Risk Factors for Permanent Injury of Inferior Alveolar and Lingual Nerves During Third Molar Surgery

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Purpose: The purpose of this study was to assess the incidence of and risk factors for permanent neurologic injuries to the inferior alveolar nerve (IAN) or lingual nerve (LN) after the removal of third molars. This report also describes the use of a Clinical Incident Review (CIR) process, allowing close monitoring of all patients with neurologic injuries as a result of dentoalveolar surgery.

Materials and Methods: A database associated with a CIR process at the Royal Dental Hospital of Melbourne from January 2006 through December 2009 was assessed. Factors assessed included gender, age, operator class, method of anesthesia, spacial relation, depth of impaction, ramus relation, proximity of the IAN on orthopantomogram, cone-beam computed tomographic usage, and side of injury.

Results: During this 4-year period, 11,599 lower third molars were removed in 6,803 patients. The incidence of an IAN injury was 0.68%, and the incidence of an LN injury was 0.15%. Important risk factors for permanent IAN injury were increasing age, surgery performed by staff dentists, type of anesthesia, and mesioangular impactions. The mean time of complete resolution was 4.3 months. No factors were found to statistically increase the risk of LN injury, although most injuries were seen in patients with a distoangular impaction.

Conclusion: The overall incidences of IAN and LN injuries were low. Some risk factors for permanent IAN nerve injury were identified. Important risk factors for permanent IAN injury were increasing age (≥25 yr old), surgery performed by staff dentists, surgery under general anesthesia, and mesioangular impaction. No factors were found to statistically increase the risk of LN injury.

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Dentoalveolar surgery, in particular the surgical removal of impacted third molars, is a common procedure in oral and maxillofacial surgery with predictable outcomes.[1] However, it is well recognized that there are potential complications associated with their removal. These include the risk of injury to the inferior alveolar nerve (IAN) and the lingual nerve (LN).[2] IAN and LN injuries also occur with other procedures, including orthognathic surgery, dental implant surgery, endodontic treatment, and even needle trauma related to IAN blocks, but they occur most commonly after third molar surgery.[3]

The IAN is the largest branch of the mandibular division of the trigeminal nerve. The IAN arises from the posterolateral surface of the main mandibular trunk and descends deep to the lateral pterygoid muscle and then passes between the sphenomandibular ligament and the ramus of the mandible to the mandibular foramen. The IAN enters the mandibular foramen slightly anterior and superior to the inferior alveolar

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artery. Then, the IAN passes through the body of the mandible within a bony canal that carries and protects the neurovascular bundle, comprised of a vein, an artery, and a nerve. The nerve gives off branches to supply the teeth and continues as the mental nerve to supply sensation to the lower lip, chin, and mucosa. During surgery, profuse bleeding from the surgical site may indicate damage to the inferior alveolar artery, which lies between the vein and nerve, and therefore also may indicate damage to the IAN.[4]

The LN branches from the mandibular nerve, traveling medially to the IAN, between the medial pterygoid muscle and the ramus of the mandible. Unlike the IAN, the LN is not supported by a bony canal, and in up to 17.6% of cases the LN can be found at the level of the alveolar crest or higher in the third molar area.[5] If lingual tissue injury occurs, the fibers of the LN can be inadvertently damaged, resulting in nerve fiber entrapment in scar tissue.

It has been well documented in the literature that the risk factors for IAN and LN injuries include increasing age, unerupted teeth, deep impaction, distoangular impaction, irregular root morphology, lack of clinician experience, lingual flap and retraction, and radiographic signs of proximity of the third molar to the IAN canal.[1,6-11] The main forms of altered sensation that can occur include paraesthesia, anesthesia, or dysesthesia, which may be temporary or permanent. The literature reports an incidence of temporary IAN and LN injury ranging from 0.26 to 8.4% and from 0.1 to 22%, respectively, whereas permanent damage ranges from 0.3 to 0.9% for these 2 nerves.[1,7,8,10,12] Most studies have reported paraesthesia resolving in the first 6 months. However, the rate of recovery depends on the type of injury and the surrounding inflammatory process initiated.[1,7-10] Neurosensory testing is commonly used to assess sensory deficits in maxillofacial procedures, including orthognathic surgery and third molar surgery. These tests consist of subjective assessment of neurosensory function with a visual analog scale (VAS), brush stroke directional discrimination, 2-point discrimination, contact detection, pinprick nociception, and thermal discrimination.[13]

A classification of neurologic injuries based on mechanism of injury has been described by Sunderland.[14] These include compression injury (neurapraxia), severe compression, crush or stretch injury (axonotmesis), complete section of the nerve trunk (neurotmesis), and other injuries (perineural inflammation). The damaged nerve will react by going through stages of Wallerian degeneration and an attempt at axon regeneration, but the altered sensation is likely to remain permanent if there is no change after 1 to 2 years.[9,10] In contrast, some researchers have claimed that patients with persistent symptoms are classified as having a permanent nerve injury if there has been no change after 3 months.[2,15] It also has been reported that the LN has a lower rate of recovery compared with the IAN.[5,16] Permanent altered sensation is more likely to occur where the nerve was severed (neurotmesis) or crushed as a result of sectioning with a rotary instrument or crushing of the nerve as a result of displacement of root tips into the IAN canal.

Traditionally, preoperative assessment of the nerve position and risk level for third molar surgery has included a clinical examination and an orthopantomogram (OPG). With cone-beam computed tomographic (CBCT) scanning widely available, imaging in coronal, sagittal, and axial views with 3-dimensional reconstructions is more commonly used in third molar surgery to potentially improve diagnostic assessment and accuracy of anatomic forms and structures and evaluation of risk.[17]

The purpose of this study was to record the incidence of IAN or LN injuries as a result of third molar surgery at the Royal Dental Hospital of Melbourne (RDHM; Melbourne, Australia) using a Clinical Incident Review (CIR) process and to assess for factors that might influence the rate of permanent neurologic injury.

Materials and Methods

A database of patients who have had neurologic complications related to the IAN and LN at the RDHM was assessed. The RDHM is the main public dental referral center for the state of Victoria. Cases were excluded from the study if there was insufficient clinical or radiographic information or if neurologic injuries were not related to the removal of third molars. The database and medical records from January 2006 through December 2009 were reviewed. This study was approved by the human research ethics committee of Dental Health Services Victoria.

A database of neurologic complications exists as a result of a CIR system set up by the Department of Oral and Maxillofacial Surgery at the RDHM. Any surgical complications were documented as part of this system manually in the patient's records and electronically in a register and were assessed in a meeting held on a monthly basis. The team consisted of the head of oral and maxillofacial surgery, surgical trainees, nursing staff, and administrative staff. Each month, reported clinical incidents were discussed, the progress and outcomes were monitored, and strategies were developed to improve patient safety and to refine clinical guidelines. Insurers of the hospital also were informed of patients added to the CIR database.

Preoperative clinical and radiographic data were collected in an attempt to identify predictive risk factors for IAN and LN injuries. These included gender,