WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

A Comprehensive Review of Mandibular Nerve Injuries in Oral and Maxillofacial Surgery

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ABSTRACT

Mandibular nerve injuries are significant complications in oral and maxillofacial surgery, affecting patients' sensory functions and quality of life. These injuries can result from various causes including surgical procedures, trauma, or pathological conditions. Common procedures such as third molar extractions and implant placements are associated with Mandibular nerve damage, leading to sensory disturbances such as anesthesia, hypoesthesia, dysesthesia, and neuropathic pain. Accurate diagnosis involves comprehensive clinical evaluation, advanced imaging (MRI, CT), and neurophysiological testing. Management strategies include non-surgical approaches like pharmacological treatment and physical therapy, as well as advanced surgical techniques such as microsurgical repair, nerve grafting, and decompression. Emerging methods in nerve repair, including nerve transfers and regenerative medicine approaches, hold promise for improved recovery outcomes. This review highlights the etiology, diagnostic methods, and management options for Mandibular nerve injuries and underscores the importance of continued research and advancements in surgical techniques and regenerative medicine to enhance patient outcomes and mitigate long-term effects.

Keywords: Mandibular nerve injuries, oral and maxillofacial surgery, third molar extractions, nerve repair, microsurgery,

INTRODUCTION

The Mandibular nerve a division of trigeminal nerve (cranial nerve V) is responsible for sensory innervation of the face and motor functions such as mastication. Injuries to this nerve can result in a range of sensory disturbances, including anesthesia, hypoesthesia, dysesthesia, and neuropathic pain.[1] These injuries can occur due to various surgical procedures, trauma, or pathological conditions. Oral and maxillofacial surgeons, as well as dentists, perform numerous procedures that can potentially injure the Mandibular nerve. Understanding the causes and management of these injuries is crucial for oral surgeons to practice safely and efficiently in both office and hospital settings. The removal of third molars is the most common cause of injury. The injury rate for the inferior alveolar nerve (IAN) is often cited as 4 per 1,000 mandibular third molar extractions, while the rate for lingual nerve injury is about 1 per 1,000 mandibular third molar extractions. Up to 25% of these patients may experience persistent sensory deficits for up to a year following the injury. Before third molar extractions, it is essential for the surgeon to thoroughly discuss the risks with the patient and obtain informed consent. Despite this process, these injuries remain a significant source of litigation against clinicians.[2] Patients who suffer from extensive traumatic avulsive injuries or defects due to ablative tumor surgery in the oral and maxillofacial region often experience a loss of sensory function, caused by damage or avulsion of one or more peripheral branches of the Mandibular nerve. These injuries lead to altered and/or painful sensations in the areas previously served by these crucial sensory nerves. Normal orofacial functions—such as eating, drinking, oral hygiene, swallowing, and speaking—rely on adequate sensory input, and the loss of this input results in significant orofacial dysfunction and diminished quality of life. Advances in nerve repair and reconstruction techniques, driven by improved instrumentation and a better understanding of neurobiology, have greatly enhanced outcomes.[3] The success of these techniques' hinges on an accurate assessment of the injury and prompt, precise repair to maximize the chances of functional recovery. Whenever feasible, the repair or reconstruction of injured Mandibular nerve branches should be coordinated with the reconstruction of other lost osseous or soft tissues in the oral and maxillofacial region. Post-surgery, a key component of comprehensive rehabilitation is a well-designed daily sensory re-education program, which helps achieve the best possible sensory recovery and associated orofacial function, thereby improving the patient's quality of life.[4] This article gives a comprehensive review of Mandibular nerve injuries in oral and maxillofacial surgery.

