



Management Of Inferior Alveolar Nerve Injury

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ABSTRACT

IAN injuries are caused by dental surgical procedures or accidents resulting when the procedure does not go well or an unexpected complication arises. The first thing to remember regarding the potential progression of an injury from acute to chronic is to have an accurate diagnosis and classification of the injury. Furthermore, if there is evidence of nerve damage and persistent symptoms, the earlier these injuries are diagnosed, the better the chances of recovery. This review will also look at the different types of chronic IAN injuries, their treatment options, and the relative outcomes of patients with different presentations of IAN injuries. Prevention strategies for the risk of injury to the inferior alveolar nerve through pre-operative imaging, guided implant placement, proper anaesthesia management and surgical practice have been highlighted as the main strategies to decrease the number of injuries. The final section of the article provides an overview of the newest advancements in regenerative strategies for treating IAN injuries, as well as recommendations for future clinical practice and research.

Keywords: Inferior alveolar nerve injury, Paresthesia, Neurosensory deficit, CBCT, Microsurgical repair.

INTRODUCTION

Inferior alveolar nerve injury (IANI) can be one of the most significant complications resulting from dental and maxillofacial surgery. The inferior alveolar nerve (IAN) travels through the mandibular canal and provides sensory nerve fibres for the lower lip, chin, and teeth of the lower arch. As a result, it can get injured during surgical, endodontic, restorative, and anaesthetic procedures. Disruption of any minor structural or vascular supply of the IAN can cause altered sensation—including paresthesia, dysesthesia, hypoesthesia, anaesthesia, and neuropathic pain[1].

The possible functional and psychological effects of an inferior alveolar nerve injury can be devastating for both the patient and the treating clinician. A patient may find it difficult to speak, eat, or control their lips and facial expressions, and will generally have an increase in anxiety, feelings of depression, and/or a decrease in the satisfaction level with the end result of treatment[1]. Due to the fact that many times this is a result of routine dental procedures (for example, extraction of third molars, placement of implants, and inferior alveolar nerve block anaesthesia), all practicing dentists, not just specialists, need to be aware of the risk involved[3].

ANATOMY

The Inferior alveolar nerve originates from the posterior division of the mandibular nerve (a branch of the trigeminal nerve, or V3) and ascends through the foramen of the mandible. The nerve runs through the mandible canal during its travels. As it travels through the mandible, the inferior alveolar nerve sends branches to the molars and premolars. The branches of the inferior alveolar nerve are contained in the area of the premolars, where the nerve divides into two branches: The mental nerve exits through the mental foramen, supplying the lower lip and chin. The incisive nerve continues forward from the mental nerve and supplies the anterior teeth[2].

ETIOLOGY

Dental extraction of third molars

One of the most common causes of IANI is surgical removal of the mandibular third molar[1][2].

Endodontic treatment of mandibular premolars and molars

The inferior alveolar nerve can be affected by endodontic procedures when the nerve is in the vicinity of the tooth being treated[2].

Dental implant placement

As the placement of dental implants increases, so does the incidence of IANI[6].

Orthognathic surgery

Mandibular osteotomies, such as sagittal split ramus osteotomy (SSRO), can potentially injure the inferior alveolar nerve (IAN).

Facial trauma

Fractures of the mandible (particularly in the body, angle or ramus) may result in injury

Pathologic condition

Tumour/cysts, inflammatory/infectious processes can produce direct or indirect injury to the IAN

Local anesthesia (inferior alveolar nerve block)

An IAN block can produce nerve impairments or disturbances, but this is less common.

Prosthetic and restorative placement

Overextension of crowns; Deep cavity preparations;
Improperly fitting denture[3].

Iatrogenic thermal or chemical injury Excessive heat from rotary instruments; Chemical injuries from medicaments;
Necrosis of bone from osteomyelitis leading to inflammation of the neural tissues[10].

CLASSIFICATION

SEDDONS CLASSIFICATION (1943)

Seddon classified peripheral nerve injuries into three types based on the amount of damage that occurred to the axons and surrounding connective tissue[10].

1. NEURAPRAXIA

The least serious injury. A result of compression or mild, blunt trauma. There is no injury to the axons. The nerve will show a conduction block as a result of ischemia and/or demyelination.

2. AXONOTMESIS

Axon is damaged, but the epineurium and perineurium have not been ruptured. Wallerian degeneration occurs distal to the site of injury. Although full recovery is possible, this type of injury recovers at a slower rate than neuropraxia (approximately 1-3 mm per day). Possible adjuvant therapies may include pharmacological agents, laser therapy, and close monitoring of neurosensory function[2].

3. NEUROTOMESIS

Complete detachment of the nerve, including loss of the axons and attaching connective tissue sheaths. There is a very low likelihood of spontaneous recovery. Requires surgical repair via microsurgical techniques (i.e. neurotomy and/or grafting)[3].

SUNDERLAND CLASSIFICATION

Expanded upon Seddon's System as 5 Degrees of Injury [13].

1st DEGREE INJURY

Temporary conduction block without Axonal disruption, so there will be rapid and complete recovery.

