**NERVE INJURIES RELATED TO MANDIBULAR THIRD MOLAR EXTRCTIONS**

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ABSTRACT

Although third molar extraction is a routinely carried out procedure in a dental set up, yet it is feared both by the patient and the dentist due to an invariable set of complications associated with it, especially in the form of nerve injuries. Hence, prior to performing such procedures, it would be wise if the clinician thoroughly evaluates the case for any anticipated complications so that adequate preventive measures can be taken to minimize the traumatic outcomes of the procedure and provide maximum patient care, which would further save the clinician from any sort of litigation.

Key words: Lingual nerve, third molar extraction, nerve injury.

Introduction

The third molar extraction is quite commonly carried out surgical procedure in the oral cavity and it is not uncommon for the dental practitioners to find their patients in a state of dilemma whether to get the procedure done or not. In such situations, apart from the pain of losing a tooth, the patients’ fears centre on the pain, swelling and discomfort which might follow the procedure. A significant adverse impact on the oral health related quality of life has been reported in patients who had experienced pain, swelling or trismus in the immediate postoperative period following lower third molar surgery. As far as mandibular third molars are concerned, there may be various reasons, which may justify their removal.

The indications for the removal of impacted wisdom teeth have been clearly established and were published in 1997 by the Faculty of Dental Surgery of the Royal College of Surgeons of England, which enable a clinician to easily decide upon whether to retain or to sacrifice the third molars of their patients. The indications for extraction include recurrent pericoronitis, cellulitis, abscess, osteomyelitis, cysts and tumors involving the third molars, unrestorable caries or periodontal breakdown and prophylactic removal in the presence of medical or surgical conditions, among others. National Institute for Clinical Excellence (NICE) of England in March 2000 further, made an endorsement of these guidelines with the added comment that the first episode of pericoronitis, unless otherwise severe, should not be considered as an indication for removal.

Complications Involved In Mandibular Third Molar Extractions

Invariably, the surgeon may face various complications associated with the extraction of wisdom teeth, especially in case of the mandibular third molars, major among which is the postoperative neurosensory deficit. It may affect either the inferior alveolar nerve or more commonly, the lingual branch of the mandibular division of the trigeminal nerve that leads to numbness of the ipsilateral anterior two-thirds of the tongue and taste disturbance.

Unintended iatrogenic injury to the lingual nerve may happen during third molar surgery due to the anatomical proximity of the cortex region of the molar to the nerve, being separated from it by the periosteum alone. Although the symptoms may resolve with time in most of the cases, an estimation of the type of injury has to be made to establish the treatment plan and allow recovery.

Judgment can be made based on various systems for classification of nerve injuries, first among which to be introduced in 1943 was Seddon’s classification that involves three categories i.e

1. **Neuropraxia i.e.** an interruption in conduction of the impulse down the nerve fiber. The recovery in such cases takes place without wallerian degeneration and hence it is considered to be the mildest form of nerve injury.

2. **Axonotmesis i.e.** loss of the relative continuity of the axon and its covering of myelin, but preservation of the connective tissue framework of the nerve.
3. **Neurotmesis i.e.,** loss of continuity of not only the axon, but also the encapsulating connective tissue.\(^4,5,6\)

Another system which came up in 1951 and is commonly followed was given by Sunderland which includes five classes as follows:

**First-degree:** It is similar to Seddon’s neuropraxia and due to compression or ischemia, a local conduction block and focal demyelination occur which recovers in 2-3 weeks.

**Second-degree:** It is similar to Seddon’s axonotmesis and recovery occurs at the rate of 1 mm/day as the axon follows the ‘tubule’.

**Third-degree:** In this class, the endoneurium gets disrupted while the epineurium & perineurium remain intact. Recovery may range from poor to complete and depends on the degree of intrafascicular fibrosis.

**Fourth-degree:** In this there is an interruption of all the neural and supporting elements although the epineurium is intact and the nerve becomes usually enlarged.

