

**A Prospective Study of The Incidence and Various Risk
Factors Associated with Inferior Alveolar Nerve injury
following Surgical Extraction of Impacted Mandibular
Third Molars**

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CERTIFICATE

This is to certify that the dissertation entitled “**A PROSPECTIVE STUDY OF THE INCIDENCE AND VARIOUS RISK FACTORS ASSOCIATED WITH INFERIOR ALVEOLAR NERVE DAMAGE FOLLOWING SURGICAL EXTRACTION OF MANDIBULAR THIRD MOLARS**” is the bonafide work done by **Dr. SHAJAL ABUBACKER**, Post Graduate student, in the Department of Oral and Maxillofacial Surgery of Saveetha Dental College and Hospitals, Chennai under our guidance and supervision towards the partial fulfillment of the requirement for the degree of “**MASTER OF DENTAL SURGERY**” Branch – I Oral and Maxillofacial Surgery, February 2005 under The Tamil Nadu Dr. M.G.R. Medical University, Chennai.

Prof. VINOD NARAYANAN,
MDS., FDSRCS., MOMSRCPS.,
Professor and Guide,
Dept. of Oral & Maxillofacial Surgery,
Saveetha Dental College & Hospitals,
Chennai – 600 077.

Prof. M.R. MUTHUSEKHAR, M.D.S,
Head of the Department,
Dept. of Oral & Maxillofacial Surgery
Saveetha Dental College&Hospitals
Chennai – 600 077.

Place : Chennai
Date :

Prof. M.F. BAIG, M.D.S.,
Dean
Saveetha Dental College & Hospitals
Chennai – 600 077.

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INTRODUCTION

It is well established that the oral and perioral regions are among the most sensitive areas in the human body⁽²⁷⁾. Considering this fact is not difficult to understand why minor oral nerve damage can be a major handicap for the individual.

Mandibular third molars show the highest incidence of impaction and have been held responsible for pathoses such as pericoronitis, periodontal defects posterior to the second molars, caries in the second and third molar, neurogenic and myofascial pain, odontogenic cyst and tumours and primary or secondary crowding of dentition ^(30, 39, 43). Early removal of these teeth to prevent such problems is therefore widely acknowledged.

The removal of impacted mandibular third molar is one of the most frequently performed oral surgical procedures⁽³⁸⁾. The close proximity of the inferior alveolar nerve to the roots of the impacted lower third molar is well known. Therefore injury to inferior alveolar nerve and lingual nerve are characteristic complications following the

removal of impacted lower third molar⁽¹⁾. As these operations are carried out very frequently, this problem affects a considerable number of patients.

The reported incidence of Inferior alveolar nerve injury after surgical removal of impacted lower third molar ranges from 0.4% to 8.4%^(10, 23). A great deal of research has been undertaken in relation to the incidence of nerve injury during lower third molar surgery but little is known about the factors affecting the rate of damage. Although a close anatomic relationship exists between the roots of the mandibular third molar and the mandibular canal, placing the inferior alveolar nerve at risk for damage, surgical technique used for the removal of the impacted third molar also exerts a definite influence on the incidence of Inferior alveolar nerve damage^(10,36).

Alteration of sensation results from direct or indirect trauma to the nerve during the surgical instrumentation.

This alteration of sensation^(23,25) was defined as

- A) Anaesthesia : Insensitivity to all forms of stimulation
- B) Paresthesia : Unusual or abnormal but not painful spontaneous or evoked sensations.
- C) Hypoesthesia : Diminished sensitivity to all forms of stimulation this term is reserved for tactile and thermal stimuli.
- D) Pain : Unpleasant and disturbing sensory and emotional experience associated with actual, impending, or potential tissue damage.

These altered sensations occurred as a result of the types of injury⁽¹⁶⁾ to the nerve.

- Paresthesia (abnormal touch sensation, such as burning, prickling often in absence of external stimulus) occurred probably as a result of neuropraxia.
- Anaesthesia (loss of sensation called numbness) occurred probably as a result of axonotemesis.

Many factors have been suggested as predisposing to the complications during the removal of third molar.

Assessment of these predisposing factors pre operatively intra operatively forms the basis of the principles that can minimize the rate of damage to Inferior alveolar nerve.

REVIEW OF LITERATURE

In **Tibetan philosophy**, wisdom teeth have a special significance, only upon the appearance of the third molar are the pre ordained relationships of the individual teeth to the another, the preservation of harmony, the balance and perfection of the whole is achieved.

