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4 Safe Technique for Extraction Impacted Third Molar Related To Inferior alveolar nerve (IAN)

"A project submitted to the scientific committee of the Department of Oral and Maxillofacial Surgery, College of Dentistry, University of Babylon , in partial fulfillment of the requirement for the B.D.S. degree"

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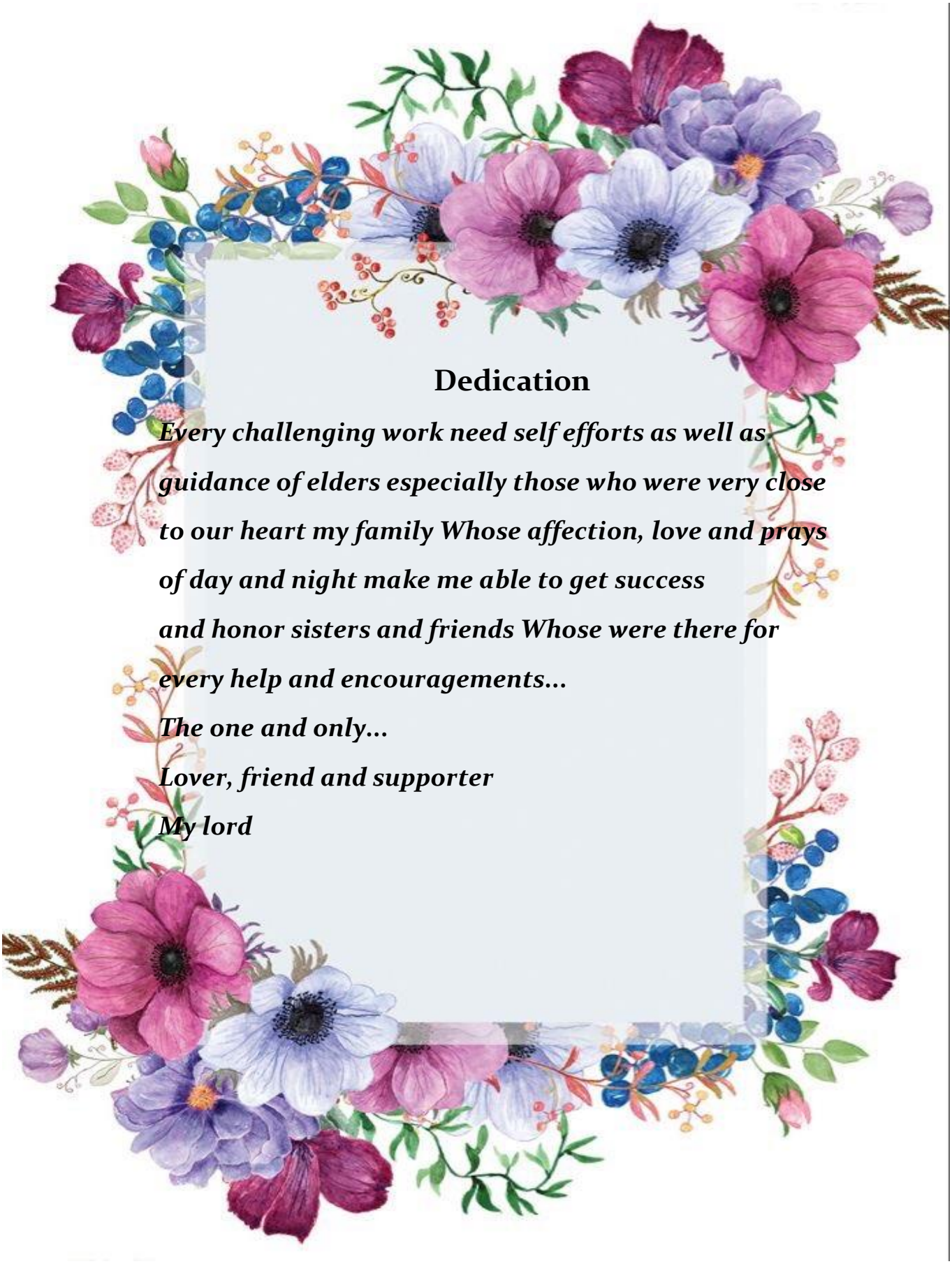

Dedication

Every challenging work need self efforts as well as guidance of elders especially those who were very close to our heart my family Whose affection, love and prays of day and night make me able to get success

and honor sisters and friends Whose were there for every help and encouragements...

The one and only...

Lover, friend and supporter

My lord

Supervisor Certification

This is to certify that this undergraduate dissertation entitled" Extraction Impacted Third Molar Related To IAN ((4 safe techniques))" was prepared by the undergraduate students Tabarak Adil ,Zainab Sattar ,Ghadeer Salim ,Aseel Salam , Duha Hamoud ,under my supervision at the College of Dentistry /University of Babylon as partial fulfillment of the requirements for B.D.S degree.

Supervisor's signature

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First praise to Allah the lord of the universe , peace in upon our prophet Mohanmmed the messenger of Allah and upon his Relatives.

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Abstract

Throughout the evolution, modern diet became softer and led to less attrition and less mesial migration of teeth resulting in an increased incidence of teeth impaction.When a mandibular third molar extraction is indicated , damage to the inferior alveolar nerve ((IAN)) is one of the most important complications . The objective of this review is to provide an overview of the alternative treatment modalities to total removal for a third mandibular molar in cases of proximity to the inferior alveolar nerve . Among the discussed options are: Coronectomy which include removing of the tooth crown while leaving the root undisturbed ; staged approached involving removal of the mesial portion of the crown creating a space for mesial migration of the teeth ; Orthodontic intervention to slowly move the tooth apex away from the mandibular canal and thus reducing the potential for neural injury during extraction; Protocol for Removal of Third Molar Root Tips from the Inferior Alveolar Canal Crossing the line ; and bone lid technique

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Introduction

Third molars , wisdom teeth , can be anatomically superfluous in the human anatomy and be considered for extraction [1] . In some patients the tooth apex may be located in close proximity , or actually in , the mandibular canal . The canal contains the inferior alveolar nerve , artery and vein and thus may incur damage during the removal of such a located molar. The actual occurrence of nerve injury is low but this can be the cause of neural sequelae and lawsuits against the surgeon [2,3] . Third molar removal is controversial because of the question of physiologic necessity for removal of these teeth . There are also economic and quality of life issues for patients and society . These issues should be discussed with the patient before third molar surgery . Diagnoses that may indicate third molar removal include recurrent pericoronitis and angular impaction against the cementoenamel junction of the second molar . The classifications of third molar impactions are based on radiographic appearance :vertical ,horizontal mesioangular , distoangular ,buccolingual [4,5] . Mesioangular position may be the most common impacted position [6] . Advanced age , increased operative time and distoangular and horizontal preoperative impaction position are associated with mandibular third molar surgery post operative morbidities [7].

