canal followed by deflection of the root.[20] However, Urib S et al. (2017) after the review of eight diagnostic studies commented as a general rule the lack of radiological signs does not predict the absence of postoperative IAN injury. On the other hand, the presence of one radiological sign, particularly one of those associated with alterations of the canal, namely diversion or interruption, or root darkening, is associated with a five-fold increment in the risk of postoperative IAN injury.[21]

Newly developed diagnostic tools such as Cone beam computer tomography (CBCT) can aid in the better visibility of IAN and mandibular third molar relation. However, Kolkmaz et al. (2017) concluded that CBCT is not superior to panoramic radiography in reducing IAN injuries. Nonetheless, CBCT may decrease the prevalence of temporary IAN injury and improve the surgical outcomes in high-risk patients.[10]

CONCLUSION

Observing radiographic sign of relationship of mandibular canal and mandibular third molar in an OPG or intraoral periapical radiograph is valuable in predicting post-operative outcome. Deviation of inferior alveolar canal and narrowing of canals are most likely to produce nerve damage than the other signs.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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