Armamentarium for Impacted Third Molar: A Narrative Review

Original Article

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ABSTRACT

Impacted tooth is a tooth which is completely or partially unerupted and is positioned against another tooth, bone or soft tissue so that its further eruption is unlikely, described according to it's a natomic position. The third molars are often found in various anatomical positions and angles, leading to frequent dental impaction. The extraction of these teeth is one of the most common dentoalveolar procedures in oral and maxillofacial surgery, whether it is for preventive, orthodontic, or prosthetic purposes, or for diagnosing associated pathologies. The mandibular third molar is frequently found to be impacted, with the prevalence ranging from 9.5% to 68% in different populations. Osteotomy is important for the extraction of the third molars that are partially erupted and/or impacted in bone. A variety of instruments are used in the surgical removal . Therefore, it is urgent to choose a surgical method or instruments that conform to anatomic landmarks and are based on physiological principles.

Key Words: Osteotomy, Chisel and mallet, Low speed hand piece, High-speed air-turbine handpiece, Piezoelectric.

Received: 28 September 2024, **Accepted:** 12 March 2025.

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ISSN: 2090-097X, April 2025, Vol. 16, No. 2

INTRODUCTION

The third molars are often found in various anatomical positions and angles, leading to frequent dental impaction. The extraction of these teeth is one of the most common dentoalveolar procedures in oral and maxillofacial surgery, whether it is for preventive, orthodontic, or prosthetic purposes, or for diagnosing associated pathologies. The mandibular third molar is frequently found to be impacted, with the prevalence ranging from 9.5% to 68% in different populations. [1–3]

The lower jaw often lacks sufficient space for the mandibular third molars to erupt properly, leading to frequent impaction. This can result in various pathological conditions such as pericoronitis, swelling, cysts, tumors, bone loss, and root resorption of neighboring teeth, causing oral dysfunction and discomfort.[4,5]

The extraction of impacted mandibular third molars is a common surgical procedure in dental clinics and oral and maxillofacial surgery outpatient departments. Complications such as infection, limited mouth opening, and nerve damage may occur during or after the procedure. Fracture of the lingual plate and displacement of roots into adjacent spaces are potential complications that can arise, although their exact incidences remain unknown.[4,5]

The radiographic preoperative evaluation criteria for surgical complexity include the spatial relationship, depth of impaction, ramus relationship/space, impaction positioning, number and shape of roots, root apex shape, and root proximity to the mandibular canal. While radiographic assessment is valuable, it does not provide a complete prediction of potential complications. [6]

Adequate space must be present between the distal of the second molar and the anterior border of the ramus to allow for eruption of the third mandibular molar into the occlusal plane. There is a general agreement that third molars may have some unidentified impact on lower anterior tooth crowding.

The third molar (M3) impacted due to its inclined position in relation to neighboring teeth, the ascending ramus, or vertical alignment. Impaction occurs when there is not enough space or when soft tissue obstructs eruption. Studies show that impacted mandibular M3 can weaken the mandible's angle area, making it more prone to fractures and late lower arch crowding. The prevalence of M3 impaction varies from 16.7% to 68.6% without any gender bias. Different methods are employed to classify impaction, with Winter's classification being a widely used method. [7–9]

Air-driven handpieces are widely used by dentists in America, while in Europe, 80 percent of dental offices opt for electric handpieces for tooth preparation. Nevertheless, there is a growing trend towards the use of electric handpieces among U.S. dentists. Several factors contribute to this shift. The first factor is related to the noise and vibration levels. [10]

With advancements in electric handpiece technology, the high-pitched noise and vibrational effects have

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significantly reduced. Patients have even noticed and appreciated the quieter sound and smoother operation of electric handpieces. These improvements are attributed to enhanced manufacturing precision, superior materials, and more efficient gearing mechanisms. [10]

The electric handpiece demonstrates superior cutting efficiency when working with different materials commonly used in dentistry, such as machinable glass ceramic, silver amalgam, and high noble alloy, in comparison to the air-turbine handpiece. [11]