**Fifth-degree:** This class involves a complete transection of the nerve with the loss of continuity.

Most studies have shown that if the paresthesia follows extraction, it is likely to be temporary and resolve within the first 6 months. However, if no improvement is seen after 2 years of follow-up, the altered sensation is likely to represent nerve dysfunction that may be in the form of permanent neurosensory disability, a complete loss of sensory function and neurogenic symptoms.\(^7,8\)

Nevertheless, it seems that compression should not cause anesthesia for more than 4 months, and sectioning should not cause anesthesia for more than 8 months. Anesthesia without improvement after 1 month is also very likely to leave some permanent residual impairment. The variable rate of recovery and improvement in symptoms could be explained by the fact that IAN or LN injuries differ in type. The lesions that recover within the first 3 months are probably neurapraxias or Sunderland first or second degree injuries, which are more common, and long-standing injuries could represent more severe axonotmesis or Sunderland third or even fourth-degree injuries. Delayed recovery from IAN injuries after more than 1 year has also been reported in the literature.\(^9\)

**Diagnosis of nerve injuries during or after mandibular third molar extraction**

It is often difficult to achieve early identification of injuries, especially if damage to the nerve has not been seen directly during the surgery. However, as far as possible an early diagnosis of at least the level of nerve injury should be established in order to carry out proper treatment. As more than half of the IAN and LN injuries recover before 3 months, observation for up to 3 months is indicated when doubt of nerve injury is present, the functional deficits suggest only hypoesthesia, the physical findings are negative (i.e., no dystrophic changes, evidence of self-induced injury, neuropathic pain, or triggers), and the clinical neurosensory examination shows only mild sensory impairment. The presence of a LN deficit after 3 months has a greater chance of being associated with a severe nerve injury, and therefore the probability of recovery is less than with an IAN deficit after 3 months. Nerve injuries persisting up to and beyond 3 months, or those associated with pain, should be evaluated for the type of injury and the character and source of the pain, if present.\(^9,10\)

There are various diagnostic tests that can be of aid in predicting as well as determining the degree of nerve injury. Among these usually the clinician relies on imaging and clinical neurosensory testing. Radiographs of importance in such situations are orthopantomographs, CT scans, magnetic resonance imaging (MRI), MSI, magnetic resonance neuroradiography (MRN) and ultrasonography. A panoramic radiograph or CT scan is capable of revealing the presence of a foreign body if any, bony lesions or loss of bone due to any reason in proximity of the IAN canal, and the association of the extracted tooth roots to the canal. Jaw reflex tracking has all been advocated for special diagnostic capabilities but most of these methods have low sensitivity and specificity. Despite of this, they serve as good adjunctive aids when applied.\(^10\)

Under clinical neurosensory testing standard tests (i.e., response to pin prick, direction and two-point discrimination contact detection, and taste evaluation), can be performed to evaluate the nerve functions, but it is important to estimate the time since injury occurred because neurosensory testing generally cannot determine the degree of injury in the first month.

Egdousi & Macgregor have described a method of testing the lingual nerve function post operatively which includes a verbal questionnaire and an evaluation of the sensory deficit by light touch (using a nylon suture thread or a wisp of cotton wool), tactile discrimination (using sharp and blunt ends of a bi-angled probe), two-point discrimina-
tion (using blunt dividers) and pain awareness (using light pressure from a sharp probe).\(^{(11)}\)

A system called the three-level dropout algorithm also enables to establish diagnosis. These procedures and psychophysical methods have been described in detail by Essick. In these tests the level A testing measures brush stroke directional sensitivity and static two-point (or moving) discrimination; level B testing measures contact detection with Semmes–Weinstein monofilaments; and level C testing measures pain threshold and tolerance with either an algometer, thermode, or sharp instrument. Testing for the IAN is performed over a 1-cm area on the labiomenatal fold of the injured and uninjured sides of the chin, and testing for the LN is over an area 1 cm distal to the outstretched tip of the tongue and 0.5 cm lateral to the midline of the injured and uninjured sides. In the presence of pain, a four-level clinical neuropathic pain examination is performed to help distinguish neuropathic pain states and determine eventual treatment. The fourth level of testing includes diagnostic nerve blocks to help distinguish potential nervous system sources for the pain. The resolution of the subjective and objective pain complaints with trigeminal nerve blocks suggests that the source is peripheral (trigeminal nerve exploration and repair resolves the pain in 70% of cases). The failure to affect the pain complaint with trigeminal nerve blocks suggests a central source (trigeminal nerve exploration and repair are never beneficial and may be harmful).\(^{(10)}\)

These diagnostic tests can be repeated at approximately monthly intervals, and most patients will gradually recover normal sensation. If there is some evidence of sensory recovery by 3 months, monitoring should be continued until there is no progressive improvement (up to 12 months). At this stage, an operation should again be restricted to patients with either a substantial deficit or persistent dysesthesia. This is how a proper diagnosis will further help in achieving an appropriate treatment plan for the particular case.\(^{(12)}\)

**Discussion**

The incidence of reported postoperative dysesthesia of the inferior alveolar and the lingual nerve varies widely in the studies published so far. In a study published in 2000 by J. Gargallo-Albiol et al., the incidence of temporary disturbances affecting the IAN or the LN was found to be in the range from 0.278% to 13%.\(^{(11)}\)