2nd DEGREE INJURY

2nd Degree injury represents Axonal damage with intact endoneurium, resulting in Wallerian degeneration,

which has a good prognosis for regeneration[12].

3rd DEGREE INJURY

A 3rd Degree Injury involves damage to both the axons and endoneurium. The perineurium and epineurium remain intact.

4th DEGREE INJURY

4th Degree injury is serious with only the epineurium intact. Internally scarred tissue will impede the regeneration of the nerve; therefore, surgical intervention is necessary.

5th DEGREE INJURY

5th Degree injury indicates a complete transection of the nerve with no chance of recovery naturally, requiring immediate microsurgical repair [15].

DIAGNOSIS AND CLINICAL ASSESSMENT

An accurate and early diagnosis of any inferior alveolar nerve (IAN) injury can help to provide timely treatment, improve the patient's prognosis and decrease the prevalence of long-term neurosensory deficits[11].

PATIENT HISTORY AND CLINICAL REVIEW

An extensive history will usually yield valuable information concerning both the mechanism of injury and when it first occurred to the patient[5].

EXTRAORAL EXAMINATION

Evaluate the asymmetry between the lower lip and chin. Check for muscle weakness or alterations in facial expressions. Palpate to determine if there is an infection/wound, excessive swelling, or a hematoma[1].

INTRAORAL EXAMINATION

Gingival and mucosal sensations: Assess the presence of sensations in the gingiva and oral mucosa. Teeth involved: Check mobility and/or pain for the tooth/teeth in question. Signs/Symptoms of trauma: Check for abnormalities in the teeth's supporting bone structure, bony fragments, and/or a hematoma of the area affected[1].

NEUROSENSORY TESTING

Neurosensory testing forms the basis of a patient's clinical evaluation. Testing can be performed at 3 different levels from 1-basic to 3- discriminative.

Level A – Sensory detection test

Level B- Direction and localisation test Level C- Discriminative sensory test[7]. **STANDARD GRADING SCALE**

The MRCS – Medical Research Council and Source S0: no response demonstrated

S1-S2: partial recovery

S3-S4: Good to Complete recovery

PANORAMIC RADIOGRAPHS

Initial screening tool to identify implant position, and also to detect narrow canals/fractures/broken bone[9].

CONE BEAM AND COMPUTED TOMOGRAPHY

Best imaging technique to assess proximity of implants to the inferior alveolar nerve canal (IAN), to evaluate if the cortical plate has been perforated, to assess the position of the root apex relative to the IAN canal (directly opposing), the degree of impaction of a third molar, and the division/bifid of the IAN canal[2].

MRI/MR NEUROGRAPHY

Indicated for imaging when soft tissue characterization is needed; Indications include: soft tissue lesions pressurizing on the IAN, nerve lesions (neuromas), and hematomas[1].

ELECTROPHYSIOLOGICAL TESTING

Somatosensory evoked potential (SSEPs)

Useful in measuring speed of conduction and integrity/path of the nerve

Quantitative sensory testing

Allows for computerized evaluation of temperature/vibration/pressure threshold levels.

MANAGEMENT OF INFERIOR ALVEOLAR NERVE INJURY

Managing neurological deficits resulting from injuries to the Inferior Alveolar Nerve is determined by multiple factors, including the underlying injury, the severity of the deficit(s), the time frame that has passed since the injury occurred, and how the symptoms have changed over time. First- line treatment options are generally more conservative in nature, and if conservative treatments do not result in resolution of the symptoms, then the provider (usually an oral and maxillofacial surgeon) will make a surgical recommendation, based on the above mentioned factors. Ultimately, the goals of treating an Inferior Alveolar Nerve injury are to restore sensation wherever possible, to relieve neuropathic pain, and to prevent long term disability[7].

PRINCIPLE

EARLY DIAGNOSIS

The sooner an assessment is performed when postoperative numbness does not resolve after the expected duration of anaesthesia, the better the prognosis and the better the information will be for determining the optimal course of treatment (ie, conservatively vs surgically). To reduce the risk of exacerbating the injury, it is essential to eliminate any sources of inflammation, mechanical injury or compression as soon as possible. Continually assess neuro-sensory test results at 2 weeks, 4 weeks, 6 weeks after injury, and then the month following until the complete resolution of symptoms. Recovery from the injury should occur in a predictable

fashion; if patient's recovery plateaus, this is a warning sign. Best surgical outcomes of IAN injuries are consistently shown to occur when surgical intervention is performed within 3 to 6 months post injury[15].

IMMEDIATE CARE AFTER INJURY

Observation and reassurance if the patient shows minor symptoms and has experienced neurapraxia, it is appropriate to provide both reassurance and observation. Anti-Inflammatory medications used to relieve nerve compression caused by swelling .Non-Steroidal Anti- inflammatory Drug (NSAIDs): Ibuprofen 400 mg – 600 mg or Corticosteroid: Prednisone 40 mg -60 mg by mouth for 3 days to 5 days (taper if desired)May reduce swelling and inflammation of nerves elimination of irritants remove or adjust any dental appliances that are causing excessive pressure, as well as make any necessary adjustments to prostheses, or, if necessary, drain any hematomas that may be causing irritation. Antibiotics (If there is a suspected infection) use amoxicillin with clavulanic acid amoxicillin with clavulanic acid, or use clindamycin in patients that are allergic to penicillin and neuromuscular electrical stimulation (NMES) are two adjunctive modalities to facilitate recovery. It is not commonly used in treatment of peripheral nerve injuries and is often utilized for pain management during the acute phase after injury[1].

