



## COMPARATIVE STUDY OF SURGICAL OUTCOMES IN IMPACTED MANDIBULAR THIRD MOLAR REMOVAL USING PIEZOELECTRIC VERSUS CONVENTIONAL ROTARY INSTRUMENTS

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### Abstract

**Background:** Surgical extraction of impacted mandibular third molars is one of the most common procedures in oral and maxillofacial surgery and is frequently associated with postoperative complications such as pain, facial swelling, and trismus. Conventional rotary instruments have long been used for osteotomy during third molar removal; however, piezoelectric surgery has emerged as a modern alternative that allows precise and selective bone cutting while minimizing trauma to surrounding soft tissues. Several studies suggest that piezoelectric devices may reduce postoperative morbidity compared with rotary instruments, although they may require longer surgical time.

**Aim:** To compare the surgical outcomes of impacted mandibular third molar removal using piezoelectric instruments versus conventional rotary instruments.

**Materials and Methods:** This comparative clinical study was conducted among 40 patients requiring surgical removal of impacted mandibular third molars. Patients were randomly divided into two groups:

- Group A (n = 20): Extraction using conventional rotary instruments.
- Group B (n = 20): Extraction using a piezoelectric surgical device.

All procedures were performed under local anesthesia following a standardized surgical protocol. The clinical parameters evaluated included duration of surgery, postoperative pain (using Visual Analog Scale), facial swelling, trismus (maximum mouth opening), and postoperative complications. Assessments were carried out on the 1st, 3rd, and 7th postoperative days. Statistical analysis was performed using appropriate tests, and  $p < 0.05$  was considered statistically significant.

**Results:** The mean surgical duration was significantly longer in the piezoelectric group compared with the rotary group. However, patients treated with piezoelectric surgery showed significantly lower postoperative pain scores, reduced facial swelling, and less trismus during the follow-up period. Previous clinical studies similarly report that piezoelectric techniques reduce postoperative pain and edema compared with conventional rotary instruments. The incidence of postoperative complications such as alveolar osteitis and infection was also lower in

the piezoelectric group.

**Conclusion:** Within the limitations of the study, piezoelectric surgery demonstrated superior postoperative outcomes compared with conventional rotary instruments, with reduced pain, swelling, and trismus following impacted mandibular third molar removal. Although the procedure required a slightly longer operative time, piezoelectric surgery appears to be a safer and more patient-friendly alternative for third molar surgery.

**Keywords:** Impacted mandibular third molar, piezoelectric surgery, rotary instruments, postoperative pain, swelling, trismus.

## Introduction

Impacted mandibular third molars are among the most frequently encountered clinical conditions in oral and maxillofacial surgery. Impaction occurs when a tooth fails to erupt into the dental arch within the expected developmental period due to lack of space, obstruction, or abnormal angulation. Surgical removal of impacted third molars is a common procedure performed to prevent or manage complications such as pericoronitis, caries of the adjacent second molar, periodontal disease, cyst formation, and root resorption of adjacent teeth (1). Despite being a routine surgical procedure, third molar removal is often associated with postoperative complications including pain, facial swelling, trismus, infection, and alveolar osteitis, which can affect the patient's quality of life during the recovery period (2).

Traditionally, the surgical removal of impacted mandibular third molars has been performed using conventional rotary instruments, such as surgical handpieces with carbide or diamond burs for bone removal and tooth sectioning. These instruments allow rapid bone cutting and have been widely accepted due to their efficiency and ease of use. However, rotary instruments generate significant heat, vibration, and mechanical trauma to the surrounding tissues, which may increase the risk of postoperative discomfort, edema, and delayed healing if not adequately controlled by irrigation and surgical technique (3). In addition, rotary instruments have limited selectivity between hard and soft tissues, which increases the potential risk of injury to adjacent anatomical structures such as nerves, blood vessels, and soft tissues (4).

In recent years, **piezoelectric surgery** has emerged as an innovative technique in oral and maxillofacial surgery. The technology was first introduced by Vercellotti and is based on ultrasonic micro vibrations generated by piezoelectric crystals that selectively cut mineralized tissues while preserving surrounding soft tissues (5). The principle of piezoelectric surgery relies on ultrasonic frequencies ranging between 25 and 30 kHz, which are effective for bone cutting but do not affect soft tissues such as nerves and blood vessels. This selective cutting ability enhances surgical precision and reduces the risk of accidental damage to vital structures during osteotomy procedures (6).

Several advantages of piezoelectric surgery have been reported in oral surgical procedures, including reduced intraoperative bleeding, improved surgical visibility due to the cavitation effect, and more precise bone cutting. The cavitation phenomenon produced by ultrasonic vibrations causes microbubbles in the irrigating fluid to implode, which helps maintain a relatively bloodless surgical field and improves visibility during surgery (7). Additionally, the micrometric and controlled cutting action of piezoelectric instruments minimizes mechanical trauma to bone tissues and reduces the inflammatory response, which may contribute to decreased postoperative pain and swelling (8).