Surgical removal of third molars is associated with postoperative pain,swelling and trismus.Parameters associated with complications are age , gender , significant medical history , oral contraceptives, pericoronitis , poor oral hygiene , smoking , position of impaction, relationship of third molar apex to the mandibular canal, increased surgical time , surgical technique used , surgeon's experience, perioperative antibiotics , topical antiseptics , intra-socket medications , and anesthetic technique , a localized alveolar osteitis, postoperative infection , hemorrhage , oro-antral communication, damage to the adjacent teeth, displaced teeth, and bone fracture [8].

Common oral surgery complications

- Edema

- Bleeding

- Infection

- Graft Rejection

They are all reversible and preventable by medication and good technique **except** nerve injury like lingual and inferior alveolar nerve injury

Nerve injury

The surgical removal of lower third molars endangers both the lingual and inferior alveolar nerves. Patients sustaining an injury to either of these nerves must be managed correctly, and this requires a diagnosis of the injury type and regular monitoring of the recovery of sensation [9].Surgical intervention for a damaged inferior alveolar nerve is not usually indicated but may be undertaken: if the nerve is completely divided and the severed ends are misaligned; if a bony fragment has compressed the mandibular canal ; or if the patient suffers from persistent neuropathic pain. In contrast, after injury to the lingual nerve, if sensory testing demonstrates no neural recovery within 3-4 months , exploration of the injury site and microsurgical repair of the damaged nerve is indicated[9].Impacted mandibular third molar teeth are in close proximity to the lingual , inferior alveolar , mylohyoid and buccal nerves . During surgical removal, each of these nerves is at risk of damage, but the most troublesome complications result from inferior alveolar (IA) or lingual nerve injuries[9] . The majority of injuries result in transient sensory disturbance but , in some cases , permanent paraesthesia (abnormal sensation) , hypoaesthesia (reduced sensation) or, even worse , some form of dysaesthesia (unpleasant abnormal sensation) can occur (**Table 1**)[9]**.**

These sensory disturbances can be troublesome causing problems with speech and mastication and may adversely affect the patient's quality of life . They also constitute one of the most frequent causes of complaints and litigation [9]. It is therefore imperative that patients sustaining nerve injuries are managed correctly, and this includes correct diagnosis of the type of injury, monitoring recovery ,and the treatment of appropriate cases [9] .

Table 1. The most troublesome complications result from inferior alveolar (IA) or lingual nerve injuries	
Anaesthesia	Absence of all sensory modalities.
Hypoaesthesia	Diminished sensitivity to stimulation , excluding special senses.
Paraesthesia	An abnormal sensation , whether spontaneous or evoked .
Dysaesthesia	Unpleasant abnormal sensation, whether spontaneous or evoked.
Hyperalgesia	An increased response to a stimulus that is normally painful.
Allodynia	Pain due to a stimulus that does not normally provoke pain.

Operations on mandibular third molars are common and are complicated by temporary injury to the inferior alveolar nerve in up to 8% and permanent injury in under 1% of cases [10,11] . Fortunately , Within 4 - 8 weeks after surgery 96% of nerve injuries recover completely ,

Whereas 4% of nerve injuries recover during 6 months after surgery or continue during life (permenant nerve injury)[12].

Relationship between the tip of root & inferior alveolar canal

The relationship between the tip of the root of the impacted lower third molar and inferior alveolar canal in panoramic radiographs was divided into four types according to a previous report 9 with some modifications [13]

type I: the tip of the root has no contact with the wall of the inferior alveolar canal,

type II: the tip of the root just contacts the upper wall of the inferior alveolar canal,

type III: the tip of the root is located in the inferior alveolar canal, and

type IV: the tip of the root is located inferior to the lower wall of the inferior alveolar canal **(Fig. 1).**

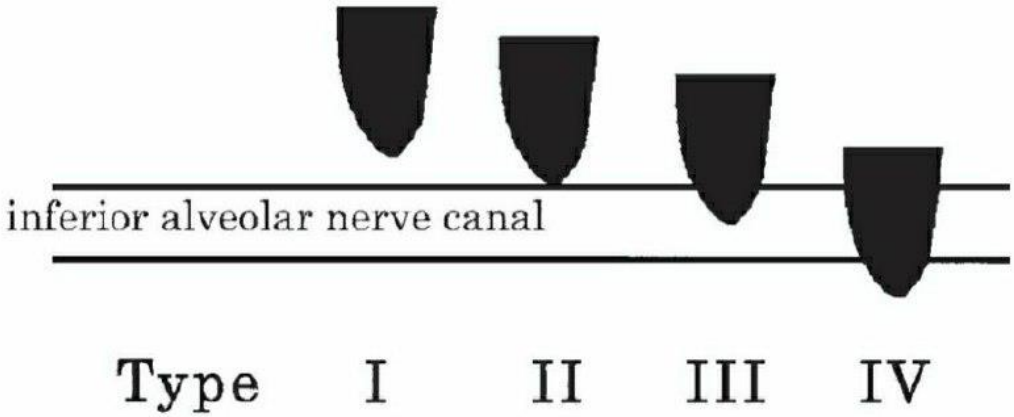


Fig. 1 The relationship between the tip of the root of the impacted lower third molar and the inferior alveolar canal in panoramic radiographs.

