

## Minimizing the Injury of Inferior Dental Nerve During Removal of Lower Third molar: Systematic Approach

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### Abstract:

Worldwide, the presence of impacted third molar is often associated with significant morbidities that may range from soreness, pain, swelling, inability to open mouth widely & chew properly & impairment of the health of adjacent teeth to more serious complication like neck infection & emergence of certain pathologies like cysts & tumors. This wide range of clinical problem made the surgical removal of these teeth are the commonest oral surgical procedure. This procedure is associated with significant morbidity including pain & swelling, together with the possibility of temporary or permanent nerve damage, resulting in altered sensation of lip or tongue. This minireview will shed some light on the systematic approach may be considered to prevent or minimize the damage to the inferior dental nerve during such surgeries.

**Key words:** oral surgery, lower third molar, inferior dental nerve, nerve damage, coronectomy.

### المخلص العربي

التقليل من إصابة العصب السني السفلي أثناء إزالة الطاحون السفلي الثالث: مقاربة منهجية

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على مستوى العالم يقترن بحالة الطاحون الثالث المنضغط انتشار مرضي يظهر على شكل مرارة، وألم، وانتفاخ، وعدم قدرة على فتح الفم بشكل كامل، وكذلك عدم إمكانية المضغ طبيعياً، واعتلال عام في صحة الأسنان القريبة، إلى ما هو أخطر من التغيرات الصحية، كالتهاب العنق وابتلاع لأمراض مختلفة مثل الالتهاب والاورام الخبيثة. هذا الانتشار الواسع للظاهرة والمشكلة المرضية جعل من عملية خلع هذه الطواحن أمراً مألوفاً في العمليات الجراحية الفمية، المقرون بظواهر مرضية مثل: الألم والانتفاخ، مع احتمال ضرر مؤقت أو دائم للعصب؛ ينتج عنه احتياج شفتاني أو لساني. هذه الدراسة المختصرة تعد مقاربة من شأنها إثارة السبيل إلى المنع أو التقليل من الضرر اللاحق بالعصب الترسفي خلال عمليات جراحية من هذا النوع.

كلمات مفتاحية: جراحة فمية، الضرس الطاحون السفلي، العصب السفلي، العصب. عطب.

### Introduction:

The history of wisdom teeth problem is probably as old as the history of mankind. Using the modern digital radiography, a nearly complete 13,000 to 15,000 year old skeleton of the “Magdalenian Girl” was examined & showed the

presence of an unerupted lower wisdom tooth in a position prone to become impacted at estimated age of 25-35 years. This was claimed to be the oldest known recorded case of an impacted wisdom tooth (1)

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The lack of functional eruption of lower third molar (LM3) teeth is very common and often associated with wide spectrum and problems ranging from pain, soreness, infection to serious pathologies like emergence of cysts and tumors. This wide range of problems made the removal of wisdom teeth to be among the most frequently practiced procedure by dentist worldwide (2).

The indications for removal of LM3 are likely to remain the subject of debate. In some areas there is evidence for clear indication for removal, but it is important to recognize that these indications may be modified by the general health of the patient & local circumstances (3)

Surgical procedure for extraction of unerupted LM3 is associated with significant morbidity including pain & swelling, together with the possibility of temporary or permanent nerve damage, resulting in altered sensation of lip or tongue. There appears to be substantial variation in management & it has been reported that conservative treatment with more rigorous adherence to specific indicators for removal would reduce surgical case significantly.

### **Prevention and Minimizing the Injury to Inferior Dental Nerve:**

Damage to the inferior dental nerve (IDN) is a well-documented complication of surgical removal of deeply impacted LM3. Over the years, the reported frequency of IDN deficit after wisdom tooth surgery has ranged from 0.4% to 8.4% (4-6) Injury to the IDN may occur from compression of the nerve, either indirectly by forces transmitted by the tooth root during elevation or directly by surgical instruments like elevators. The nerve may also become transected by rotary instruments or during removal of a tooth whose root is grooved or perforated by the IDN.