George Winter⁽⁵²⁾ (1926) first described a method by means of which the position and depth of an impacted tooth within the mandible can be determined.

Pell and Gregory³⁷ (1933) classified impactions based on the space available between the ramus and distal surface of the second molar.

Wahl⁽⁵⁰⁾ (1940) stated that most patients with an impacted or displaced lower third molar had no symptoms and were unaware of its presence. If the tooth is causing symptoms they are usually those associated with pericoronitis causing pain in the region of the tooth,

swelling of the face, increasing trismus, and enlarged, tender submandibular lymphnodes.

NODINE⁽³⁵⁾ in 1943 stated that impaction of teeth is due to the softer and more refined diet that required less chewing and making a powerful masticatory apparatus unnecessary. So the growth stimulus to the jaw is lost and hence the modern man had impacted teeth. This fact is strengthened by the fact the examination of the jaws and teeth of ancient Egyptians, Eskimos and the Australian aboriginies showed that these people did not have impacted teeth.

Durbeck⁽¹²⁾ (1952) stated that any trauma to the contents of the inferior dental canal may elicit distressing haemorrhage from the inferior dental artery. Whilst **Gealey** reported that he removed a perforated mandibular third molar by twisting it in order to avulse the neurovascular bundle than attempt to minimize haemorrhage.

Ward⁽⁵¹⁾ (1955) suggested that the standard periapical radiograph taken should include the whole third molar, its investing bony tissue, the inferior dental canal and the adjacent molar teeth and a clear super imposition of buccal and lingual cusps of the second molar tooth in both the horizontal and vertical planes. An occusal view will show the exact position of the crowns and roots whether they are

placed buccally or lingually. A lateral oblique will show in addition to the vertical depth of mandible, the presence of double impactions, ectopic tooth, the amount of bone below a deeply buried third molar, associated abnormalities and the existence of pathological processes in the vicinity of wisdom tooth. The type of angulation and the displacement of the root configuration, the root pattern of the second molar, the presence of first molar on that side of the arch, relationship of the roots of the impacted tooth to the inferior dental canal and the density of the surrounding bone.

Ward⁽⁵¹⁾ (1955) described in a case of a mandibular third molar being perforated by the inferior dental canal, the tooth should be widely exposed by removal of buccal bone and then sectioned at the level of the neurovascular bundle. The pieces of the root are then removed, leaving the contents of the canal intact. If this procedure is not practical, the neurovascular bundle should be cut with a sharp scalpel and then several ends placed in apposition often removing the tooth. A cleanly cut nerve regenerates for more quickly than a crushed and avulsed one.

According to **Fordyce⁽¹⁶⁾ (1957)** the types of injuries to the nerve can be divided into 3 main groups. In the first of these groups are placed

those injuries caused by the compression of the canal and its contents. In the second group are those injuries causing rupture of the blood vessels in the canal. The third group consisted of traumatic injuries causing division of the inferior dental nerve and blood vessels.

Stockdale⁽⁴²⁾ (1959) suggested that trauma to the inferior dental nerve following removal of mandibular third molars is more common, than realized. Of the 100 cases of extracted lower third molars, all the unerupted teeth were closely related to the inferior dental canal, 55% of the partially erupted third molar teeth were related to inferior dental canal.

Howe and Poyton⁽²³⁾ (1960) who have worked on 1,355 cases of impacted lower third molars have determined certain predisposing factors causing post operative impairment of labial sensation.

Pre operative diagnosis by means of radiography will show depression of the roof of the inferior dental canal by the root apices, or the roots will be grooved, notched or perforated by the inferior dental canal. In such cases three signs have been described as the presence of a band of radiolucency across the root. According to **main, Durbeck⁽¹²⁾**, narrowing of the canal described by **Lacronique**,

Austin and deflection of the roots by the canal described by **Durbeck**.

Howe and Poyton⁽²³⁾ (1960) reported that damage to the inferior alveolar nerve occurred in 5% of the cases in which the third molar was removed by the buccal approach under local anaesthesia.

Ash, Costich and Hayward⁽⁴⁾ (1962) In a study of 225 upper and lower third molars extracted by one surgical technique found a high incidence of pocketing distal to the second molar both before and after the operation. They concluded that the ill effects of extraction were reduced if the operation was performed on young individuals in whom the third molar root was not yet complete.