In general , when using the usual technique for each of these cases, the percentage of nerve injury appears as follows

- If usual technique was used for 3molar extraction in case " safe distance between root of 3molar and IAN or mandibular canal , No chance of nerve damage will occur
- Or in case " contact No fenestration " , the use of the usual technique is possible , but there is little chance of injury to the nerve
- While in case " Fenestration of upper cortex " there is a 30 % chance of injury to the nerve in using of usual technique

There are Rood and Shehab's seven signs

- ✓ If one of them exists , 63% of the cases have contact with fenestration
- ✓ If two or more of them exists , 99% of the cases have contact with fenestration

In both of cases CBCT is required [14]

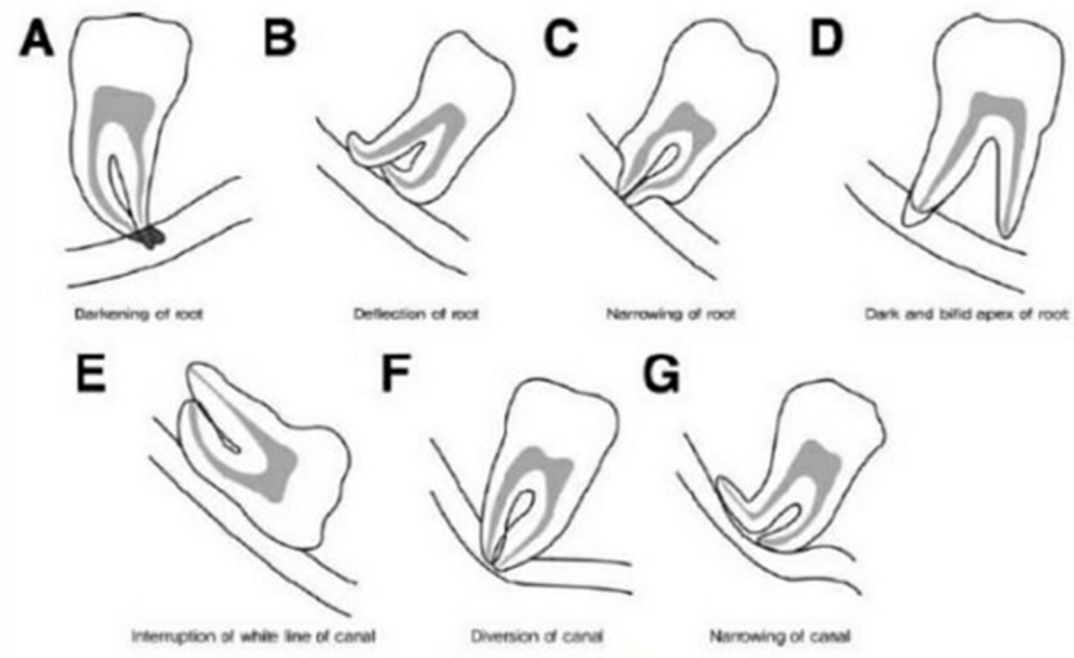
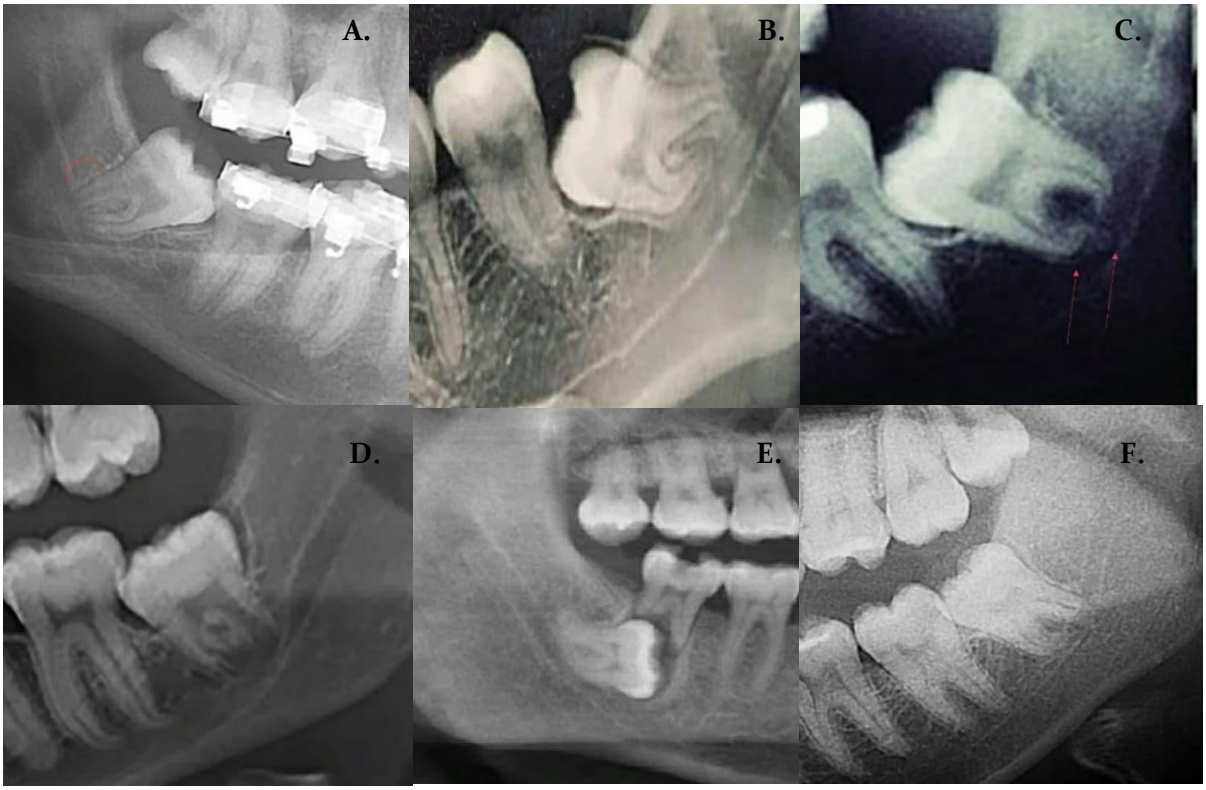