Andrew et al carried out a study in 2004 to determine the incidence of inferior alveolar nerve paraesthesia in those patients where an exposed inferior alveolar nerve bundle is seen during third molar surgery and it was concluded that such a situation hints a high probability of intimate relationship of the nerve with the tooth and carries a 20% risk of paraesthesia with a 70% chance of recovery by one year from surgery.\(^{(13)}\)

Later in 2005, another study reported an incidence of inferior alveolar nerve (IAN) damage due to lower third molar extraction as 1.1%.\(^{(14)}\)

The total incidence of inferior alveolar nerve and lingual nerve injury following impacted lower third molar removal was reported to be 13.4% by Lopes et al., who also observed that a similar incidence of sensory deficit and morbidity was present in the patients who do not have clinically sound indications for surgery when compared to those with accepted symptoms.\(^{(1)}\)

Recently L. K. Cheung et al carried out a study in which it was seen that of all the lower third molar extractions performed by various grades of operators, 0.35% developed IAN deficit and 0.69% developed LN deficit.\(^{(2)}\)

However the true incidence cannot be established from this data base as in some studies surgery was performed by many different surgeons, while in few, the surgical technique was not standardised. Other studies fail to provide details on inclusion criteria, or appear to be based on surgery performed under general anaesthesia.

Factors associated with nerve injuries due to mandibular third molar extraction:

- The incidence of nerve injuries, especially for lingual nerve varies and depends on a number of factors like the experience of the surgeon, difficulty of the case, depth of impaction, presence of overlying ramus bone, lingual flap elevation, operating time, and the surgical approach used.\(^{(3)}\)

In a study carried out to investigate the risk factors for temporary and permanent lingual nerve injury after extraction of mandibular third molars, the authors concluded that the predictors for permanent lingual nerve injury in order of importance were perforation of the lingual plate during surgery, the skill of the surgeon, difficulty of the case (distoangular impactions), exposure of the nerve and an increased age of the patient. They further stated that the surgical factors are the main contributors to lingual nerve injury during third molar extraction while patient and dental factors are also involved.\(^{(15)}\)
With regard to inferior alveolar nerve paresthesia, risk factors included the patient’s age (26-30 years), horizontally impacted teeth, close radiographic proximity to the inferior alveolar canal (IAC), and treatment by trainee surgeons. (16)

Surgical excellence and experience of the operator has been concluded as one of the main risk factors of developing permanent sensory dysfunction in the distribution of these nerves which may further affect the patient’s quality of life. (16)

The depth of the impacted mandibular third molar and its lingual angulation are other factors which may affect the probability of nerve damage occurring. Eduard Valmaseda-Castellón et al carried out a study to assess the risk of lingual nerve injury after surgical removal of lower third molars, and concluded that anatomical factors such as lingual angulation of the third molar, surgical maneuvers such as retraction of the lingual flap or vertical tooth sectioning, and surgeon inexperience all increase the risk of lingual nerve damage, although permanent lesions seem to be very rare. (17)

In case of greater lingual angulation of the tooth involved, there may be a need to manipulate the lingual flap, which may significantly increase the chances of lingual nerve injury. (18)

L. K. Cheung et al from their study concluded that distoangular impaction was found to increase the risk of LN deficit significantly, wherein the depth of impaction was related to the risk of IAN deficit. On the other hand, sex, age, raising of a lingual flap, protection of LN with a retractor, removal of distolingual cortex, tooth sectioning and difficulty in tooth elevation were not found to be significantly related to IAN or LN injury. (22)

Few studies have supported this observation and report in a similar fashion that the deeper the third molar, the higher the rate of lingual nerve damage. However, there are other authors who oppose this observation by stating that the depth of impacted third molar is not clearly related to the incidence of lingual nerve damage and the explanation given is in the fact that the true cause of nerve damage is the surgical maneuver required during extraction such as lingual flap retraction, ostectomy, and tooth sectioning and not the mandibular depth of third molar. (19, 20, 18, 16)

Age is also considered to be a risk factor for the persistence of the IAN injury. It was also concluded by Elena Queral-Godoy et al that older patients are at an increased risk of incomplete recovery of chin and lip sensibility and suffer more severe damage which could be attributed to decreased nerve regeneration or neuronal plasticity. This latter hypothesis is supported by reports on the effect of age on peripheral nerve regeneration and by the fact that older patients, despite a macroscopically less traumatized IAN, show poorer recovery after mandibular ostotomies. (14)

Jozsef Szalma et al had also emphasized that advanced age is a risk factor for IAN injuries after third molar extraction and mandibular ostotomies and also, the chances of recovery are lesser in older patients. (9)

The technique used also determines to some extent the probability of injury to inferior alveolar or lingual nerve. The literature mentions basically two approaches for removing a mandibular impacted third molar namely, the lingual split technique and splitting with a burr technique. A great controversy exists regarding superiority between the two mentioned techniques but however, the skill of operator is another determining factor of the degree of nerve damage.