Ash and others⁽⁴⁾ (1962) recorded loss of bone distal to second molar in 85% of cases after the surgical removal of mandibular third molars. He found that the greatest incidence occurred when the surgery was delayed until after the age of 22 years and particularly when the third molar was partly erupted.

Killey and kay (1965) classified impacted wisdom teeth according to the angulation, position, status of eruption and the number of roots.

Killey and kay (1965) stated that age of the patient is an important factor in the assessment of lower impacted tooth. In a patient under the age of 25 years the bone texture is usually soft and resilient but in older patients the bone becomes more hard, brittle and dense.

Berger(1966,1982)^(6,7) suggested that long continued inflammation, with a resultant increase in the density of the overlying mucous membrane, unduly long retention of temporary teeth, lack of space due to under developed jaws, premature loss of temporary teeth, acquired diseases, such as necrosis due to infection or abscess, and inflammatory changes in bone due to exanthematous diseases in children are local etiological factors for impaction.

Wolf et al grooves and Moore⁽²⁰⁾ (1968) studied the type of soft tissue incision and found no correlation between the type of incision and post operative healing and stated that the soft tissue management can't be implicated in periodontal breakdown

Chapnick⁽⁹⁾(1969) discussed about the asymptomatic impacted third molars.He suggested that patients had been advised to leave the impacted or unerupted tooth undisturbed for years unless they cause discomfort.

Kramer(1970) took Panorex radiographs of 3,745 patient attending oral surgery clinics. He found that 37.44% of the patients had impacted third molar teeth. He found no significant relationship to sex incidence.

Thoma⁽⁴⁵⁾ (1977) stated that any third molar which is malposed or cannot erupt because of lack of space should be removed. He is of the opinion that it is easier to remove the impacted tooth when the patient is young because of the membrane which is a remnant of the dental follicle between the tooth and bone. This facilitated the dislodgment of the tooth.

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JP Rood⁽²⁴⁾ (1990),studied the radiological prediction of inferior alveolar nerve injury during third molar surgery. Pre operative assessment was carried out radiologically in an attempt to identify the proximity of the impacted tooth to the inferior alveolar canal.

The important radiological signs, four of which are related to the root of tooth and three signs were related to the appearance of inferior alveolar canal

- a) **Darkening of root** was due to decreased amount of both tooth substance or loss of cortical lining of the canal between source of x-rays and film.
- b) **Deflected roots** was due to deviation of the root to the buccal or lingual sides or both, and even to the mesial or distal aspect.
- c) **Narrowing of root** – this meant that the greatest diameter of root has been involved by the canal or there is grooving or perforation of the root.
- d) **Dark and bifid root** – appeared when inferior alveolar canal crossed the apex of the root, this was identified by double periodontal membrane shadow of the bifid apex.
- e) **Interruption of the white line** – this appeared due to dense structure of canal walls
- f) **Diversion of inferior alveolar canal**- happened when it crossed the mandibular third molar. It changed its direction.

- g) **Narrowing of inferior alveolar canal** – this happened when it crossed the root of mandibular third molar.

Peter Sandstedt⁽³⁶⁾ (1995) studied about neurosensory disturbances of trigeminal nerve. His study assessed the physical and psychosocial consequences of trigeminal nerve damage. Their material of study consisted of patients with neurosensory disturbance in the lip or tongue. In all cases, the injuries were unilateral. The stimuli of touch and temperature were the main factors eliciting discomfort. Pain was one of the most disturbing and disabling of all the sensory problems. Patients with dysesthesia had more neuroses and depression than patients with no pain. Women and older patients had the highest degrees of discomfort. The altered sensation caused functional disturbance in speech and eating which in turn had social and psychological consequences.

S.Schultze⁽⁴¹⁾(1993) Assessed the inferior alveolar and lingual nerve disturbance after dento alveolar surgery and the recovery of sensitivity. The incidence of temporary sensitivity disturbances depended on the different surgical interventions performed. For evaluation and follow-up, pain and thermal sensitivity (PATH) tester

was used. In patients with sensitivity disturbances an increased threshold temperature on the non affected side was found on the 7th post operative day. Later it was found that trauma of the cranial nerve on one side leads to sensitivity disturbances on the contralateral nerve.

G.G.Stacy, G-Hajjar⁽¹⁸⁾ (1994) studied Barbed needle and inexplicable paresthesias and trismus after dental regional anesthesia possibility of pain, dysesthesia, and hematoma after use of barbed needle have been alluded, but no factual evidence is found. Possibility of needle point trauma inducing epineural hemorrhage can give rise to constrictive epineuritis. Needle trauma is also reported to cause trismus. Barbing of needle at the time of injection followed by tissue damage is a likely explanation in some rare cases of post injection persistent paresthesia, trismus or paresis for which no cause or explanation can be found.