Figure 2. Rood and Shehab's seven signs



(Figure 3. A. Darkening of root B. Deviation of root C. Bifidity of root D. Narrowing of canal E. A bsence of upper white line F. 2 signs " root darkening + deviation of canal ")

Assessment of Roods and Shehab criteria if one or more radiological signs are present in orthopantomogram using cone beam computed tomography : a radiographic study

Damage to inferior alveolar nerve (IAN) can manifest as transient sensory disturbances such as paresthesia, hypoesthesia, dysaesthesia ,and sometimes prolonged anesthesia [15-18]. Incidence of transient sensory disturbance ranges from 0.4 to 6% and 0.2 to 1% for permanent damage [15,16] . Injury to the nerve can occur directly by surgery if the nerve is placed buccally or high up in deeply impacted teeth [19] .

Nerve can get injured indirectly , during unfavorable movements of the third molar roots during luxation of the tooth in apical, buccal or lingual directions [20].Sometimes there is direct grooving of the root by the nerve which increases the nerve injury if the tooth is removed. Therefore the risk increases when there is close relation between the nerve and the root of the tooth [16,21] The topographic relationship of the third molar root apices and mandibular canal should be evaluated to reduce IAN injury. The topographic relation is evaluated using different imaging techniques.

Orthopantomogram (OPG) is one of the widely used techniques. According to Roods and Shehab various radiographic markers are present in OPG indicating close relationship between the third molar and the mandibular canal , for example darkening of root, deflection of root , narrowing of root, bifid root apex, diversion of canal, narrowing of canal, and interruption of white line [14,22] . It is a common consensus that OPG provides limited information. The buccolingual relationship between the inferior alveolar canal and the third molar cannot be evaluated [23]. It has limited accuracy in determining the number of roots and root morphology.

Conventional computed tomography (CT) has also been used to verify the relationship between the third molar root apices and the mandibular canal [24- 27]. The drawbacks of CT are higher radiation dose and increased financial costs [25-28]

Cone beam computed tomography (CBCT) has recently been introduced as a valuable diagnostic method [20,29]. It has been suggested for examination of the mandibular third molars as it provides detailed information about the position and course of the mandibular canal [20,29] . Compared to conventional CT , CBCT presents short scanning time and radiation dose up to 15 times lower [30].

The Safe techniques for extraction M3molar

Firstly , Coronectomy of mandibular third molar

The technique of coronectomy, or deliberate vital root retention,has been proposed as a means of removing the crown of a tooth but leaving the roots, which may be intimately related with the inferior alveolar nerve , untouched so that the possibility of nerve damage is reduced[31].Coronectomy was first described by **Ecuyer and Debien in 1984** as an alternative procedure to traditional extraction of third molars . Several reports have been published since regarding the technique , indications , efficacy , and outcome of this procedure. Most recently , it has been investigated as an alternative to traditional surgical extraction of third molars, particularly for those with an increased risk of damage to the inferior alveolar nerve (IAN) . Several studies have demonstrated that coronectomy does significantly decrease the risk of iatrogenic injury to the IAN, with some studies also suggesting a lower complication rate . **O'Riordan,** in a study of 100 patients , showed that the risk of subsequent infection was minimal and morbidity was less after coronectomy than after the traditional operation . Over a period of 2 years some apices migrated and were removed uneventfully under local anesthesia . On the premise that coronectomy reduces the risk of nerve injury, it has been recommended for those patients for whom there is great risk of nerve injury[32].**Pogrel et al** evaluated forty one patients who underwent coronectomy on 50 lower third molars with follow - up of at least 6 months . This technique was used because there was radiographic evidence of a close relationship between the roots of the tooth and the inferior alveolar nerve. The authors reported that there were no cases of inferior alveolar nerve damage in this study . **Renton et al** evaluated 128 patients who required operations on mandibular third molars and who had radiological evidence of proximity of the third molar to the canal of the inferior alveolar nerve. Patients were divided in two groups: extraction group (102 teeth) and coronectomy group (94 teeth). The mean follow - up was 25 months.

The authors reported that 19 nerves were damaged (19%) after extraction and none after coronectomy . **Hatano et al** compared coronectomy with traditional extraction on 220 patients, 118 in the extraction group and 102 in the coronectomy group . The mean follow - up time was 13 months in the extraction group and 13.5 months in the coronectomy group . Six inferior alveolar nerve injuries (5%)were found in the extraction group.In the coronectomy group,1 patient (1%) had symptoms of nerve injury . In the study of **Leung and Cheung**, nine patients in the extraction group (n = 178) presented inferior alveolar nerve deficit, compared with one in the coronectomy group (n = 171) . The follow - up of the study was 24 months [33] . Root canal treatment is not indicated during coronectomy . **Sencimen and colleagues** found that patients having coronectomy with root canal treatment had a much higher infection rate than those patients who underwent coronectomy without root canal treatment . Seven of the 8 patients undergoing root canal treatment developed postoperative infections , whereas only 1 of 8 patients in the control group developed an infection . The investigators suggested that mobilization of the root during root canal therapy and / or prolonged procedure time may contribute to the higher infection rate in the study group . In a study published in April 2012, discussed the technique of coronectomy in a 50 year old patient with previous episodes of pericoronitis . As shown on the cone beam computed tomography (CBCT) , the third molar root was in close proximity to the inferior alveolar nerve (IAN) . Here, the authors highlight some surgical steps of the protocol that are crucial to the final clinical result . Following this surgical protocol, the authors have performed 85 coronectomies without any instances of intra operatory failure after nearly 2 years of follow up . the authors reported on 43 coronectomies of inferior third molars that present 2 year follow-up [34] .