Instruments used for bone removal in lower impacted third molar removal

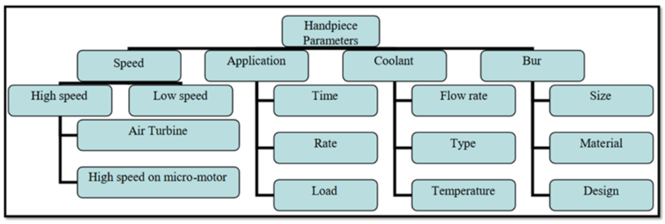
It has been observed that the surgical extraction of impacted third molars is a commonly bothersome minor surgical procedure for patients. Additionally, post-operative swelling following the surgical extraction of impacted third molars is a frequent complaint among patients who have undergone this type of surgery. Despite the presence of pain or trismus, the post-operative swelling affects their facial appearance and restricts their social and work activities. [12]

Various techniques are employed to remove alveolar bone in order to access the impacted tooth, such as the use of chisels (manual or pneumatic chisel), handpieces (low and high speed), and ultrasonic devices (Piezosurgery). However, the technique used for alveolar bone removal results in a degree of tissue trauma that impacts the post-operative outcomes. [34]

The use of a handpiece to remove alveolar bone leads to the generation of heat. If the heat generated exceeds 47°C for 15- minutes, it causes denaturation of the protoplasm of alveolar bone cells. Consequently, alveolar bone cells become nonviable and subsequently lead to the release of inflammatory mediators and membrane phospholipids that cause pain, swelling, and trismus[13,14]

The post-operative results are influenced by various factors related to the handpiece, including the speed, time, rate, and load of application, as well as the type, flow, temperature of the coolant used, and the size, design, wear, and material of the bur. Increasing the speed of the air turbine handpiece with integrated coolant reduces vibration, making it more comfortable for both the surgeon and the patient by reducing pressure, surgery time, and tissue trauma. [15]

Numerous researchers have investigated the impact of various parameters on the heating of alveolar bone during the use of drilling burs. The parameters examined include the speed of the handpiece, duration of application, rate and load of the handpiece, coolant flow rate, as well as the type, temperature, size, material, and design of the bur, as noted by Hobkirk & Rusiniak and Reingewirtz et al[16,17]



Factors related to the handpiece that influence post-operative outcome Fig (1-3):
Chisel and mallet

Pell and Gregory were the first to fully describe the extraction of impacted mandibular third molars using a mallet and chisel to split off the distal portion of the mandibular third molar in 1933. They described the benefits of this technique included smaller incisions, reduction or elimination of bone cutting, and reduction in operative time, swelling, trismus, and injury to the inferior alveolar nerve and surrounding tissues. A mallet and chisel have also been used in the lingual split technique first described by Ward in 1956. [18]

A standard full-thickness mucoperiosteal flap is performed to expose the impacted third molar. The tip of the Molt #9 elevator is then used to remove the thin alveolar bone around the coronal aspect of the impacted third molar. If the buccal bone is too thick to remove with the Molt #9 elevator, then a 4-mm stainless steel monobevel chisel and mallet are used. [18]

The monobevel chisel is placed at the mesiobuccal aspect of the impacted tooth with the bevel against the buccal bone aiming distally and is advanced slowly to remove the occlusal buccal bone with a mallet.[18]

The chisel can be readjusted until enough of the buccal and coronal bone is removed and appropriate access is achieved. A stop cut is not used by the authors, as proper placement and positioning while using the mallet and gentle tapping prevents inappropriate fracturing of the buccal plate. [18]

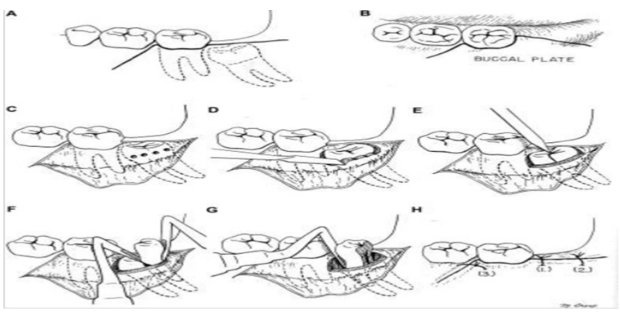


Figure 1: Removal of class I, position C, mesioangular-impacted mandibular third molar s with a chisel

Figure 2: Mallet. This is the Salvin Mead Mallet

Figure 3: Monobevel chisel.

