

# Anatomical Risk Factors of Nerve Injuries Following Surgical Removal of Mandibular Third Molar

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## ABSTRACT

**Introduction:** Surgical removal of the mandibular third molar has its own set of complications. The mandibular impacted teeth are in proximity to the Inferior Alveolar Nerve (IAN), Buccal Nerve and Lingual Nerve (LN). Therefore, each of these nerves is always at risk of injury during extraction.

**Objectives:** This study was to evaluate the anatomical risk factors of nerve injury after the surgical extraction of mandibular third molars in patients visiting the department of oral and maxillofacial surgery of People's Dental College and Hospital.

**Methods:** This prospective study was conducted with 315 participants who presented with a mandibular third molar impaction and underwent Intraoral Periapical Radiograph (IOPAr), panoramic radiograph as well as Cone Beam Computed Tomography (CBCT). CBCT was done in those patients in which mandibular third molar were in close contact with mandibular canal.

**Results:** Collected data from 315 patients showed that the incidence of Inferior alveolar nerve (IAN) and lingual nerve(LN)injury was 0.31%. Of which one had mesioangular class B, level II type of impaction in 17year male and the other had horizontal class C, level II type of impaction in 47year female respectively. In both cases the tooth was lingually placed in relation to IAN.

**Conclusions:** Various factors are responsible for the nerve injury after removal of mandibular third molar. In our study, incidence of nerve injury to IAN and LN was comparatively low and the most common risk factor was angulation and anatomical position of impacted mandibular third molar.

**Keywords:** Impacted mandibular third molar; inferior alveolar nerve; lingual nerve; nerve injury.

## INTRODUCTION

Tooth impaction is a frequently occurring dental anomaly with an approximate prevalence remaining less than 50% in general population.<sup>1</sup> Depending upon population characteristics like age, gender and ethnicity, prevalence could be higher or lower.<sup>2</sup> Compared to maxilla, occurrence of impaction is more common in mandible which is more than 50%

and most of the post-operative complications are also associated with mandibular impaction.<sup>3</sup>

Surgical removal of the mandibular third molar has its own set of complications. The mandibular impacted teeth are in proximity to the Inferior Alveolar Nerve (IAN), Buccal Nerve and Lingual Nerve (LN). Therefore, each of these nerves are always at risk of injury during extraction.<sup>4</sup>Incidence of nerve damage during surgical removal of impacted teeth can range from 0.4%-22%. The frequency of IAN injury ranges from 1.3%-5.3%, and LN injury ranges from 0%-22% after surgical extraction of mandibular third molar.<sup>5</sup> However, the problems associated with nerve injuries can affect the patient's quality of life and could be a significant cause of complaints and litigations.<sup>4</sup>

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In the context of Nepal, there are only studies concerning incidence and pattern of impaction, leaving a gap in the understanding of nerve damage following the surgical extraction.<sup>6-9</sup>

Various factors such as age of the patients, type of impaction, anatomical position of mandibular third molar are discussed as the anatomical risk factors of the nerve injuries.<sup>10</sup>

## METHODS

A prospective observational from 09/2021 to 02/2022 was conducted with the approval of the Institutional Review Committee(IRC) of People's Dental College and Hospital, Sorakhutte, Kathmandu, Nepal with CH No.3Ref.No.1 2078/2079, among 315 patients visiting in the department of Oral and Maxillofacial Surgery, in Peoples Dental College and Hospital with a Mandibular third molar impaction. They underwent Intra Oral Periapical Radiograph (IOPAr), Panoramic radiograph as well as Cone Beam Computed Tomography (CBCT).