Among these patients, two patients underwent a second surgery to remove the previously sectioned roots—after 10 months and 1 year, respectively . Prior to the second surgery , the first patient complained of intermittent pain; the other patient was completely asymptomatic . In neither case were there neurological injuries to the patient as a result of removal of the root fragments, because the root fragment had migrated from the mandibular canal. During the follow-up period, none of the patients reported fever. Alveolitis was reported in only one coronectomy ; it occurred 15 days after the surgery. This case was treated with antibiotic therapy, after which the patient did not report any further complications. The authors strongly believe that the ability and the surgical experience of the operator is crucial to the final outcome [34] .

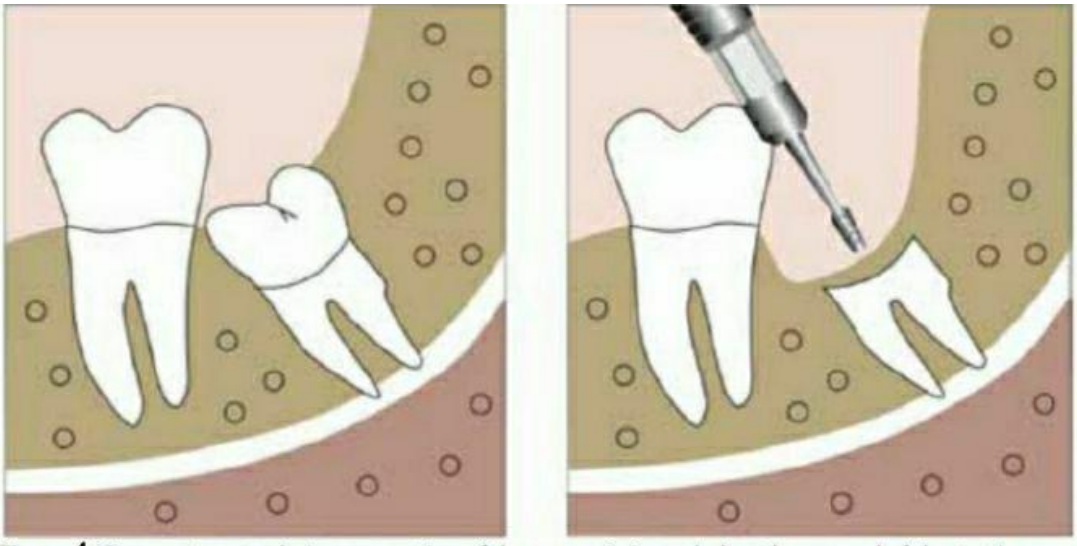


Figure 4. Coronectomy technique: resection of the crown 2–3 mm below the enamel of the tooth.

Clinical Protocol

1. Diagnosis

Coronectomy should be planned after a CBCT radiograph confirms the actual proximity between the third molar roots and the alveolar nerve. Real proximity is defined as the absence of the cortical wall of the mandibular canal and the existence of an effective contact between the root and nerve . Note : Coronectomy cannot be performed if the third molar presents with deep caries. [34]

2. Pharmacologic Therapy

The patient received antibiotic prophylaxis (2 g of amoxicillin in tablet form) 1 hour before surgery and postoperatively for 4 days (1 g every 8 hours). Starting the day after surgery , the patient rinsed twice a day with 0.2% chlorhexidine for 10 days. For postoperative pain,the patient was prescribed an anti-inflammatory agent: 600 mg of ibuprofen , two tablets daily. [34]

3. Flap Design

When the tooth is partially impacted, in order to obtain a primary closure of the wound it is advisable to perform a triangular flap with a mesial releasing incision distal to the second molar . In this circumstance, the releasing incision is not repositioned, and the flap is sutured to the lingual side to obtain the closure.

In the case of a completely impacted tooth, it is easier to obtain a primary wound closure because there is sufficient gingival tissue, and the surgeon can choose either a triangular or envelope flap. [34]

4. Osseous Surgery

After flap reflection, the ostectomy should be minimal to avoid the risk of root mobilization during crown resection. When the third molar is in the vertical position, it is possible to perform the crown resection without any osseous surgery. [34]

5. Crown Resection

When the third molar is in a vertical position, the surgeon can use a fissure bur at an approximately 45° angle to obtain a superficial lingual cut 2 mm to 3 mm below the bony margin. With this mesio–distal dissection the surgeon avoids totally transecting the crown to the lingual plate in order to prevent injury to the lingual nerve. A second dissection in the bucco–lingual direction is advisable to obtain two small fragments , which can be gently removed with a tissue forceps. [34]

If the third molar is in a horizontal position , it is necessary to perform more osseous surgery to visualize the crown that is sectioned in a bucco–lingual direction and in a mesio–distal direction . In this case, the crown section is similar to the protocol adopted for complete extraction . In cases of root mobilization, during crown dissection, the root should be extracted because the mobility can easily lead to infection of the alveolus.

After the crown removal , the third molar root is reduced using a round bur in a high-speed surgical drill so that the remaining root fragments are at least 3 mm to 4 mm below the crest of the lingual and buccal plates.

The exposed dental pulp is irrigated with saline solution and no endodontic treatment is necessary. Before suturing , a periapical radiograph should be taken. [34]

6. Postoperative Follow-Up

In the study published,1 the authors reported that patients who had undergone coronectomy did not experience more pain in the postoperative week than ones treated with complete extractions.

The first follow - up radiograph should be taken 3 months after surgery. The clinical protocol tested at the Oral Surgery Department of the University of Bologna provides a periapical radiograph at 3, 6, and 12 months and twice annually for the following 4 years.

In young patients (≤ 26 years) , the risk of root migration is higher and more common in the first 3 months. At 6 and 12 months, root migration decreases because bone apposition coronal to the root fragments inhibits root movement. If the root migration occurs, it usually indicates bone regeneration at the distal surface of the second molar , as in orthodontic - assisted extrusion.