Types of handpieces:
The use of rotary cutting instruments may be necessary for osteotomy and odontosection procedures, depending on the level of impaction. Despite the fact that studies have indicated that rotary cutting instruments can generate higher temperatures during osteotomy, potentially leading to peripheral necrosis and hindering bone repair, pneumatic high-speed turbines remain the most widely used tools in outpatient surgeries. These turbines operate at high speeds, produce noise and vibration, and possess low torque, resulting in speed loss when encountering obstacles. [19–23]

Corkery reviewed the currently used methods for bone and tooth cutting in oral surgery. He pointed that bone and tooth may be cut by burs or chisel. The selection of any one of these two methods depends on the convenience and training of surgeon. He also pointed that the use of high speed was less traumatic than conventional speed, and was more efficient.[24]
He recommended the use of adequate water or saline as a coolant, and the use of higher speed as it was less time consuming and more efficient. On the other hand, he did not recommend the use of air turbine in oral surgical procedures, as the use of air turbine has the risk of surgical emphysema.[24]

The view of Thompson and McConell (1995) was that as far as most bone cutting is concerned the bur is superior to the chisel, especially when there are large masses of hard cone to be removed and when access is limited. In these situations the bur gives nicely and less risk of accidental bone fracture, with greater speed and less after-pain, always provided a copious jet of water is used.

According to McCagie (1957) and Moore and Gillbe (1968), chisels are very unpleasant for out-patient surgeries under local anaesthesia, McCagie (1957) also stated that a bur is the method of choice in most cases, it is well tolerated by the patient and it only requires one hand. Interest in the use of rotary cutting instruments in the oral surgery has been reawakened by the wide spread acceptance of high speed equipment, Spatz (1965).

Air Turbine
The high-speed air-turbine handpiece was introduced to improve the efficiency of new diamond and carbide burs (Cherry, Gibbons and Ronaye, 1974; Myers, 1995). Because the new air-driven handpiece was so much faster (capable of bur speeds up to 300,000 rpm, compared to 3,000 rpm with the older electric belt-driven handpieces), it required substantially less hand pressure by the dentist to cut tooth structure. This, combined with the new water spray, reduced the amount of heat and vibration generated at the tooth surface, enabled dentists to complete treatment procedures more quickly, and, ultimately, improved patient comfort and acceptance as compared previous pedal- and electric motor-driven handpieces. [25]

Although the air driven high speed handpiece rotates at a speed of around 2 lakh to 8 lakh r.p.m. It is also reported to be quieter, exhibits less vibration, and provides a defined cut with high concentricity. The primary reported disadvantage is its low torque, which, together with its constant energy input (dependent on the air flow and pressure), causes load- dependent decreases in rotational rates, and even stalling.
Rafat studied the effect of use conventional speed handpiece 40000 rpm, air turbine 200000 rpm and automatic engine mallet in removal of impacted mandibular third molars and it's effect on post operative complications on 45 patients. He found air turbine to have a more pronounced post-operative swelling followed by automatic engine mallet then conventional speed handpiece. Post-operative trismus and pain was maximum in air turbine followed by automatic engine mallet then conventional speed handpiece.

Kilpatrick studied the use of air turbine in comparison with hand and motor driven mallets. He stated that: high speed has the advantage of reducing operation time by at least one third. Also there were less postoperative sequelae. According to Erik Argen, the finding of this study was based on uncontrolled clinical impression.

Electric motors

Have now taken over these turbines in dental equipment, offering speeds ranging from 50,000 to 200,000 rpm while maintaining the flexibility of a continuous high-torque drive system. This allows for greater tactile sensitivity for the operator. The extraction of impacted third molars, although a relatively common procedure, is considered invasive surgery. Postoperative pain, swelling, and limited mouth opening due to surgical trauma are common complications.