In this study preoperative predictive variables were recorded with data record of name, age, gender, type of impaction, anatomical position of impacted third molar in relation to IAN and radiographic relationship between the impacted mandibular third molar and Inferior Alveolar Canal (IAC). Post-operative assessment was done after one week at the time of suture removal. For paraesthesia or anaesthesia they

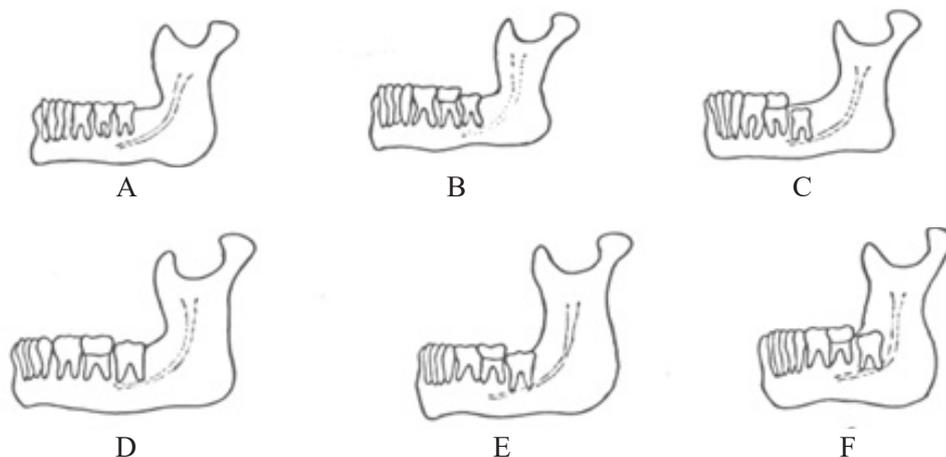
were questioned about altered sensation on lip, chin and tongue. Specific questions were also asked about accidental biting of lips, drooling, burning and pain or tingling sensations. Neurosensory tests like two point discrimination, pinprick test and light touch test were also performed. Before and during the test, subject was asked to close the eyes.

The impaction patterns of the mandibular third molar were determined by two main classification criteria with the help of radiography.

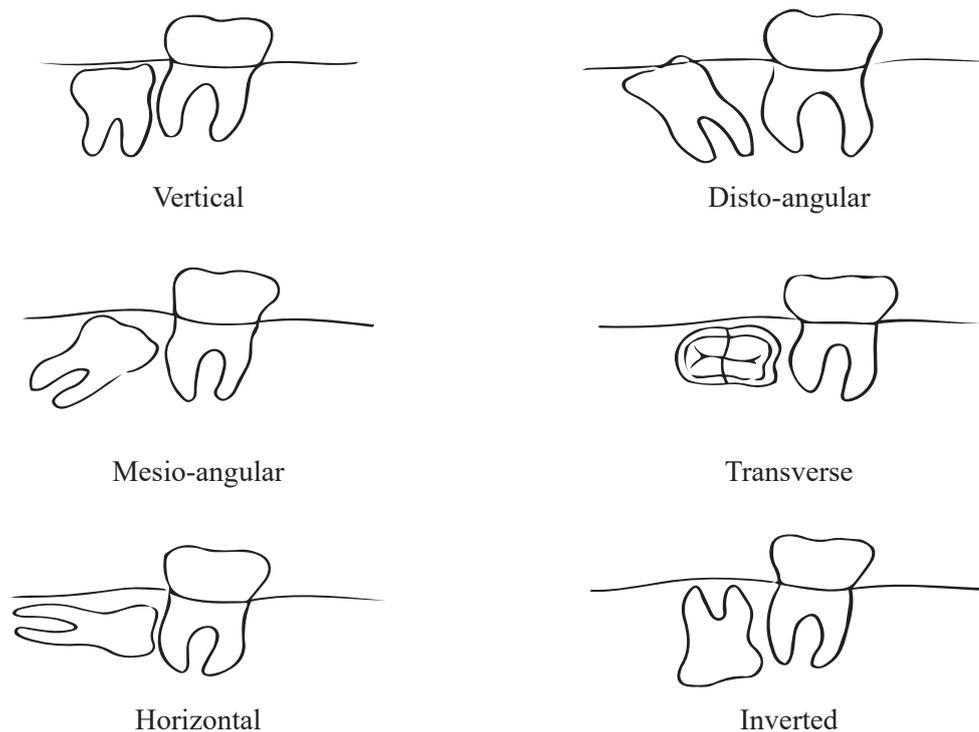
### Pell and Gregory classification<sup>10</sup>