Root migration may also cause the eruption of the root fragments in the oral cavity . In these cases , the extraction is uncomplicated because there is no proximity to the inferior alveolar nerve and the roots are mobile. [34]

Michael Leizerovitz & Olga Leizerovitz introduced the modified and grafted coronectomy method (MGC), describes the measures to prevent or minimize the known drawbacks of the standard coronectomy

Indications

Coronectomy should be considered if there are signs that the patient is at a high risk of nerve damage during extraction:

- Lower wisdom tooth is shown to be close to the inferior alveolar canal radiographically : [35]
    - Signs of narrowing or diversion of the canal
    - Roots are darkened / Canal is interrupted
    - Interruption of lamina dura
    - Juxta-apical region on the radiograph [35]
- Not medically compromised [35]
- Tooth vital , caries/pathology free and non-mobile [35]

Contraindications

- Non -vital tooth
- Tooth is mobile or becomes mobile during procedure
- Tooth is horizontal or distoangular impacted
- Medically compromised patients. e.g immunocompromised
- Patients who are predisposed to local infection for example if they have undergone radiotherapy in the area they may have poor healing [35]
- Caries or persistent infection [35]

Other local factors excluding coronectomy are patients scheduled for an osteotomy in future. Patients excluded for systemic reasons from undergoing coronectomy include immunocompromised patients (chemotherapy , AIDS , radiation therapy , immuno-modulating drug therapy , and so forth), poorly controlled diabetics , and those patients who are to undergo radiation therapy. [36]

Advantages

Prevents potential neuropathy [37]

The risk of altered sensation is significantly lower than convention surgical removal of mandibular third molars with 8% of the cases affected temporarily and 3.6% of the cases got permanently affected. 30% of the roots will migrate post-coronectomy, erupting away from the inferior alveolar canal. This makes extraction of the remaining roots safer .

Disadvantages

There is a 5% chance of failure of coronectomy, the root will become mobilized during transection.[38] In 5% of the cases, follicle remnants will form deep periodontal pockets which will lead to infection [38]

Post operative complications

Early

If the patient presents with dry socket, irrigate with chlorohexidine mouthwash and place resorbable dressing such as Alvogyl. If the patient has recurrent infection, consideration to remove the roots should be noted.

Late

In a few cases the remaining roots may erupt which can minimise the morbidity of the inferior alveolar nerve , however the roots may be in close contact to the inferior alveolar nerve requiring surgical separation [35]

Secondly Staged extraction Technique

A staged surgical extraction was proposed by **Landi et al.** [39] This technique means that the anatomic crown was partially sectioned and the sectioned part removed (surgical removal of the mesial portion of the anatomic crown of third molar) without exposure to pulp , This approach create adequate space for mesial third molar migration . After the migration of the M3 had taken place, the extraction could then be accomplished in a second surgical session minimizing neurological risks.

Procedure

the patient under local anesthesia (articaine with epinephrine, 1:100,000) (Ubistesin; 3MESPE, Seefeld, Germany) , a hockey stick-shaped full-thickness flap was designed and raised to expose the impacted tooth . Ostectomy was carried out with carbide and diamond burs to obtain access to the tooth. Then, by use of a fissure bur , the anatomic crown was partially sectioned and the sectioned part removed. Care was taken to avoid pulp exposure. At this point, the distance between the distal aspect of the second molar and the mesial aspect of the sectioned impacted tooth was measured and recorded to monitor the degree of migration of the mandibular third molar. Before closing, a periapical radiograph of the area was obtained as a reference . Single interrupted resorbable No. 5-0 sutures (Vicryl; Ethicon, Somerville, NJ) were used to close the flap. An anti-inflammatory drug (400mg of ibuprofen 3 times daily) was administered at the end of the procedure for pain management. The patient was instructed to rinse twice a day for the rest of the week with 0.2% chlorhexidine. Healing was uneventful, and a week later, the sutures were removed. A monthly check-up was scheduled for the first 3 months.

At the 3-month visit ,a new periapical radiograph was obtained ,The mandibular third molar had already reached the distal aspect of the second molar . Radiographically , mandibular third molar had reached a safe position with respect to the IAN, A riskless surgical extraction was then done

If there was not enough clearance between the alveolar canal and root apex . performing second sectioning of the third molar is decided to allow further migration . With the patient under local anesthesia limited flap was raised without a vertical releasing incision and a further portion of the residual crown was cut away. Pulpotomy is necessary if the pulp is exposed and the chamber access was sealed with a temporary filling material (Coltosol; Coltene Whaledent , Langenau , Germany). The flap was then sutured back , and a radiograph was obtained . Two months later, another periapical radiograph was obtained , and at that time, the mandibular third molar had reached a safe position with IAN then the conventional extraction is done without any neurologic consequences

Indication

1. in the case of horizontal or mesially inclined 3molar impaction

2. when radiographic evidence of the proximity of the third molar roots to the IAN is confirmed on a computed tomography scan

3. when the crown of the third molar is in contact with the distal aspect of the second molar

4. if an established pathologic process is detectable in the area of impaction (caries or deep periodontal defect) that indicates the need for third molar removal

5. preferably (but not exclusively) in young patients

6. whenever orthodontic-assisted extraction may be very complex to apply [39]

Advantage

This way reduces Inferior Alveolar Nerve injury risk

Disadvantage

the main drawback of this technique is subjecting the patients to 2 or more surgeries and to surgical morbidities such as pain, swelling, and wound infection . It was also mentioned that when the pulp of the third molar is exposed, pulpotomy has to be performed and the pulp was sealed with a temporary filling. [33,39]

Complications

After the extraction of an impacted third molar, once the short-term complications and side effects (e.g, swelling, pain) had occurred, In addition , postoperative tooth hypersensitivity induced by the odontectomy should be taken into consideration as a potential complication , the area might not require a specific follow - up protocol and no long - term complications would be anticipated except those related to the second molar that may require either periodontal or restorative interventions [39]