A comparison of the cutting efficiencies of electric motor and air turbine dental handpieces was conducted by Eikenberg. As part of a larger comprehensive evaluation of performance to determine whether electric motor handpieces are a suitable substitute for air turbine handpieces in a portable field of dental treatment and operating system.71

The author compared the cutting efficiencies of electric motor and air turbine handpieces. A device was made that applies an identical cutting force to a glass ceramic material for each type of handpiece. 71

The laboratory results show that with equal amounts of applied force, the electric motor handpiece cut a glass ceramic material more efficiently in respect to the volume of material removed per second, than did the air turbine. In clinical trials, after minimal experience utilizing the electric motor, the majority of dentists felt that the electric motor cut tooth and amalgam more efficiently than did the air turbine.

Piezosurgery

The term “piezo” has been derived from the word “Piezien,” which implies pressure in the Greek language. Piezoelectric effect was first described by Jacques and Pierre Curie in 1880 and involves the appearance of an electric charge across certain crystals when they are under mechanical pressure. Inversely, when an electric current is applied across them, they deform. This phenomenon of deformation when under alternating current creates microvibrations or oscillations of ultrasonic frequency.

It was in 1988 that Italian oral surgeon Tomaso Vercellotti developed the first commercially available Mectron® piezoelectric bone surgery unit to cut bone tissue while minimizing the limitations of conventional tools. The first use of piezoelectric surgery was for osteotomies by oral and maxillofacial surgeons and later on used for neurosurgical and orthopedic procedures. This revolutionary tool not only lowers the chance of damage to adjacent vital soft-tissue structures such as nerves and vessels during osteotomies, but also preserves osteocytes, which in turn complements bone healing.

The working tips of a piezoelectric system used for surgical purposes are interchangeable inserts, which can be of different shapes, sizes, and cutting edges based on the intended clinical applications. These inserts can be made of different materials and be coated with titanium or a dimond layer to improve the cutting efficiency.

The Piezoelectric unit also allows for election of modes of operation, which are preset power modes with varying frequencies to match the clinical application. The frequency is usually set between 25 and 29 kHz, which can create microoscillations of 60–210 µm amplitude, providing the handpiece with power exceeding 5 W. The vibrations produced in the “Low mode” result from average ultrasonic powers, without frequency overmodulation, and allow the operator to perform endodontic procedures.

Depending on the severity of these complications, the patient's daily routine may be impacted. Evaluating the effects of third molar surgery on daily activities and the patient's overall well-being is crucial for making clinical decisions and providing appropriate postoperative instructions. Therefore, it is essential to explore new techniques that enhance precision and surgical safety, reduce postoperative complications, and offer increased comfort during the post-extraction period. [20,29,30]

Advantages

1.Decreased risk of damage to adjacent soft tissues:

This is the major advantage with use of a piezoelectric surgical unit. When used as recommended, at the appropriate frequency, the micrometric oscillating motion decreases the chance of damage or cutting of adjacent soft tissue while cutting through hard tissues.

2.Improved visibility:

With use of piezosurgery, better visibility is secondary to the decreased amount of bleeding and the phenomenon of cavitation. Cavitation refers to the phenomenon of “microboiling” occurring in liquids in a solid-liquid interface at intermediate frequencies of vibration secondary to the creation of imploding bubbles when the irrigating solution contacts the insert. Improved visibility helps the operator to place the osteotomy in the preferred location with increased accuracy.

3. Increased patient comfort:

Due to the micrometric nature of the vibrations and decreased noise, use of a piezosurgery device improves patient comfort and decreases anxiety during procedures done under local anesthesia. When used for bone harvesting, it also reduces the need for use of chisels, which can help improve the patient experience and reduce stress.

Disadvantages/Limitations:

Expenses

The cost of equipment is sometimes an additional burden to the provider. Each individual cutting tip in a piezosurgery equipment setup is generally more expensive than traditional cutting tools such as burs, chisels, or saw blades. These tips can also potentially break or fracture when improperly used, which can again increase the need for more equipment.

Pacemakers and defibrillators

Piezosurgery is relatively contraindicated for use in patients with pacemakers, although there is no evidence of electromagnetic interactions produced by piezoelectric devices according to one in vitro study.