According to the depth of impaction with regards to adjacent teeth: 1) Class A, when the highest point of the occlusal surface of the impacted mandibular third molar is at the same height as the occlusal surface of the adjacent tooth; 2) Class B, when the highest point of the occlusal surface of the impacted mandibular third molar is between the occlusal surface of the adjacent tooth and the cervical line; 3) Class C, when the highest point of the occlusal surface of the impacted mandibular third molar is below the cervical line of the adjacent tooth. Figure 1.A, B, C

In addition, Class I, II, III were classified by the distance between the anterior margin of the ascending mandibular ramus and the distal surface of the mandibular second molars: 1) Class I, when the distance from the anterior margin of the



**Figure 1: Pell and Gregory classification<sup>10</sup>**



**Figure 2: Winter's classification.**<sup>4</sup>

ascending mandibular ramus to the distal surface of the mandibular second molar is wider than the width of the occlusal surface of the impacted mandibular third molar; 2) Class II, when the distance from the anterior margin of the ascending mandibular ramus to the distal surface the mandibular second molar is narrower than the width of the occlusal surface of the impacted mandibular third molar and wider than  $\frac{1}{2}$ ; and 3) Class III, when the distance from the anterior margin of the ascending mandibular ramus to the distal surface of the mandibular second molar is narrower than the width of the occlusal surface of the impacted mandibular third molar.<sup>4</sup> (Figure 1:D, E, F)

Winter's classification<sup>4</sup>

Impacted third molar was classified into vertical, mesioangular, horizontal, distoangular, transverse, and inverted which is based on angle of impaction. The reference angle is the angle to the long axis of the mandibular second molars. (Figure 2)