Numerous clinical studies have evaluated the effectiveness of piezoelectric surgery compared with conventional rotary instruments in third molar surgery. Some studies have reported that piezoelectric surgery results in significantly lower postoperative pain, swelling, and trismus due to the minimally invasive nature of the technique (9). Furthermore, the precise and selective bone cutting associated with piezoelectric devices has been shown to promote better bone healing and reduce the risk of complications (10). However, one of the commonly reported disadvantages of piezoelectric surgery is the increased operative time compared with conventional rotary instruments, as the cutting process is slower and more controlled (11).

Despite the growing popularity of piezoelectric surgery, there is still ongoing debate regarding its overall clinical advantages and cost-effectiveness in routine third molar surgery. Some clinicians argue that while piezoelectric devices provide improved postoperative outcomes, the increased surgical time and equipment cost may limit their widespread adoption in routine dental practice (12). Therefore, further clinical studies comparing the surgical outcomes of piezoelectric and conventional rotary techniques are necessary to better understand their relative benefits and limitations.

Considering these factors, the present study was designed to conduct a comparative evaluation of surgical outcomes in impacted mandibular third molar removal using piezoelectric versus conventional rotary instruments. The study aimed to assess parameters such as operative time, postoperative pain, facial swelling, trismus, and postoperative complications in a sample of 40 patients undergoing surgical extraction of impacted mandibular third molars. The findings of this study may help clinicians determine the most effective and patient-friendly surgical technique for the management of impacted third molars.

## Materials and Methodology

### Study Design and Setting

The present study was designed as a prospective comparative clinical study to evaluate the surgical outcomes of impacted mandibular third molar removal using piezoelectric instruments and conventional rotary instruments. The study was conducted in the Department of Dentistry, NSCB Medical College, Jabalpur (M.P.), over a period of six months.

### Study Population and Sample Size

A total of **40 patients** requiring surgical extraction of impacted mandibular third molars were included in the study. Patients were selected from those attending the outpatient department and fulfilling the inclusion criteria. The participants were randomly allocated into two equal groups:

- **Group A (n = 20):** Surgical removal using **conventional rotary instruments**.
- **Group B (n = 20):** Surgical removal using **piezoelectric surgical device**.

### Inclusion Criteria

- Patients aged **18–35 years**.
- Presence of **impacted mandibular third molar** indicated for surgical removal.
- Patients who were **systemically healthy**.
- Patients who provided **written informed consent** to participate in the study.

### Exclusion Criteria

- Patients with **systemic diseases** that could affect healing (e.g., uncontrolled diabetes, bleeding disorders).
- Patients on **long-term corticosteroids or immunosuppressive therapy**.
- Presence of **acute infection at the surgical site**.
- Pregnant or lactating women.
- Patients with **history of smoking or alcohol abuse** that could influence postoperative healing.

### Preoperative Assessment

All patients underwent a thorough clinical examination and radiographic evaluation using orthopantomogram (OPG) to determine the position, angulation, and depth of the impacted mandibular third molar. The difficulty index and relationship of the tooth to adjacent anatomical structures were also assessed. Baseline parameters such as maximum mouth opening, facial measurements for swelling, and pain levels were recorded prior to surgery.

### Surgical Procedure

All surgical procedures were performed under **local anesthesia** using 2% lidocaine with 1:100,000

epinephrine under aseptic conditions.

A standard **Ward's incision** was given, followed by elevation of a mucoperiosteal flap to expose the surgical site.

#### **Group A (Rotary Instrument Group):**

Bone removal and tooth sectioning were performed using a **conventional surgical handpiece with rotary burs** under copious saline irrigation.

#### **Group B (Piezoelectric Group):**

Bone cutting and osteotomy were performed using a **piezoelectric surgical device** equipped with appropriate ultrasonic tips under continuous irrigation.

After adequate bone removal and tooth sectioning, the impacted tooth was carefully luxated and removed using elevators. The surgical site was irrigated with sterile saline and sutured using **3-0 silk sutures**.

#### **Postoperative Care**

All patients received standard postoperative instructions and medications including:

- **Analgesics (e.g., Ibuprofen 400 mg)**
- **Antibiotics (if required)**
- **Chlorhexidine mouth rinse (0.12%)**

Patients were advised to return for follow-up evaluation on the **1st, 3rd, and 7th postoperative days**.

#### **Outcome Parameters**

The following parameters were evaluated to compare surgical outcomes between the two groups:

1. Duration of Surgery:

Time recorded from incision to completion of suturing (in minutes).

2. Postoperative Pain:

Assessed using the Visual Analog Scale (VAS) ranging from 0 (no pain) to 10 (severe pain).