Low effciency/increased operating time

One of the major drawbacks with ultrasonic/piezo surgery osteotomes is the increased time required for the procedure. The cutting efficiency of a piezosurgery device has been reported to be 3–4 times less than that of conventional osteotomes for some procedures. For example, in a randomized prospective crossover clinical study done by Stefano Sivolella, piezoelectric osteotomy of a lower third molar took 9.4 min longer than rotary tools to complete.

Applications for Piezosurgery:

1.Dentoalveolar Procedures

Piezosurgery can be applied toward multiple dentoalveolar procedures where there is a requirement for meticulous bone preparation, atraumatic tooth extraction/exposure, and when the location of the surgical site is in proximity to vital anatomical structures. Example of applications in dentoalveolar surgery include ankylotic tooth root extraction, impacted third molar extraction, surgical exposure of impacted teeth, and extractions in patients with a thin periodontal biotype. In all of these indications, piezosurgery has the potential to limit bone loss and maximize maintenance of alveolar bone integrity, especially when the alveolar bone is thin and the procedure requires a high degree of precision.

2. Sinus Floor Elevation:

Perforation of the Schneiderian membrane during lateral wall osteotomy, and/or while raising the maxillary sinus foor manually, is a common complication, which can affect the bone grafting procedure. Use of piezosurgery in sinus lift procedures not only minimizes the chance of perforation during osteotomy but also eases the separation of the membrane as well. In the commonly used lateral approach technique for sinus lift, piezoelectric devices have a superior action in each technique or step compared to traditional instruments. The chance of membrane perforation with conventional techniques is reported to be 14–56%, while studies on the use of piezosurgery devices report it to be 5–7%.

3. Alveolar Ridge Splitting

With use of piezosurgery, one can decrease the chance of the damage to adjacent structures during the osteotomy as well as reduce the risk of bone thermonecrosis, while simultaneously providing better control of propagation of the ridge split osteotomy. Although ridge splitting was traditionally used in the maxillary arch, piezoelectric bone surgery allows ridge expansion even in highly mineralized tissues like the mandible with ease. Blus et al. conducted a study on ridge splitting for more than 200 implants placed in 57 patients and reported 96.5% success rate with a 36-month follow up.

4. Lateralization of the Inferior Alveolar Nerve

In order to place implants in atrophic edentulous mandibles, IAN lateralization can be used as an alternative to bone augmentation procedures. Bovi, in 2005, frst reported a technique for IAN mobilization with simultaneous implant placement utilizing a piezoelectric device. He reported that IAN mobilization with a piezoelectric device minimizes the risk of irreversible damage to the IAN and enables the surgeon to make a smaller bony window, which, in turn, decreases overstretching of the mental nerve.In an in vitro study, Metzger compared transposition of the IAN with use of a piezoelectric device versus conventional burs. His study also supported the lower rate of nerve injury from use of piezosurgery.

Latest advancements

During the past two decades, lasers have been widely used in many branches of medicine. Initially, CO2 lasers were used for cutting mineral tissues. Erbium-doped yttrium aluminum garnet (Er:YAG) lasers are solid-state lasers that emit light with a wavelength of 2940 nm. Due to its wavelength that is precisely fit with the optical absorption spectrum of water and also is absorbed by the hydroxyapatite, these lasers are an efficient device in cutting rigid structures like bone, so that after the cutting, they leave only a superficial layer of bone with a size of a few micrometers. [31]

Several studies have attempted to compare bone removal techniques. Some of these researches have reported very promising results related to laser surgery . Numerous studies have assessed several consequences including pain, swelling, trismus, ecchymosis, and patient’s satisfaction from the treatment. The different outcomes of the studies have had many differences, and comparison of the laser with the piezosurgery in the few studies has not reported significant results in some cases. [31]

A study was conducted to evaluate the effectiveness of Er:YAG laser during impacted third molar surgery. A random sample of 10 patients entered the case group, using piezosurgery in one side and Er:Yag laser on the other side to remove the mandibular wisdom teeth. Ten others entered the control group, using conventional rotary instruments to remove the mandibular wisdom teeth on both sides. The laser used in the study was the Er:YAG Fidelis plus III laser. [31]