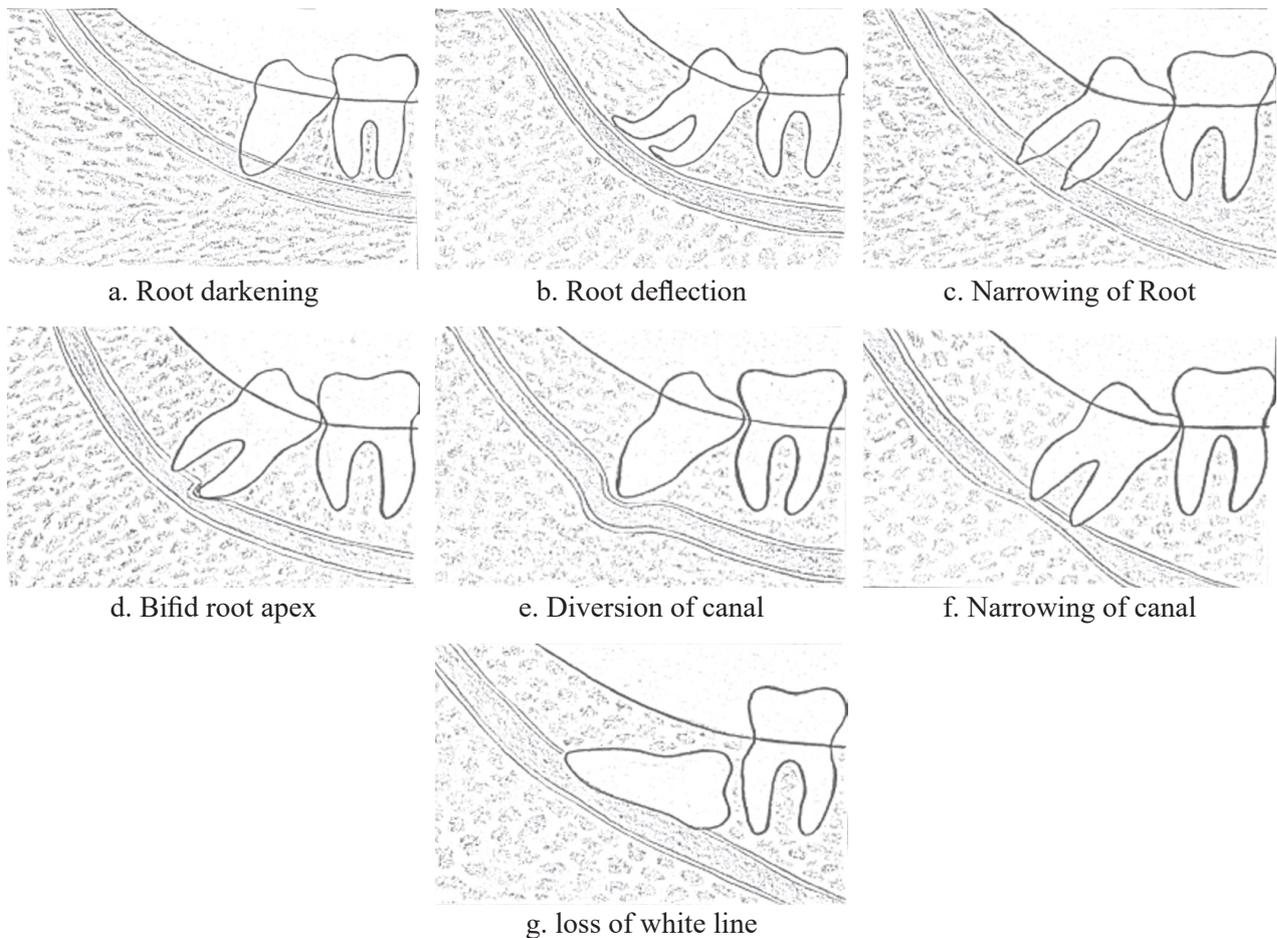
Radiographic analysis-Type of impaction and the positional relationship between the root of the

mandibular third molar and the inferior alveolar nerve was analysed. In the IOPAr and panoramic radiograph, the root of the mandibular third molar and IAN overlapped so CBCT was done to see the true relationship between inferior alveolar canal and impacted third molar root and also to see the position of third molar in relation to IAN. And the relationship between the IAN and mandibular third molar root was observed based on seven radiographic signs suggested by Rood and Shehab classification, (1) Darkening of root, (2) Deflection of root, (3) Narrowing of root, (4) Bifid root apex (dark line at the apex), (5) Diversion of canal, (6) Narrowing of canal, (7) Interruption in white line of canal.<sup>24</sup> (Figure 3)

Finally, patients who complained of nerve injury after surgical extraction were investigated using medical records.

Evaluation of peripheral nerve injury

At the postoperative visit, each patient was specifically asked about sensation of lower lip,