The prediction of the risk of the IDN injury during the surgical removals of LM3 has been extensively investigated by many researchers through retrospective, prospective studies or through case series investigations. Tables 1 and 2 show the summary of these potential predictor markers. Assessing the LM3 for the potential of IDN during surgery is largely based on critical analysis of the preoperative radiological

investigations available for the surgeon. These may include plain intraoperative, panoramic views of the jaws, occlusal films, conventional CT scan or cone beam CT.

These radiographical risk predicting signs only indicate to surgeons that there is an increased risk of nerve damage associated with the removal of the corresponding wisdom tooth, but they cannot actually help prevent the nerve deficit if the tooth is bound to be removed.

The effective strategies that may prevent or minimize the risk of injury to IDN can be collectively categorized into two main groups. Preoperative and intraoperative strategies. preoperative group include the critical assessment for the need to remove the LM3, clinical examination and radiographical investigations. intraoperative measures may include the proper selection of local anaesthetic agent and injection technique, the modification of the surgical procedure and the measures considered to reduce the degree of the potential injury to the nerve.

### **Preoperative Strategies:**

Problems which may arise due to tooth impaction include pericoronitis, cheek biting, pressure on adjacent teeth causing pain, food impaction in the area, buccal or lingual eruption, pericoronal infection, caries, periodontal problems with associated teeth, and association with pathological lesions such cysts and tumors. All these problems may necessitate the removal of the wisdom teeth. However, prophylactic removal to avoid some of the above mentioned problems is often performed but it is a persistent source of discussion. the debate may be based on defining the state of tooth impaction as a mere pathological condition even in the absence of any associated morbidity. in order to minimise this controversy, many guidelines have been proposed by many international advisory bodies like the National Institute of Clinical Excellence (NICE), Royal college of Surgeons in UK, the British and American Association of Oral and maxillofacial Surgeons. Most of these guidelines indicate that Surgical removal of impacted LM3 should be limited to patients with evidence of pathology. Such pathology includes unrestorable caries, non-

treatable pulpal and/or periapical pathology, cellulitis, abscess and osteomyelitis, internal/external resorption of the tooth or adjacent teeth, fracture of tooth, disease of follicle including cyst/tumor, tooth/teeth impeding surgery or reconstructive jaw surgery, and when a tooth is involved in or within the field of tumor resection. Furthermore, the NICE guidelines suggested that specific attention should drawn to plaque formation and pericoronitis. Plaque formation is a risk factor but is not in itself an indication for surgery. The degree to which the severity or recurrence rate of pericoronitis should influence the decision for surgical removal of a third molar remains unclear. The evidence suggests that a first episode of pericoronitis, unless particularly severe, should not be considered an indication for surgery. Second or subsequent episodes should be considered the appropriate indication for surgery. Third molars have been postulated to be a cause for incisor crowding for more than 150 years. This concept is accepted by many oral surgeons and orthodontists, not to mention the public at large. Despite a great wealth of publications suggested that the teeth crowding is a complex and multifactorial, there no evidence of any available study designed to isolates the effect of third molars from all other factors that may be associated with crowding. Therefore, a cause and effect relationship between LM3 and dental crowding cannot be clearly established. American Association of Oral and Maxillofacial Surgeons guidelines suggested that clinicians should educate patients that the cause of dental crowding is multi-factorial and, while LM3 may play a significant role in some patients, the current state of knowledge does not allow us to identify with accuracy who is at risk. The dentist's decision to remove symptomatic and asymptomatic LM3 often relays on their prediction of the tooth eruption. Several factors have been proposed to play a role in determining the likelihood of eruption, including tooth angulation, degree of root development, depth relative to the occlusal plane,

size of the tooth, and the available space for eruption .The review of literature have identified following markers: **1)**The most significant variable associated with LM3 impaction is inadequate hard tissue space, **2)** The available space for eruption can also be measured from the occlusal surface to the occlusal plane using a variety of radiographic techniques, **3)** the radiological follow up studies indicate that the unerupted teeth can change position even beyond the middle of the third decade of life, and **4)** Eruption to the occlusal plane does not ensure proper periodontal support, that is, adequate osseous space does not guarantee adequate physiologic space for the maintenance of a tooth in good health (Reviewed in White paper on LM3 data AAOMS).