CONSERVATIVE MANAGEMENT

The focus on conservative management in the first three months post-SCI is on enhancing the regenerative capacity of the nerve[1].

PHARMACOLOGICAL MANAGEMENT

VITAMIN /NERVE GROWTH SUPPLEMENTATION

Current recommendations for vitamin/nutrition supplementation for those with spinal cord injury- related nerve damage include the following: B vitamins (thiamine (B1), pyridoxine (B6), cobalamin (B12)), vitamins building blocks of those nutrients needed to regenerate and repair damaged nerves. Alpha-lipoic acid (antioxidant) Folic acid vitamins responsible for repair and rebuilding damaged nerves[12].

NEUROPATHIC PAIN MANAGEMENT MEDICATIONS

Medications used for those who experience neuropathic or dysesthetic pain include: Gabapentin Pregabalin , Amitriptyline or Nortriptyline , Duloxetine[11].

Dosage is titrated up over the first few weeks depending on the severity of the pain. **TOPICAL MEDICATIONS**

Commonly used topical agents include: Lidocaine patches. Capsaicin cream for allodynia (A type of neuropathic pain characterized by a painful sensation from even light stimuli).

SENSORY RE-EDUCATION THERAPY

Evidence suggests that beginning sensory reeducation therapy as soon as possible facilitates optimal sensory recovery and improves sensorimotor function[5].

ACTIVE THERAPIES

Patient-driven tactile stimulation activities

Tactile exposure treatments (stroking, tapping, vibration). **PASSIVE THERAPIES**

Clinician-supervised exposure to sensory stimuli. Evidence suggests that the earlier the initiation of sensory reeducation therapy, the better the functional and sensory recovery[1].

LOW -LEVEL LASER THERAPY (LLLT)

Evidence supports LLLT as an adjunct to conventional treatments for spinal cord injury-related neuropathy and recommends LLLT for: Increased nerve regeneration rates, Decreased nerve swelling and inflammation, and Relief of neuropathic pain. A common treatment for low-level laser therapy is: Wavelength 630–980 nm, Power: 50–500 mW, Number of times/week: 3-4, duration of treatment is 4-6 weeks[2].

PRP/PRF APPLICATIONS

Platelet-rich plasma and platelet-rich fibrin provide the body with growth factors (PDGF, VEGF, TGF- β , etc.) that can enhance axonal regeneration, improve vascularization, and reduce potentially disabling neuropathic pain[2].

PRP and PRF are given as injections during the repair surgery or afterwards.

PHYSICAL THERAPY AND OTHER ADJUNCTIVE MODALITIES

Transcutaneous electrical nerve stimulation[12]. **SURGICAL MANAGEMENT OPTIONS EXTERNAL NEUROLYSIS**

Indicated for cases when scar tissue or external pressure is causing constriction of the nerve
Procedure: Remove fibrous adhesions and Restore mobility of the nerve[15].

INTERNAL NEUROLYSIS

Indicated for cases of localized scar formation inside the nerve and requires precision of a microsurgical area[8].

DIRECT NEURORRHAPY (PRIMARY REPAIR)

Indicated for cases with confirmed: Transection, Laceration, Implant perforation injuries. Methods of primary repair: Epineurial repair and Perineurial repair (more precise/complex). **NERVE GRAFTING**
When nerves cannot be directly approximated without tension. There are two types of grafts:

1. Autogenous grafts: Sural nerve and Great auricular nerve
2. Allografts: a processed nerve allograft; [7].

NERVE DECOMPRESSION:

If you have a nerve that is compressed by: Cysts, bone fragments, hematomas, implants. The surgical decompression procedure will remove the influences of pressure and reshape the canal.

MANAGEMENT OF NEUROMAS

A painful neuroma can be treated by: Resection, Grafting and Relocation techniques.

REHABILITATION FOLLOWING SURGERY**SENSORY RETRAINING**

During the retraining process it is crucial to enable your brain to establish accurate “mapping” of your sensory input[7].

PAIN CONTROL

Continue to use neuropathic medications for a period of several months after surgery FOLLOW UP SCHEDULE

CONCLUSION

The inferior alveolar nerve injury is one of the most important complications in general practice and maxillofacial surgery, affecting an individual's long-term functional, psychological, and medico-legal status. Injury may occur during the surgical extraction of a third molar, dental implant surgery, ENDODONTIC TREATMENT, ORTHOGNATHIC PROCEDURES, and/or LOCAL ANESTHETIC TECHNIQUES. The severity of injury ranges from a temporary conduction block to complete transection of the nerve, requiring prompt diagnosis and management[1].

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