REVIEW OF LITERATURE

A retrospective study by Matias Garcia-Blanco analyzed 30 patients with Mandibular nerve injuries, finding that the inferior alveolar nerve was most frequently affected (74%), with lower molar extractions being the leading cause (47%). Treatment at dental institutions was significantly associated with

obtaining informed consent. The study highlights the need for careful planning to prevent debilitating Mandibularinjuries.[5] Herbert Depp's study analyzed 1,559 cases of mandibular oral surgery in a university outpatient setting, revealing a low incidence (2.69%) of Mandibular nerve injuries, with the majority of cases linked to periradicular surgery.[6] Shahrokh and Bagheri's study on the microsurgical repair of peripheral Mandibular nerve injuries due to maxillofacial trauma demonstrated significant improvement or full recovery in 86% of patients, highlighting favorable outcomes compared to other causes. Additionally, outcomes of Mandibular nerve injuries following mandibular SSRO showed that 85.2% of patients achieved functional sensory recovery after surgical intervention.[7,8] Pogrel concluded that when performed appropriately, Mandibular nerve microsurgery can enhance sensation in more than 50% of patients.[9] Rood and Shehab identified seven radiological signs indicative of a close relationship between the lower third molar and the inferior dental nerve (IDN) using panoramic radiography.[10] However, Pippi et al. found that none of these signs were significantly associated with nerve injury, even when two or more were present, and reported nerve injuries in only 6.5% of cases with nerve exposure compared to 29.3% without, suggesting that proximity rather than exposure is a risk indicator.[11] Additionally, they found a 16-fold higher risk of nerve injury when the mandibular canal was positioned lingually rather than buccally. Kim et al. associated contact between the lower third molar and the mandibular canal with a 21-fold increased risk of paresthesia. In terms of anesthesia, Nyugen et al. reported a significantly higher frequency of permanent damage in lower third molar surgeries performed under general anesthesia compared to local anesthesia, while Costantinides et al. noted a 2-16 fold greater risk of IDN injury under general anesthesia. Hasegawa et al. observed a higher rate of IDN injury in patients with nerve exposure during surgery.[12,13,14,15] Charan Babu et al. reported an elevated risk of lingual nerve (LN) injury with greater impaction depth and found a higher risk in distoangular and horizontal impactions, though these associations were not statistically significant.[16] Finally, Shad et al. suggested that permanent LN injury can occur when the lingual flap is not properly separated from the bone.[17]

Aspect	**Details**
Lingual Nerve Injuries	Can affect speech, taste, and chewing; significant anatomic variability; injuries during surgery due to incision or bur perforation; increased risk with retraction.
Lingual Nerve Position	Located above the lingual aspect of the alveolar crest in 7% of cases; in direct contact with the lingual plate in 26% of cases; vertical distance of 2.75 mm on average.
Inferior Alveolar Nerve Injuries	Easily identified on imaging; risk assessed preoperatively; injuries linked to impaction depth; indicators include darkening roots and mandibular canal deflection.
Nerve Block/Infiltration Injuries	Permanent paresthesia rare; incidence ranges from 1 in 26,762 to 1 in 160,571; most recover spontaneously; risk with blunt/barbed needles.
Dental Implants	Increased use; risk of altered sensation if boundaries not respected; anterior loop extends 5 mm anterior to mental foramen; safe distance from neurovascular structures recommended.
Endodontic Treatment Injuries	Overzealous instrumentation causing chemical/mechanical irritation; nerve fibrosis or exophytic neuroma possible if epineurium violated.
Orthognathic Surgery	Inferior alveolar nerve expected to have temporary paresthesia; risk with lingual retraction or long screws; mental nerves at risk in genioplasty; infraorbital nerves in LeFort I osteotomy.
TMJ Arthroscopy	Auriculotemporal nerve at risk; up to 23.4% temporary paresthesia; severe complications involve fluid extravasation compressing nerves.
Maxillofacial Trauma	Causes significant Mandibularnerve injuries; risk with mandibular trauma, fractures, gunshot wounds; ZMC fractures affect infraorbital nerve; frontal bone fractures affect supraorbital nerve.
Surgical Repair of Fractures	Nerves can be impaled by hardware; thorough examination and documentation needed; monocortical plating and careful hardware placement recommended
Disease-Related Nerve Injuries	Malignancies and neurodegenerative processes can cause paresthesia; central cortical lesions from strokes can contribute to sensory deficits.