Thirdly Orthodontic extrusion

Injury of the IAN is of most concern for surgeons. Sometimes, it is unavoidable and most likely to lead to legal disputes between doctors and patients **(Giulio et al., 2007 , Srinivas et al., 2003) .** In order to avoid this severe complication, especially lower impacted third molar close to the mandibular canal , there are different orthodontic techniques have been developed . each of these techniques has orthodontic anchorage . Three types of orthodontic anchorage appliances were reported in the publications , they are teeth anchorage unit , removable orthodontic appliances and temporary anchorage devices (TADs) or miniscrews [40]

"Orthodontic extraction" (**Checchiet et al. 1996, Marchetti et al. 2004 , Alessandri Bonetti et al. 2007**) is a combined orthodontic–surgical approach for extracting impacted mandibular third molars that are in close contact with the mandibular canal , orthodontic anchorage prepares firstly , then surgical crown exposure is needed before orthodontic extrusion , when the root / roots of third molar are set apart from the mandibular canal ,the extraction would be quicker and riskless . **Bonetti et al . 2007** used orthodontic extraction to treat more than 80 patients without complications. **Bonetti et al** used the mesial adjacent teeth as anchorage . **Albena Gencheva et al.** modified the **Bonetti et al**.technique,used standard orthodontic ring placed on tooth 47 with soldered bar and a wire ligature.**Yong Wang et al.** used two orthodontic surgical techniques : one is using orthodontic brackets and hooks on the maxillary teeth (molars) as anchorage unite ; the other is using temporary anchorage devices (TADs) or bone mini screws ,They set TADs between the upper second and third molar, the elastic traction was directly attached to the TADs . However , TADs at the maxillary dentition , even at the maxillary tuber , could not provide an enough distal force , thus the mesial part of the crown of M3 should always be cut off .**Hirsch et al , Flanagan et al** also used antagonist maxillary teeth as anchorage unite . **Park et al** introduced TADs (orthodontic miniscrew) installed between the mandibular second premolar and the first molar to strengthened the teeth anchorage unit or to offer the anchorage needed to apply orthodontic forces to extrude the lower 3 molar.

There is another study called Two-stage Method for the extraction of a horizontally impacted lower third molar was developed by **Yasutaka Kubota at el .** During the first stage, only The crown of the impacted third molar was cut off from the root , and a surgical screw was inserted vertically into the root . An elastic band was then placed between the screw and the continuous loop wire that firstly was performed on the medially located first and second molars . Thereafter , the root (s) was pulled toward the anterior direction with an elastic band at 130–150 g over a 7-day period . Next , the root(s) was extracted. This method was firstly attempted for 20 horizontally impacted lower third molars , the roots of which had been close to the mandibular canal in panoramic radiographs and were pulled for 20.8 ± 11.5 (n = 20) days . The roots in 17 of 20 cases (85%) were loosened from the sockets and extracted easily without any complications. These outcomes suggest that this two stage method is useful for the extraction of a horizontally impacted lower third molar in order to decrease the rate of inferior alveolar nerve injury. A another present study has proposed "novel orthodontic extraction method with a removable appliance" to avoid inferior alveolar nerve (IAN) injury during impacted mandibular third molar removal . **Zhiqiang Wang et al.** introduced removable appliance received support from the maxillary dentition , a buccal arch with a hook end was fixed on the appliance .The limitations of the teeth anchorage unit and removable appliance are uncomfortable **Yanjie Bai et al.** used TADs, ((miniscrews)) were applicated at the mandibular ramus for orthodontic extrusion of the high risk impacted third molar.

Disadvantages

Most of the previous authors mentioned that these techniques of orthodontic extrusion , though very effective in reducing the risk of paresthesia , is time -consuming , is more expensive , and may not be well tolerated by the patient . The orthodontic device is applied in an area of the mouth that is very difficult to access, and it may cause compression and ulceration of the neighboring tissues with a certain degree of discomfort , sometimes patients also need frequent follow ups to untie, reshape and reactivate the cantilever every 4–6 weeks before the tooth is ready to be extracted , this technique may need an orthodontist to design and put a special bar on the tooth to control the direction of traction.

Fourthly , Protocol for Removal of Third Molar Root Tips from the Inferior Alveolar Canal Crossing the line

Rohit Punga and Kiran Keswani introduced a simple novel technique which can be used to remove third molars showing evidence of proximity to IAC on presurgical radiographic evaluation ,as well as those root tips which, during removal, accidentally enter the IAC space. **Rohit Punga** has been practicing this technique and has been successfully able to remove third molar root tips with this method which on presurgical evaluation presented with signs of proximity. There have been only 2 incidents of nerve injury in terms of partial anesthesia of the lip and alveolus , the first recovered within 1 month with oral Mecobalamin 1,500 mcg OD till complete recovery and the second patient took nearly 2 months for complete recovery, although she was able to recover most of her sensation in the first 10 days itself with the same regimen, following which she was unwilling to continue the medicine.

Procedure

After achieving successful pulpal anesthesia with an IAN block, preferably a modified ward's incision for better access to a greater depth and improved visibility is made. If necessary, a gutter of bone on the buccal and distal aspect of the third molar may be prepared, using the Moore and Gillbe collar technique. After this the tooth is sectioned if necessary (as dictated by the angulation and presurgical evaluation). The suggested protocol is as follows:

1. More often than not , the root usually fractures at this point spontaneously on application of an elevator, after splitting the tooth . The root tip if curved or in proximity with the IAC is sectioned intentionally , to leave just the tip, apically.

2. Remove the bone in the furcation region using a small round bur. A slow speed "touch and go" motion under heavy irrigation with normal saline may be used to shave the bone at the angle formed between the superior cortex of the inferior dental canal and the interradicular bone (Fig. 5a).

3. Under dripping saline irrigation , to keep the neurovascular bundle moist at all times, an apexoelevator or the broad end of a Mitchell's trimmer (depending on access) may be used to gently tease the root tip even if within the cortex of the IAC (Fig. 5b).

4. After this point it is made sure that in case the tooth is sectioned all other fragments of the tooth have been removed to allow straight line access to the IAC / base of the socket for further instrumentation which could be otherwise impeded (Fig. 5c).