The dentist should consider all these factors critically before decide to go on to remove LM3. this will significantly avoid the removal of many of teeth the high risk potential to IDN injury as many of the later cases are usually totally asymptomatic.

The radiographical analysis of the impacted LM3 along with their anatomical surrounding cannot be overemphasized. the minimal radiological assessment of these should include a Panoramic film. the use intraoral radiograph is a common practice among general dental practioner and often fail to provide the necessary information about the exact relationship between the IDN canal and the roots of LM3. When feasible the surgeon may get the help of the increasingly available volumetric analysis using cone beam CT which can provide an accurate three dimensional anatomical relationship.

At the stage of obtaining an informed consent, all patients should receive a detailed description about the proximity of their LM3 to the IDN canal with the estimated risk of potential injury to the nerve during the planned surgery.

### **Intraoperative Strategies:**

The operative measures considered to minimize the injury to the IDN should start at the local

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anesthetic step rather than the operative surgical procedure. This stage is often underestimated by most of dentists and surgeons. the last decade has shown sufficient evidences in literatures suggested a significant risk of damage to both IDN and lingual owed to the IDN block anaesthesia. the injury may be related to the pharmacological properties of the medicine itself or to the injection technique.

#### **Local Anesthetic agent-related injury:**

The literature suggest that the IDN may get permanently injured during block anaesthesia. The reported incidence varies from a high of 1 in 20,000 blocks to a low of 1 in 850,000 blocks (7,8). Studies appear to show that when nerve damage occurs, the lingual nerve is affected approximately twice as frequently as the inferior alveolar nerve, and one suggested reason for this may be the fascicular pattern in the region where the injection is given. It also appears that about half the patients feel an “electric-shock sensation” on injection, but approximately half do not (7).

The phenomenon has been noted with every local anesthetic used in dentistry, but it has been suggested there may be a higher incidence with articaine and prilocaine. Although the reason for this is unknown, suggestions have been made that it may be because they are 4 percent solutions, whereas the other local anesthetics are at lower concentrations. however, Haas and Lennon suggested that local anaesthetic formulations may have the potential for neurotoxicity, in particular articaine 4% and prilocaine 3–4%. Experimentally, neurotoxicity has been demonstrated to induce loss of conductivity and structural changes after intrafascicular microinjection of local analgesic solutions of concentrations used in current clinical practice (9).

#### **Mechanical Needle Injury:**

It has been claimed that needle contact with a nerve felt by the patient as an ‘electric shock’ is related to injection injury. on other hand some investigation suggested an incidence of ‘electric shock’ of 7% in a prospective study looking at injection-related nerve injuries, and it was argued that ‘electric shock’ is not an etiological factor

since no patients in this group suffered a nerve injury, temporary or permanent (10). supporting the same notion other found no difference in the severity of nerve injury with or without the experience of an ‘electric shock’ (9).

By an obvious explanation, the chance of mechanical injury to the nerve is likely to be higher in case of multiple repeated attempts of IDN block. So it is crucial that operator is able to achieve an optimal pain control with minimal episodes of injection along with administration of the minimally required anesthetic agent. finally it should be clear that articaine solution should not be administered in close proximity of nerve trunk as in block anaesthesia.

#### **Surgical Procedures:**

The surgery should be planned based on the information obtained from the preoperative assessment process. The modification of surgical procedure should aim to minimize the manipulation around the IDN canal. These measures include the careful planned access, tooth sectioning and elevation techniques. In many scenario the removal of the whole tooth may carry an unavoidable risk of injury to the nerve, therefore intentional retaining of part of the tooth have been proposed via a planned procedure introduced around 15 years ago called coronectomy.