DIAGNOSIS OF MANDIBULAR NERVE INJURIES

Diagnosing Mandibular nerve injuries requires a comprehensive approach that integrates clinical examination with advanced imaging and neurophysiological testing. Clinical examination focuses on identifying sensory deficits, such as tingling, numbness, or pain in areas innervated by the Mandibular nerve, assessing pain characteristics including burning or shooting sensations, and evaluating functional impairments affecting activities like chewing, speaking, or facial expressions. Imaging techniques play a crucial role, with MRI providing detailed views of the nerve and surrounding tissues to identify structural abnormalities, while CT scans are useful for visualizing bony structures and detecting fractures or lesions impacting the nerve. Additionally, neurophysiological tests such as electroneurography measure electrical activity in the nerve to gauge the extent of damage, and somatosensory evoked potentials (SEPs) assess the nerve's ability to convey sensory information from peripheral receptors to the brain.[18]

LOCAL ANESTHETIC-RELATED NERVE INJURIES

Local anesthetic-related nerve injuries, while a recognized complication in dental procedures, are notably prevalent due to the unique practice in dentistry of targeting nerves directly rather than using ultrasound for guidance. This approach results in a prevalence rate of 1 in 14,000 blocks in UK dental practice, with 25% of these cases leading to permanent nerve injury. Practicing dentists may cause 4-6 temporary and one permanent nerve injury related to inferior dental blocks (IDBs) throughout their careers. The risk factors include physical, ischemic, or chemical trauma, with the lingual nerve being at higher risk for permanent damage compared to the inferior alveolar nerve due to its anatomical characteristics. High-concentration anesthetics are more neurotoxic, and increased exposure time exacerbates the risk of Schwann cell death.[19] Intra-operative documentation of unusual pain responses is essential, as these can be indicative of persistent nerve injury. Strategies to minimize risk involve using infiltration anesthesia to avoid direct nerve contact, reducing the concentration and volume of local anesthetics, and avoiding multiple injections. Studies indicate varying efficacy among anesthetics for different procedures, with 4% articaine being more effective for certain maxillary infiltrations but not necessarily for all cases. Effective management includes patient follow-up, reassurance, and medical interventions such as NSAIDs and Vitamin B complex, with long-term care for unresolved injuries potentially involving psychological support and topical anesthetics. Adhering to these practices can help reduce the incidence of local anesthetic-related nerve injuries and improve patient outcomes.[20]

IMPLANT-RELATED NERVE INJURIES

Implant-related injuries to the inferior alveolar nerve (IAN) vary from 0% to 40%, with recent studies highlighting cases of persistent neuropathic pain due to such injuries. To prevent these injuries, it is crucial to avoid direct damage to the inferior dental canal (IDC) during implant preparation. A thorough pre-operative assessment, including effective use of CBCT imaging to plan a safety zone, and careful consideration when placing implants near the mental nerve are essential. During surgery, ensure the implant bed preparation is above the safety zone, halt drilling if the patient reports pain, and use drill guides and markers to avoid breaching the IDC. Post-operatively, take periapical radiographs to check for any proximity or breach of the IDC. If nerve injury is suspected, immediate implant removal and medical management are recommended, with a review of the patient within 24–36 hours. Support the patient through reassurance and follow-up, and if neuropathy persists, initiate appropriate treatment, including high-dose NSAIDs and Vitamin B complex. Psychological interventions may also be necessary for long-term management of persistent nerve injuries.[21]

MANDIBULAR THIRD MOLAR EXTRACTION-RELATED NERVE INJURIES

Mandibular third molar extractions can potentially damage the the inferior dental nerve (IDN) and the lingual nerve (LN). The risk of neurosensory deficits varies significantly, with reported rates ranging from 0.26% to 8.4% for IDN injuries and from 0.1% to 22% for LN injuries. IDN damage can lead to paresthesia, anesthesia, or dysesthesia in the lip, chin, or gingiva, while LN damage affects sensitivity on the affected half of the tongue, sometimes altering taste. Permanent nerve lesions are distinguished from transient ones; the former may not recover spontaneously within 6–12 months. The potential for nerve damage during third molar extractions is a common cause of litigation in dentistry. Literature reviews have highlighted various radiological risk factors that increase the likelihood of nerve injury significantly, from 0.2% to 2% for permanent and 2% to 20% for temporary nerve injuries, emphasizing the need for careful assessment and risk management during such procedures.[22]