Hellman and Scherstan et al⁽²²⁾ (1995) found a higher incidence of third molar impactions, as with females twice as much as males. It was due to the fact that the jaws of females stopped growing when the third molar just began to erupt, where as in males the growth of the jaws continued beyond the time of eruption of the molar.

K Gel Berg et al reported that the operating time was fifteen minutes with a standard surgical bur technique with the buccal approach for the removed of mandibular impacted third molars.

Abel Garcia Garcia⁽³⁾(1997) evaluated the trismus and pain after removal of impacted lower third molars and investigated whether these responses were related to the difficulty of surgery. He concluded that trismus and pain was less severe after simple extractions than after surgical extractions. However the severity of trismus after surgical extraction does not depend on difficulty of surgery.

Josephina G.P. De Beukelaen⁽²⁵⁾(1998) wanted to see whether short term neurosensory testing after removal of mandibular third molars were efficacious. Neurosensory dysfunction includes anesthesia, paresthesia, touchsensation such as burning, prickling or formication in the absence of external stimulus.

The purpose of this study was the validation of two point discrimination, semmes – Weinstein and Pinpricktest of possible sensory disturbances of inferior alveolar nerve after surgical removal of lower wisdom teeth. A disadvantage of Two point pin prick test was that patients did not understand how they were supposed to respond.

They concluded that sensory dysfunction does not correlate with outcome of Two point discrimination, Semmes-weinstein and Pin prick neurosensory testing of mental nerve. Neurologic disturbances outlined by Two point discrimination and pin prick test were prevalent in patients who had no subjective complaints of sensory loss. Neurosensory testing after third molar removal is limited because of inconsistency between objective test result and subjective finding.

C.R. Brann, MR Brickley and Sphepherd⁽⁸⁾(1999) studied various factors influencing nerve damage during low third molar surgery. Almost all patients experienced some kind of pain, swelling and difficulty in mouth opening, after operation. From all the greatest degree included nerve damage causing permanent anaesthesia of lip, tongue or both. There was no significant relation between prophylactic removal and nerve damage, caries and nerve damage, cystic damages and nerve damage or periodontal indications for removal and nerve damage. The incidence of nerve damage under general anaesthesia was greater than five times than the incidence of damage under local anaesthesia. No evidence was found between pathology, eruption status, age or anatomical position of the tooth.

Edward Val Maseda⁽¹⁴⁾ (2000) related lingual nerve damage with lower third molar surgery. His study data proved only 2% caused temporary nerve damage though no lesion lasted for more than 13 weeks. Lingual flap retraction, vertical sectioning of the tooth, surgeon inexperience, lingual angulation of the tooth, and prolonged operating time increased the risk of damage. At suture removal few patients had lingual nerve paresthesia, none had bilateral lingual nerve deficit. Anaesthesia was a cause of nerve damage and the surgical technique employed was one main risk factor. Lingual nerve injuries increased when osteotomy and lingual flap operation were performed in the same operation.

G.M. Hill⁽¹⁹⁾ (2001) study included nerve morbidity following wisdom tooth removal under Local and General anaesthesia. Several factors were potentially responsible, the most important being the depth of impaction, removal of distal bone, length of operating time and rising a lingual flap. Surgical technique can also effect nerve morbidity, however the risk was greater when duration of the procedure was longer than 15 minutes in unilateral cases. More recently **Brann et al⁽⁸⁾** concluded that patients who were operated under general anaesthesia were five times more likely to have disturbed

sensation. Use of Howarth's retractor offered minimum protection even if correctly positioned, and it may lead to crush injury and conduction block injury. Results of the study showed that there were no differences in incidence of nerve damage under Local and general anaesthesia..

Awnar B. Bataineh⁽²⁾ (2001) in his prospective study sought to determine the rate and factors influencing sensory impairment of inferior alveolar and lingual nerves after removal of impacted mandibular third molar under local anaesthesia. He included data like age and gender, site of the operation, angulation of the tooth, lingual flap elevation, use of vertical or horizontal tooth division, experience of the operation. He found that the incidence of inferior alveolar nerve damage was about 3.9%. Of this the only statistically significant factor in relation to inferior alveolar nerve paresthesia in this study was experience of the operator and nerve damage.