Coronectomy is the removal of the crown of a tooth, leaving the root “in situ.” When applied LM3 or any unerupted posterior tooth in the mandible, it is a measure adopted to avoid damage to the IDN. With enormous growing support, this new technique is advocated although many surgeons have expressed resistance to the adoption of this treatment alternative as it is contrary to the dogma of exodontia. This resistance may be explained by the lack of long term follow up, in particular with regard to the potential risk of an intentionally retained root. many surgeon worry that the roots may become a source of infection, leading to an apical periodontitis following pulp necrosis, which could spread to the inferior alveolar canal given the root proximity and may necessitate additional surgical interventions. Following are the summaries of



some of key report on the current coronectomy for the LM3.

Pogrel et al (11), forty-one patients had **50 LM3** treated by coronectomy. There were no cases of IDN damage; there was however one case of transient lingual nerve involvement, probably due to lingual retractor use. Only one patient required subsequent removal of the roots of both lower third molars because of failure to heal, and one patient required subsequent removal of a root because of subsequent migration to the surface. Root migration was noted in approximately **30%** of patients over a **6** month period.

O’Riordan (12) conducted a retrospective study of 52 patients who were operated over a **10** year period. **3 of 52** patients had to have the roots removed subsequent to the coronectomy procedure due to pain or infection. Neural complications included **3** cases of temporary sensory disturbance of the lower lip which the author attributes to pressure transmitted to the nerve when splitting the crown from the root, or a slight elevation of the root when splitting. One case of prolonged anesthesia of the lip was noted, due to bur damage.

Another prospective randomized study by Renton et al (13) reported **128** patients requiring operations on mandibular third molars which had radiographic evidence of proximity to the inferior alveolar canal nerve. Patients were randomly assigned to either the extraction [**n = 102**] or the coronectomy [**n = 94**] group. Some roots were dislodged during intended coronectomy and were therefore removed, resulting in two subgroups (successful coronectomy **n = 58**, and failed coronectomy **n = 36**). Nineteen nerves were

damaged (**19%**) after extraction, none after successful coronectomy, and three (**8%**) after failed coronectomy (**p = 0.01**). The incidence of dry socket infection was similar in the three groups (**10/102, 10%, 7/58, 12%, and 4/36, 11%**, respectively). The incidence of acute localized osteitis was found in **10–12%** in all groups. Follow up of the coronectomy procedure after **13** months showed five root segments had started to migrate.

In summary coronectomy is an alternative procedure that shown a significant reduction in the incidence of injury to IDN in high risk case of impacted LM3. the technique require a meticulous explanation of the procedure to patient and good planning as not all cases are suitable for this the procedure. The contraindication include; **1)** Carious or teeth with active infection around them, particularly infection involving the root portion, **2)** Teeth that are mobile because it might be felt that the roots may act as a mobile foreign body and become a nidus for infection or migration, **3)** Teeth that are horizontally impacted along the course of the inferior alveolar nerve may be unsuitable for this technique because sectioning of the tooth itself could endanger the nerve, **4)** patient undergoing mandibular orthognathic surgery. Figure 1 show a classical example of coronectomy.

In conclusion the risk of the injury to IDN during LM3 surgery can be significantly reduced through appropriate patient assessment and planning of the surgery considering the alternative techniques like coronectomy when indicated.