NON-SURGICAL MANAGEMENT

Non-surgical management of Mandibular nerve injuries encompasses various approaches to alleviate pain and improve function. Pharmacological treatments include anticonvulsants like carbamazepine and gabapentin, which help control neuropathic pain, and tricyclic antidepressants such as amitriptyline, which modulate nerve signal processing to provide pain relief. Analgesics, both over-the-counter and prescription, can be used for general pain symptoms. Physical therapy, involving gentle facial exercises or massage, supports maintaining function and reducing discomfort. Additionally, neurostimulation techniques like transcutaneous electrical nerve stimulation (TENS) may help alleviate pain by stimulating nerve pathways.[23]

SURGICAL MANAGEMENT

Surgical management of Mandibular nerve injuries includes several advanced techniques aimed at restoring nerve function and alleviating symptoms. Nerve grafting involves replacing the damaged section of the nerve with a graft from another part of the body or a donor nerve, facilitating nerve regeneration. Decompression surgeries address pressure on the nerve caused by tumors, blood vessels, or other structures, thereby relieving symptoms. Emerging techniques in nerve repair include nerve transfers, which redirect a healthy nerve to restore function to the damaged area, and regenerative medicine approaches, such as stem cell treatments and bioengineered nerve conduits, which aim to enhance nerve repair and regeneration.[24,2,3,4]

MANDIBULARNERVE MICROSURGERY

Mandibular nerve microsurgery is considered for persistent neurosensory disturbances lasting more than three months, lack of improvement, development of dysesthesia, or observable nerve transections. Magnetic resonance neurography may confirm complete nerve injuries. Contraindications include central neuropathic pain, improving sensory function, well-tolerated hypoesthesia, excessive time since injury, and significant medical comorbidities. The surgery is performed under general anesthesia with a mouth prop and tongue retractor for clear visualization. For lingual nerve injuries, a sulcular incision is made, and a mucoperiosteal flap is elevated to expose the nerve. For inferior alveolar nerve repairs, a surgical guide is used to minimize bone removal, with careful decortication over the mandibular canal. Microsurgical repair is typically done at the epineurium level, using non-inflammatory materials like nylon for sutures. If primary repair isn't possible, nerve grafting or conduit-guided repairs are employed. External neurolysis removes scar tissue around the nerve, while internal neurolysis addresses nerve fibrosis. Neuromas are excised, and healthy nerve segments are coapted. Historically, autogenous nerve grafts were used, but allogeneic grafts like Avance® are now preferred for their advantages. Platelet-rich plasma (PRP) is being explored for enhancing nerve recovery, showing promising results in preliminary studies.[1,6,25]

CONCLUSION

Mandibular nerve injuries present significant complications in oral and maxillofacial surgery, impacting patients' quality of life due to sensory deficits and pain. Effective management of these injuries requires a thorough understanding of their etiology, which includes surgical trauma, compression, and iatrogenic factors. Accurate diagnosis involves a multi-faceted approach, combining clinical evaluations of sensory and functional impairments with advanced imaging techniques such as MRI and CT scans, and neurophysiological tests like electroneurography and somatosensory evoked potentials. Management strategies range from non-surgical interventions, including pharmacological treatments and physical therapy, to advanced surgical options such as microsurgical repair, nerve grafting, and decompression surgeries. Emerging techniques, like nerve transfers and regenerative medicine approaches, show promise for enhancing nerve repair and function. Continued research and technological advancements are crucial for improving both prevention and treatment. Innovations in surgical techniques, coupled with advancements in regenerative medicine, including the use of nerve conduits and biologic therapies like platelet-rich plasma (PRP), offer hope for better recovery outcomes. Understanding these developments and applying them effectively in clinical practice can significantly enhance patient outcomes and mitigate the long-term effects of Mandibular nerve injuries.

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