D-Gulicher, K.L.Gerlach⁽¹¹⁾,(2001) studied sensory impairment of the lingual and inferior alveolar nerves following removal of impacted mandibular third molars. Alteration of sensation resulted from direct or indirect trauma to the nerve during instrumentation. The nerve can be disrupted by rotating instruments leading to neurotmesis with

complete sensory loss .Use of root elevators may cause blunt trauma to inferior alveolar nerve. The nerve can be disrupted if it crosses between the roots of the tooth. The raising of mucoperiosteal flap from the lingual aspect can affect the lingual nerve. The needle used for local anaesthesia can effect both the nerves. Post operative odema, hematoma formation or infection may induce diminution of sensation. As far the lingual nerve is concerned general anesthesia and the individual operator were the main factors predictive of nerve damage.

Bart F, Blaesser⁽⁵⁾ (2003) studied the association between specific panoramic radiographic signs and inferior alveolar nerve injury during mandibular third molar removal. He traced a sample consisting of patients who underwent removal of impacted mandibular third molars. The presence of radiographic signs had positive predictive values ranging from 1.4% to 2.7%, representing a 40% increase over baseline likelihood of injury. This study further confirms previous analysis showing that panoramic findings of diversion of the inferior alveolar canal, darkening of third molar root and interruption of cortical white line was associated with injury.

Andrew Ban Guan Tay⁽¹⁾ (2004), In his prospective study sought to determine the incidence of inferior alveolar nerve paresthesia in patients with an exposed inferior alveolar nerve bundle seen intra operatively. According to his studies sighting an exposed intact Inferior alveolar nerve bundle during the third molar surgery indicated its intimate relationship with the third molar and carried a 20% risk of paresthesia. Females had less risk of paresthesia than males, an increase of age by 1 year increased the risk of paresthesia by 6.9%. Pat's who had curved roots had more risk of paresthesia than those who did not have. This paresthesia seen had a 70% chance of recovery by 1 year from surgery.

GW Bell⁽¹⁷⁾ (2004) in his study used the dental panoramic tomograph to predict the relation between mandibular third molars and inferior alveolar nerve. This was used to assess the position, depth and type of impaction as well as the texture of the investing bone.

The most reliable sign indicative of damage to inferior alveolar nerve was darkening of root, and secondly interruption of the radio-opaque outline of inferior alveolar canal. In his study, a total of 300 teeth were removed and the neurovascular bundle was directly observed. He found that the root was grooved or root apices were deflected by the

bundle. Post operatively 100 patients had altered labial sensation. He conducted that there was an intimate relation between the mandibular third molar tooth and inferior alveolar nerve in cases when darkening of root was observed and in few cases where interruption of radio opaque outline of inferior neurovascular bundle was observed.

Nicholas A⁽³⁴⁾ (2004). studied the relation between inferior alveolar nerve injury and mandibular third molar surgery. One of the risk factor was proximity of roots to the inferior dental canal. This was identified by three radiological features—darkening of the roots, diversion of the canal and interruption of the white line of the canal wall. When the white lines of the canal are unbroken it is unlikely that any grooving or perforation were present. In case of perforation both lines were lost. Coronectomy was the procedure recommended. Parallax has been used to determine the position of the nerve with respect to root apex. Other method such as linear tomography, tuned aperture computed tomography (TACT) were also recommended

SUMMARY AND CONCLUSION

The close proximity of the inferior alveolar nerve to the roots of impacted lower third molar is well known. Therefore the possibility of injury to the inferior alveolar nerve resulting in paresthesia in the course of surgical removal of the impacted third molar has been widely demonstrated.

The various risk factors associated with nerve damage included patients **age** (older age had a higher risk of nerve injury), **type of impaction** (deep or fully impacted third molars) were associated with a greater risk of inferior alveolar nerve paresthesia, **angulation of the impacted tooth**(horizontal and disto angular impacted teeth had a higher risk for nerve injury), **the operating time**(operating time of more than thirty minutes significantly increased the risk) and a **close proximity between the third molar root and Inferior alveolar canal** significantly increased the risk.

Prevention of inferior alveolar nerve damage should be based on a thorough understanding of the anatomy, as well as on an accurate planning for surgery, avoiding impingement of the

mandibular third molar roots or surgical instruments in the mandibular canal. The risk factors should be identified before surgery and these factors should be carefully considered.

Only on the basis of these principles can the rate of Inferior alveolar nerve damage to minimized.

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