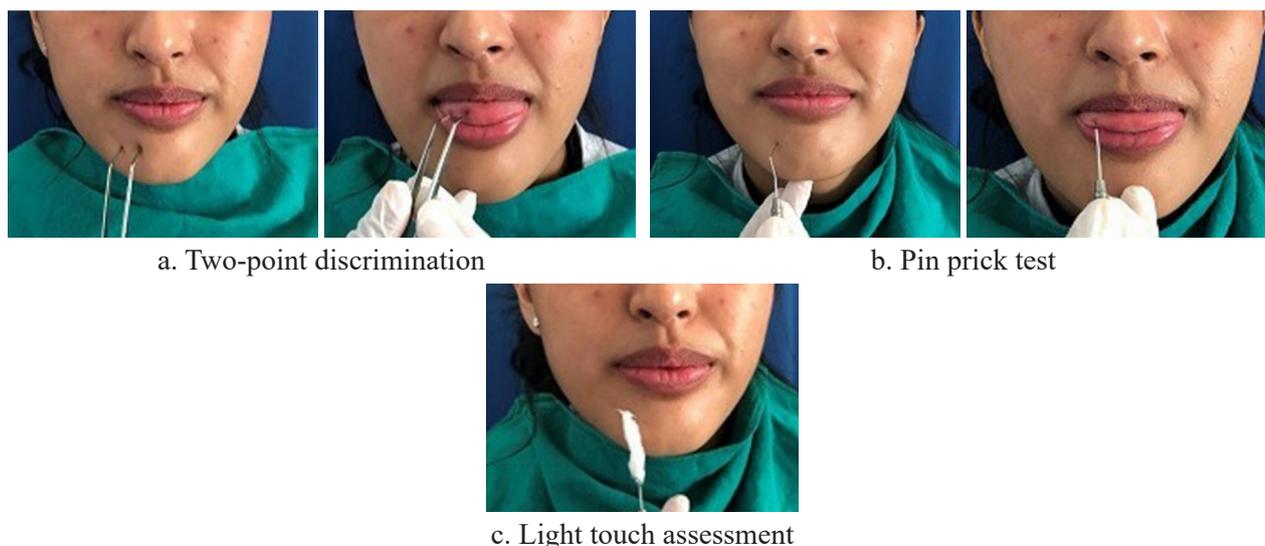
**Figure 3: Radiographic relationship between the IAN and mandibular third molar root.<sup>10</sup>**

chin between operated and non-operated side. Assessment of nerve injury was done by following clinical neurosensory test. Before and during testing, the subject was asked to close the eyes.

a. Two-point discrimination (TPD)<sup>4</sup> - In this neurosensory test, the probes of calliper device were drawn across the surface of skin or mucosa at constant pressure and patient was asked whether one or two points are felt. One at a time blunt dual probes were applied to the skin or mucosa, and the subject was asked to raise his left hand if two points were sensed. The minimum separation that was consistently reported as two points was termed as two-point discrimination threshold. The separation distance at which the subject was capable of distinguishing two points in 5/6 trials was recorded for that particular zone. (Figure 4. a)

b. Pin prick test (PP)<sup>4</sup> - In this test, a sharp dental probe was applied to the skin in a quick pricking movement and pain perception of the patient was assessed. Each test area was pricked three times bilaterally, and subject was asked if any difference was felt between the sides. Sensation was checked by pricking tongue, mucosa, lip, and skin over chin region. (Figure 4. b)

c. Light touch assessment (LT)<sup>4</sup> - This method was used for testing gently touching (tactile stimulation) the skin and evaluating the detection threshold of the patient. For this test, cotton stick was used to perform the test. Stimuli were applied at randomly and area of anaesthesia was mapped by moving outward in small steps until stimulus is felt. (Figure 4. c)



**Figure 4: Evaluation of peripheral nerve injury.**

**RESULTS**

Data was collected from 315 patients visiting the department of Oral and Maxillofacial Surgery for surgical removal of impacted mandibular third molar done by a single surgeon following strict surgical protocols. Out of 315 patients, 120 were females and 195 were males. Patient’s age ranged from 15 to 60 years of which majority belonged to group of 21 to 30 years. The

mean age for the patients is as indicated in the Table 1.

On evaluation of the risk factors associated with nerve injury, majority of the radiograph showed root darkening i.e. 131(42%) followed by IAC interruption, dark line of root, root deflection, IAC diversion, root narrowing and IAC narrowing in this study (Table 2). However, only two cases of nerve injury were reported, both of which were associated with root darkening.