Some authors have even suggested that coronectomy should be preferred over extraction in patients where there is radiological evidence of proximity of the third molars with the inferior alveolar canal in order to avoid any complications. However, Pogrel et al. noted that following coronectomy and subsequent migration of the third molar roots may be an issue in the long term. (16)

Rood et al in 1992 reported an incidence of 12.8% of temporary lingual nerve dysesthesia when using the lingual split technique and only 2.3% when using drills. However earlier in 1988 Mason had mentioned that there was no difference when using either technique. (21, 19)

Yeh et al also did not find any single incident of damage to the lingual nerve using the lingual split-bone technique in their study. (22)

Considering that lingual nerve damage is the most common event following lower third molar extractions, a study was carried out to ascertain the impact of lingual nerve protection in patients undergoing third molar gerectomy (i.e. removal of the developmental bud prior to anchoring of the roots in the jaw). No lingual nerve injury was observed after third molar gerectomy regardless of whether or not lingual nerve protection was used and so the authors concluded that lingual nerve protection is unnecessary for lower third molar gerectomy. Several other reports have also been mentioned regarding the use of lingual retractors and rotating instruments during surgery. Generally, minimal interference of the lingual soft tissues during third molar surgery is associated with a lower inci-
dence of lingual nerve trauma, compared with the incidence when lingual flaps are raised.\(^2\(^3\)\)

Hence, currently, there is a trend of not raising a lingual flap, in an attempt to reduce the incidence of lingual nerve dysaesthesia.\(^1\(^1\)\)

Another controversy exists regarding the use of type of lingual nerve retractors in order to protect the lingual nerve during surgery. Some studies have shown that the raising of a lingual mucoperiosteal flap, clumsy instrumentation, and lingual plate fracture may result in lingual nerve paresthesia and to avoid this, is essential to protect the lingual nerve from direct trauma with instruments, by positioning a periosteal elevator underneath the lingual periosteum. However, if at the same time, this technique is used by a less experienced surgeon, there is even greater risk of stretching the lingual nerve. The type and breadth of the retractor used further is said to affect the outcome of lingual nerve protection. In a comparison of the Howarth’s periosteal elevator (retractor) with a broader retractor, Rood suggested that IAN and LN damage was significantly related to bone removal with a surgical drill, and the application of a Howarth’s periosteal elevator (retractor) is of no benefit. Absi and Shepherd also came to the same conclusions. The type of retractor used may also affect the outcome. Rood also found that even if the Howarth’s periosteal elevator is carefully positioned, it is not wide enough to protect the lingual nerve along the whole length of the surgical field. He suggested that the retractor should be continually repositioned to provide optimum protection. Greenwood et al. compared the Howarth’s elevator with a broader retractor. They found that the use of the second resulted in a reduced incidence of tongue numbness 1 month postoperatively and thus offered greater protection of the lingual nerve. Other studies have suggested that there is no indication for the use of periosteal elevators as retractors during third molar surgery. A systematic review by Pichler and Beirne concluded that the use of a lingual nerve retractor during third molar surgery was associated with an increased incidence of temporary nerve damage, but did not influence that rate of permanent nerve damage.\(^3\(^6\)\)

Management of nerve injuries due to mandibular third molar extraction

Management of nerve injuries following third molar extractions, can be done conservatively or if required, using a surgical approach. An evaluation of the prognosis of recovery from LN and IAN injury should be first established and usually, it is similar for both the cases but the rate of recovery may depends on factors like age and experience of the operator.