**Table 1. Overall Risk Factors for IDN injury**

<b>1. Full bony impactions.</b>
<b>2. Horizontal impactions.</b>
<b>3. Use of burs for removal.</b>
<b>4. Radiological risk markers.</b>
<b>5. Clinical observation of the bundle during surgery.</b>
<b>6. Excessive hemorrhage into the socket during surgery (presumably, this can cause pressure on the nerve, and the resulting clot organization and fibrosis may cause additional nerve damage).</b>
<b>7. The age of the patient.</b>

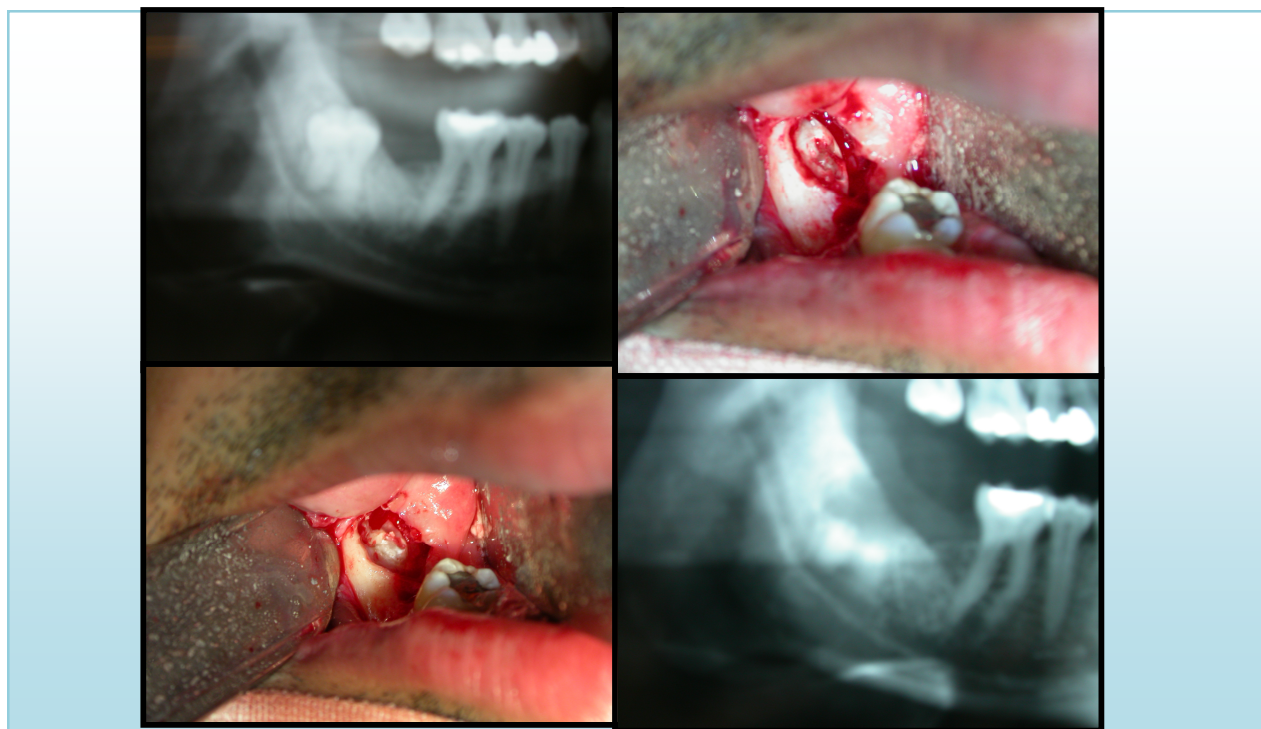
**Table 2. Radiological Signs Predicting the Increased Risk of IDN Injury**

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1. apices of the LM3 located inferior to the lower border of the inferior dental canal
2. Darkening of the root
3. Abrupt narrowing of the root
4. Interruption and loss of the white line representing the inferior dental canal
5. Displacement of the inferior dental canal by the roots
6. Abrupt narrowing of one or both of the white lines representing the inferior dental canal



**Figure 1.(clockwise) the preoperative radiograph for LM3 with close proximity to IDN canal, the operative procedure of coronectomy and finally the 3 week post operative radiograph showing the internationally retained roots (Courtesy: Tara Renton).**

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