**Table 1: Mean age with standard deviation.**

Age Range (Years)	Age		
	Female (n=120)	Male (n=195)	Total
	Mean (SD)	Mean (SD)	Mean (SD)
15-20	19.8 (0.42)	18.43 (1.31)	18.85 (1.31)
21-30	24.94 (2.40)	25.82 (2.64)	25.47 (2.64)
31-40	34.27 (2.43)	35.61 (3.04)	35.07 (3.04)
41-60	46.2 (4.93)	47.37 (5.89)	46.97 (5.89)
Total	27.99 (7.31)	28.70 (8.31)	28.43 (7.94)

**Table 2: Relation between the IAN and the mandibular third molar in radiograph.**

Radiographic sign	Number	Percentage (%)
Root darkening	131	41.58%
IAC Interruption	55	17.46%
Dark line	40	12.69%
Root deflection	35	11.11%
IAC diversion	29	9.20%
Root narrowing	17	5.39%
IAN narrow	8	2.53%

**Table 3: Impaction pattern (Winter's classification).**

Type of impaction	Female	Male	Total	Percentage (%)
Mesioangular	54(45%)	96(49.23%)	150	47.61
Vertical	28(23.3%)	36(18.46%)	64	20.31
Distoangular	22(18.33%)	41(21.02%)	63	20
Horizontal	14(11.66%)	19(9.7%)	33	10.47
Transverse	2(1.66%)	2(1.02%)	4	1.26
Inverted	0	1(0.51%)	1	0.31

**Table 4: Distribution of the Pell and Gregory classification.**

Pell and Gregory	Number	Percentage (%)
Total	315	100
Class A	166	52.7
Class B	136	43.1
Class C	13	4.1
Class I	108	34.28
Class II	192	60.95
Class III	15	4.76

**Table 5: Anatomical position of impacted mandibular third molar.**

Position	Number	Percentage (%)
Lingually placed	180	57.1
Others	135	42.8
Total	315	100

**Table 6: Incidence of nerve injury.**

Nerve injury	Female	Male	Incidence	Risk factors		
				Radiograph	Impaction pattern	Position
Inferior alveolar nerve	0	1	0.31%	Root darkening	Mesioangular class BII	Lingually
Lingual nerve	1	0	0.31%	Root darkening	Horizontal class CII	Lingually

Based on Winter's classification, 150(47.61%) patients had mesioangular type of impaction, followed by vertical, distoangular, horizontal, transverse and inverted. (Table 3)

Based on Pell and Gregory classification, 166 had class A followed by class B and class C whereas 192 had class II followed by class I and class III type of impaction.(Table 4)

Additionally, in our study, 180(57.1%) of the impacted mandibular third molar were placed

lingually and had contact with mandibular canal. (Table 5)

There were two incidence of nerve injury, of which 1 case reported with IAN injury, having mesioangular class BII type of impaction. Another case was reported with LN having horizontal class CII type of impaction and in both cases, tooth was lingually placed in relation to IAC and both had radiographic relationship between IAN and mandibular third molar root as root darkening. (Table 6)

## DISCUSSION

Impaction of the mandibular 3<sup>rd</sup> molars are common and their removal is advocated to prevent unwanted complications seen due to the impacted tooth like infection, cyst formation and sometimes even pathologic fractures of the mandible.<sup>11</sup>

Impacted third molars either in maxillary or mandibular region can result from various factors such as late eruption, position/angulation, size of the adjacent tooth, excessive soft tissue, small arch length and space, abnormal path of eruption, and dense overlying bone. During the extraction of impacted mandibular third molar, the surgeon may face various complications among which major complication is neurosensory deficit that leads to discomfort to the patient and lowers the quality of life.<sup>4,9</sup>

This study was conducted to evaluate the anatomical risk factors of nerve injury after the extraction of mandibular third molar in patients' visiting Oral Surgery department of People's Dental College and Hospital. Prevalence of third molar impaction and the gender difference regarding the impacted mandibular third molar varied from study to study.<sup>12-16</sup>

Males had a higher prevalence of impaction than female and patient's age 15-60 years old were accounted for this study in which 67.61% of patients were presented between the ages of 20 to 30 years.