The greatest probability of recovery occurs in the first 3 months and the probability of recovery from IAN injury is about 60% after 3 months, 55% at 6 months, 45% at 9 months, and 17% even up to 15 months post injury. While for LN, the probability of recovery decreases rapidly after 6 months and is about 60% at 3 months, 35% at 6 months, and < 10% at 9 months or longer. Treatment is indicated when after 3 months there is still moderate or severe sensory impairment or there is neuropathic pain. In case, an injury is witnessed during the surgical procedure, it is advisable to provide treatment for the same immediately and no later than within 4 weeks.\(^1\(^0\)\)

L. K. Cheung et al found that postoperative recovery from IAN and LN deficits was most significantly noted at 3 and 6 months, respectively. By the end of the follow-up period, 67% of IAN deficits and 72% of LN deficits had recovered completely.\(^2\)

Conservative approach

Nonsurgical therapy includes three options: (1) medical treatment to control the pain; (2) physical therapy with transelectrical nerve stimulation; or (3) behavioral therapy using hypnosis or imaging, among others.\(^1\(^0\)\)

Patients who are ultimately left with a minor degree of hypoesthesia (reduced sensation) or mild paraesthesia (abnormal sensation) cope well with the sensory deficit, are unlikely to benefit from intervention, and are probably best left untreated.\(^1\(^2\)\)

Several drugs have been found to be effective in providing a symptomatic relief due to nerve injuries, and basically include vitamin B complex preparations with others being anticonvulsants, antidepressants, opiates, antiarrhythmics, or topical anesthetics. Although an improvement in the peripheral nerve regeneration has been established using vitamin B complex group in animal models, there is no evidence supporting their beneficial effects on human beings. Similarly, low-power laser therapy has been mentioned as another treatment modality, which acts by increasing the axonal density and improve nerve regeneration after nerve injury, but more evidence-based studies need to come up for establishing its true efficacy.\(^9\)

Sensory retraining should be considered when a nerve injury is reported immediately following third molar surgery and continued for at least 1 year or until recovery, because the benefits of sensory retraining seem to be early and progressive.\(^1\(^0\)\)

It is surprising that some patients who sustain a nerve injury may be left with profound anaesthesia but no
dysesthesia, while others complain bitterly of chronic pain and tingling, often exacerbated by moving or touching the affected area. For this group a pharmacological approach is appropriate like use of tricyclic antidepressants, anticonvulsants, etc.\(^{1(2)}\)

**Surgical approaches to treatment**

Surgical approaches need to be considered when neurosensory testing indicates severe or complete sensory impairment and the prognosis for recovery is very poor. The surgical intervention to provide relief has to carefully planned after thorough evaluation as primary repair of the nerve even after sectioning may not be normally required. The reason behind is the mandibular canal which provides a well supported confine to the neurovascular bundle due to which even after section of the nerve, its ends do not usually retract. Sometimes on exploring the surgical site, the nerve may be found intact but associated with scar tissue and the appropriate treatment in such a case would be to free the nerve of the scar tissue.

In case of bleeding from the bundle while surgically managing the nerve, a gentle pressure pack with gauze can be applied, which is then removed before the wound is closed. Any thermal or chemical injury by diathermy or certain haemostatic agents respectively should also be avoided. However, in a situation where both the ends of the nerve get separated and displaced, an attempt should be made to re-approximate them with epineurial sutures inserted with the help of loupes or an operating microscope under general anaesthesia. \(^{1(2)}\)

Various other surgical treatment options for nerve injury include neurolysis, neurography, nerve grafting, distal nerve share, and proximal nerve repositioning. However, the management depends strongly on whether the source of pain is peripheral or central. Sometimes, when there is a foreign body impinging on the nerve (i.e., a retained or displaced root tip, alloplastic material such as hydroxyapatite, dry socket medicament, or endodontic paste) which is the cause of pain, a surgery can be done to remove the cause by not essentially involving the nerve. For recalcitrant and/or central trigeminal neuropathic pain a neurosurgical therapy in the form of ablative neurolysis and gamma knife surgery of lesions in the trigeminal root is indicated.\(^{1(2)}\)

Microsurgical techniques allowing nerve repair include directly suturing or grafting the damaged nerve and is said to meet a success rate of 80%. However P.P Robinson et al reported that results from direct reapposition of the lingual nerve by epineurial sutures seemed to be better than those reported after other methods of repair such as nerve grafting, artificial conduits, or some reports of external neurolysis.\(^{1(2)}\)

**Conclusion**

Mandibular third molar extraction is a very commonly carried out procedure in day to day dental practice and is undoubtedly associated with few risks especially neural injuries and therefore, a thorough evaluation of the risks and benefits from surgery is of utmost importance, both for patient benefit and safety from litigation for the dentist. In the modern dental era, where evidence-based practice enables a clinician to utilize the available evidence to allow the best treatment outcomes, it would be wise to take up cases in which extraction is justified and based on clear cut indications, and also where the benefits outweigh the risks involved in the procedure. Further, a mandatory post operative assessment should be made at timely intervals, to diagnose the complications that arise at an earlier stage and enable quick recovery by initiating timely treatment.

**REFERENCES**


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