5. Next, insertion of a thin beaked, long shanked, non toothed tissue forceps under drop-by-drop irrigation by the assistant , aids in retrieval of the tooth root tip (Fig. 5d).

The procedure is best carried out using 2.5× surgical loupe magnification although it is not mandatory.

Disadvantage Extreme care, caution and patience is mandatory in carrying out this technique

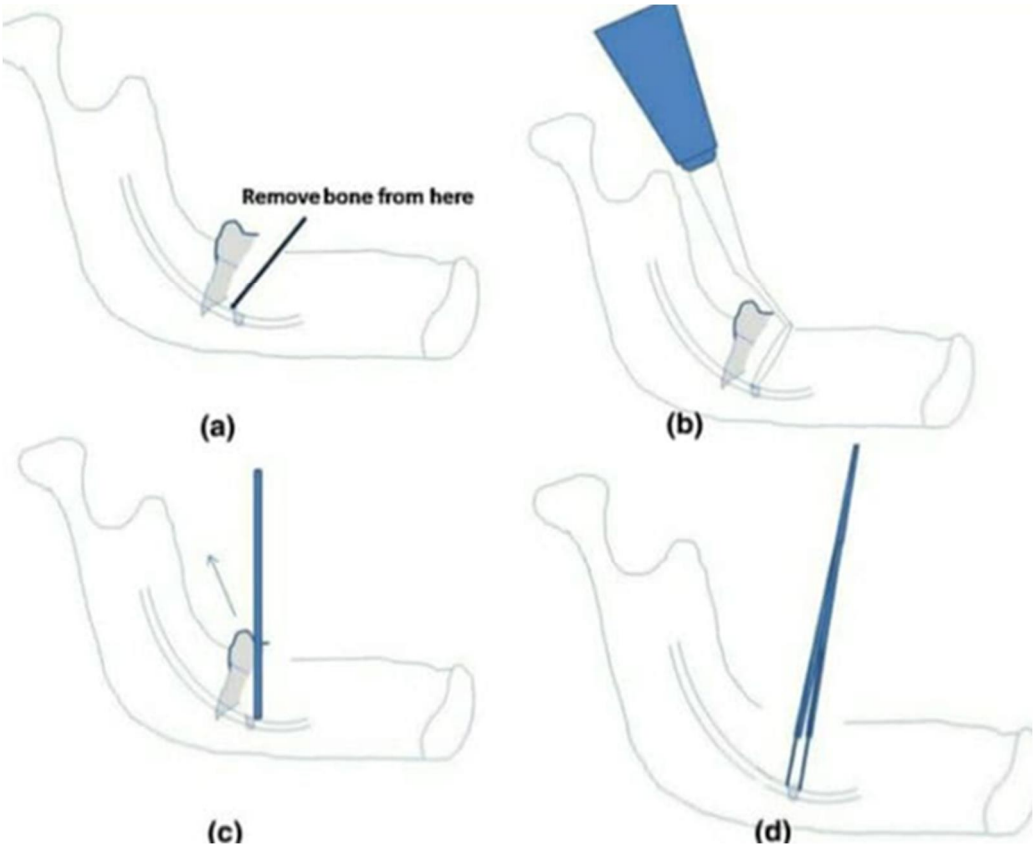


Figure 5. Protocol for Removal of Third Molar Root Tips from the Inferior Alveolar Canal Crossing the line

Finally , The removal of deeply impacted lower third molars by means of the bone lid technique with piezoelectric instruments

In case of deep impaction, a different surgical approach, proposed in 1993 by **Alling and Alling** and consisting of the removal of a "bone lid" from the buccal side to expose the impacted tooth [41,42] may be indicated. This approach can provide better access and visibility of the impacted tooth and the possibility, once the impacted tooth has been removed, to reposition the bone lid in its original position, with practically no loss of bone [41]

Matteo Chiapasco et al. treated six patients with symptomatic deeply impacted lower third molars in close relationship with the inferior alveolar nerve by means of the "bone lid" technique with piezoelectric instruments . Post – operative recovery was uneventful in all patients . Three patients reported a transient paresthesia in the area innervated by the inferior alveolar nerve which lasted from 7 to 30 days . No patients suffered permanent neural disturbances.

Surgical procedure

The surgical procedure consisted of the elevation of a muco-periosteal flap further extended towards the coronoid process and towards the buccal vestibule , similar to the one used in the traditional approach. The vestibular side of the flap was retracted to improve the access and visibility of the surgical field and to protect the soft tissue and important anatomical structures such as the facial artery .

By means of piezoelectric instruments, four osteotomic paths were outlined to isolate a bone block of adequate dimensions in the area of tooth impaction and removed with the aid of a surgical chisel; the bone lid was preserved in sterile saline to be fixed in its position after the removal of the tooth .

The impacted tooth was then sectioned according to surgical needs and removed , maintaining the inferior alveolar nerve under direct control and protection . After tooth removal , the bone lid was repositioned in its original place and fixed with titanium microscrews (in four cases). In one case, in which the nerve was buccal to the impacted tooth and it was associated with an odontogenic tumour the bone lid was not repositioned. In one case, in which the nerve was very buccal to the tooth, the bone lid was not repositioned due to a high risk of nerve compression. Finally, the surgical flaps were sutured.

To reduce post-operative swelling, dexamethasone (8 mg) was administered perioperatively via intravenous injection . Antibiotic therapy with amoxicillin and clavulanate was prescribed to all patients (1 g every 12 hours for 6 days) , in association with non-steroidal anti-inflammatory drugs . The patients followed a liquid and cold diet for 24 hours after surgery. Chlorexidine mouthwashes were prescribed in association to the usual oral hygiene for 10 days.

Disadvantages

This technique may cause periodontal damage to the second molar and may leave a residual bone defect

Conclusion

Through this study ,we concluded that the safe surgical approach to the lower third molars related to the mandibular canal is by using one of the following techniques according to the condition and type of third molar impaction which are coronectomy , staged removal for lower 3 molar , orthodontic extrusion , Protocol for Removal of Third Molar Root Tips or extraction lower third molar by bone lid technique .

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