According to Winter's classification, mesioangular, vertical, distoangular, horizontal, transverse and inverted type of impaction was more common respectively. According to Pell and Gregory, the most common prevalent was Class BII in female and Class AII in Male which is more similar to other studies.<sup>5,8,9,10,14,17</sup> Most of the impacted mandibular third molar i.e. 57.14% was placed lingually in relation to IAN in this study.

Similarly, some studies<sup>7</sup> reported that most of the mandibular third molars (97.3%) situated lingually had a higher occurrence of mandibular nerve

involvement which is the most common risk factors for IAN and LN injury.<sup>7</sup>

This study done in Nepalese population reported that mesioangular, followed by horizontal, vertical and distoangular is most common pattern of impaction. And there was no significant difference between the pattern of impaction in the right and left sides of the mandible.<sup>8,9</sup>

There are some studies<sup>18</sup> reported that there is a relationship between the depth of the impaction and the incidence of IAN injury. The impaction depth increases the possibility of IAN damage.<sup>18</sup> Other studies<sup>4</sup> showed about three to four times increases in possibility of IAN damage in the mesioangular and horizontal impacted teeth with lingoversion.<sup>4</sup>

The incidence of IAN and LN injury was 0.31% in this study which had mesioangular class B, level II type of impaction in a 17-year male and horizontal class C, level II type of impaction in 47-year female respectively. In both cases the tooth was lingually placed in relation to IAN. Lingual flap was raised in case of LN injury which is similar to or lower than that reported in other studies.<sup>4,19</sup> The results of this study concluded that the elevation of lingual flap could be a significant factor for LN paraesthesia. Similarly, the study of Vikas Sukhdeo and his co-workers reported that out of total 147 patients, 2 cases reported with LN paraesthesia having horizontal class II, position C and distoangular class II, position A type of impaction and 1 case was of IAN paraesthesia having mesioangular, class II, position A type of impaction.<sup>4</sup>

Although the symptoms of nerve injury may resolve with time but a measurement of type of injury has to be made to reassure the patient and allow recovery. There are various types of nerve injuries among which the first one was introduced in 1943 as Seddon's classification and in 1951 as Sunderland classification.<sup>20</sup>

In this study, according to Seddon and Sunderland classification, IAN injury was transient in nature

with no altered sensation after a month's follow-up. However, in the case of LN injury, the paraesthesia was still persistent on a 6-month follow-up, but with decreasing severity.

Most of the studies have reported that paraesthesia following extraction is likely to be temporary and resolved within 6 months. The lesion that recover within the first 3 months are probably neuropraxia which is more common and long standing injuries represent sever form of injury like axonotmesis and delayed recovery from IAN injuries after more than 1 year has also been reported in the literature.<sup>4,21</sup> So, recovery is preferable and permanent nerve injury is very rare.<sup>22</sup>

But there are some studies<sup>23</sup> with the incidence of permanent nerve injury related to IAN and LN in the range between 0.1-1.1% and 0.04% to 0.6% respectively.<sup>23</sup>

So, various factors are responsible for the nerve injury after removal of mandibular third molar. In this study, incidence of nerve injury to IAN and LN was comparatively low and the most common risk factor was based on angulation and anatomical position of impacted mandibular third molar. However, our study did not have a significant number of participants to

conclude the risk factors for the injury of the IAN and LN though all precautions should be taken to prevent nerve injury before the surgical procedure.

Limitations of the study: It would be better in future if the study was carried out with larger number of participants to conclude the risk factors of nerve injuries following surgical removal of the mandibular 3rd molars along with proper use of radiographic images, patient education and counselling are needed to explain the risks and benefits of surgical removal of the impacted tooth.

## CONCLUSIONS

The removal of impacted 3<sup>rd</sup> molar is associated with its own complications including the injury to the inferior alveolar nerve and lingual nerve, as seen from this study.

Although this study did not have significant results (2 cases) but has showed that inferior alveolar nerve and lingual nerve injury can occur during the removal of the impacted mandibular 3<sup>rd</sup> molars.

**Conflict of Interest:** None

**NJHS**

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