In the teeth group operated by laser, the surgeon used protective glasses and the same condition of the laser with a wavelength of 2.94 μm and power of 20 W that was set to the duration of each pulse of 100 μs, energy of each pulse of 350 mJ, and frequency of 20 Hz. The handpiece used for the laser was non-contact in which the distance between the laser tip and the bone surface was 10 mm. The piezoelectric surgery device applied in the study was Piezosurgery. [31]

New scaler tips special for osteotomy (OT1, OT7, OT5A) were used for the bone incision. results demonstrated that the pain immediately after surgery and 2 days and 7 days after surgery is higher in the laser group insignificantly. In addition, the swelling immediately after surgery is slightly higher in the laser group but not significant. Swelling at 2 days after surgery is significantly higher in the piezosurgery group but insignificantly higher at 7 days after surgery. [31]

The pain in the piezosurgery group was significantly decreased 7 days after surgery compared to 2 days after surgery; the swelling immediately after surgery and at 2 and 7 days after surgery was significantly higher than that before surgery; the swelling at 2 and 7 days after surgery was significantly increased compared to that immediately after surgery; and the swelling at 7 days after surgery was significantly decreased than that at 2 days after surgery. [31]

Methods for teeth sectioning

Tooth sectioning is a crucial step for successful extraction of a lower third molar. Estimating when the removal of a third molar may be more difficult than normal is a constant challenge for surgeons. From the diagnostic point of view, cases that are estimated to be difficult in the pre-operative phase often go on to demonstrate tooth sectioning in the intra-operative phase that is more difficult than normal. [32]

Straight Handpiece and Carbide Bur

This procedure can divide the tooth in minimum time due to high torque; therefore, it minimises postoperative pain and swelling. Furthermore, unlike the air turbine approach, this technique makes possible minimally invasive small tooth segment extraction. [32]

Siegel & Von Fraunhofer studied the effect of irrigating solution and pressure effects on tooth sectioning with surgical burs. The purpose of this study was to determine the influence of the applied load on the handpiece, type of cooling agent, and type of tooth on surgical tooth dissection with a tapered crosscut fissure bur. Cutting studies were performed at handpiece loadings of 295 g (gram) and 590 g through use of a straight handpiece, tapered crosscut fissure burs, and an established cutting regimen.

Extracted molars were dissected under irrigation with water, 0.9% saline solution, and lactated Ringer's solution at constant flow rates of 15 and 25 ml/min. This study pointed that saline solution was a useful coolant/irrigant for the dissection of teeth under most conditions, but lactated Ringer's solution might be beneficial with respect to cutting efficiency when lower handpiece loads are required. Complications associated with the turbine bur could be avoided. On the other hand, limitations of this procedure include an increased risk of overcutting the alveolar bone because of difficulty experienced in distinguishing bone from tooth, which is thought to be due to the high torque employed. This can lead to certain postoperative complications, such as neurological complications localized to the lingual and inferior alveolar nerves due to drilling injury.[32]

Air-driven high-speed handpiece

The air-driven high-speed handpiece is a popular tool and is most commonly used in restorative dentistry for cavity preparation. Although other types of handpieces are available for tooth extraction, this type of handpiece is often used for removing bone and cutting teeth. 33.According to an instruction manual for air-driven high-speed handpieces, these handpieces are driven by compressed air at 0.20 to 0.29 MPa, with an air flow of approximately 64 l/min The tip of a bur rotating at approximately 400,000 rpm generates frictional heat, which could burn tissues and debris. For cooling and clearance of debris, all current air-driven high-speed handpieces have air/water sprays. [33]

The tip of a bur rotating at approximately 400,000 rpm generates frictional heat, which could burn tissues and debris. For cooling and clearance of debris, all current air-driven high-speed handpieces have air/water sprays. The use of an air-driven high-speed handpiece was associated with subcutaneous emphysema in 50% of the cases; in 19% of the cases, subcutaneous emphysema was caused by mandibular third molar extraction using an air-driven high-speed handpiece.[33]

CONFLICT OF INTEREST

the authors declare that there are no conflict of interest.

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