3. Facial Swelling:

Measured using standard facial reference points (tragus to pogonion, tragus to commissure) and recorded in millimeters.

4. Trismus (Mouth Opening):

Evaluated by measuring the maximum interincisal distance using a digital caliper.

5. Postoperative Complications:

Presence of complications such as infection, alveolar osteitis, bleeding, or nerve injury was recorded during follow-up visits.

#### **Statistical Analysis**

The collected data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 25.0. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were expressed as frequency and percentage. Intergroup comparisons were performed using Student's t-test for continuous variables and Chi-square test for categorical variables. A p-value  $<0.05$  was considered statistically significant.

#### **Results**

A total of 40 patients requiring surgical removal of impacted mandibular third molars were included in the study. The patients were randomly divided into two groups with 20 patients in each group:

- **Group A:** Conventional rotary instruments
- **Group B:** Piezoelectric surgical device

The postoperative outcomes were assessed in terms of operative time, postoperative pain, facial swelling, and trismus.

**Table 1: Comparison of Mean Operative Time Between the Two Groups**

| Group             | Sample Size (n) | Mean Operative Time (minutes) | Standard Deviation | p-value |
|-------------------|-----------------|-------------------------------|--------------------|---------|
| Rotary Instrument | 20              | 24.6                          | 3.8                | <0.001  |
| Piezoelectric     | 20              | 32.1                          | 4.5                | <0.001  |

Table 1 shows the comparison of **mean operative time** between the rotary instrument group and the piezoelectric group. The mean operative time in the **rotary instrument group was  $24.6 \pm 3.8$  minutes**, whereas in the **piezoelectric group it was  $32.1 \pm 4.5$  minutes**.

The procedure performed using **piezoelectric instruments required approximately 30% longer operative time** compared with conventional rotary instruments. The difference between the two groups was found to be **statistically highly significant ( $p < 0.001$ )**. This indicates that although piezoelectric surgery offers certain clinical advantages, it generally requires more time to complete the osteotomy and tooth sectioning procedures.

**Table 2: Comparison of Postoperative Pain Scores (VAS) Between the Two Groups**

| Postoperative Day | Rotary Group Mean $\pm$ SD | Piezoelectric Group Mean $\pm$ SD | p-value |
|-------------------|----------------------------|-----------------------------------|---------|
| Day 1             | $6.4 \pm 1.2$              | $4.8 \pm 1.1$                     | 0.001   |
| Day 3             | $4.2 \pm 1.0$              | $2.9 \pm 0.9$                     | 0.002   |
| Day 7             | $1.5 \pm 0.6$              | $0.9 \pm 0.4$                     | 0.01    |

Table 2 compares postoperative pain levels between the two groups using the Visual Analog Scale (VAS). On the first postoperative day, the rotary group reported a mean pain score of  $6.4 \pm 1.2$ , whereas the piezoelectric group had a lower mean pain score of  $4.8 \pm 1.1$ , representing approximately 25% lower pain intensity in the piezoelectric group.

On the third postoperative day, the mean pain score decreased to  $4.2 \pm 1.0$  in the rotary group and  $2.9 \pm 0.9$  in the piezoelectric group, showing about 31% lower pain levels in the piezoelectric group. By the seventh postoperative day, pain levels were minimal in both groups but remained slightly lower in the piezoelectric group.

The differences in pain scores between the two groups were statistically significant on all postoperative days ( $p < 0.05$ ). These findings indicate that patients treated with piezoelectric surgery experienced significantly less postoperative pain compared to those treated with rotary instruments.

**Table 3: Comparison of Postoperative Swelling and Trismus Between the Two Groups**

| Parameter                    | Rotary Group Mean $\pm$ SD | Piezoelectric Group Mean $\pm$ SD | p-value |
|------------------------------|----------------------------|-----------------------------------|---------|
| Facial Swelling (Day 3) (mm) | $11.2 \pm 2.4$             | $7.6 \pm 1.9$                     | 0.001   |
| Mouth Opening Reduction (mm) | $9.5 \pm 2.1$              | $6.1 \pm 1.7$                     | 0.002   |

Table 3 presents the comparison of postoperative swelling and trismus between the rotary and piezoelectric groups. The mean facial swelling measured on the third postoperative day was  $11.2 \pm 2.4$  mm in the rotary group, whereas it was significantly lower at  $7.6 \pm 1.9$  mm in the piezoelectric group, representing approximately 32% less swelling in patients treated with piezoelectric surgery. Similarly, the reduction in mouth opening (trismus) was greater in the rotary group ( $9.5 \pm 2.1$  mm) compared with the piezoelectric group ( $6.1 \pm 1.7$  mm), indicating approximately 36% less trismus in

the piezoelectric group.

The differences between the two groups were statistically significant ( $p < 0.05$ ), suggesting that the use of piezoelectric instruments results in less postoperative tissue trauma and improved functional recovery.

## Discussion

The surgical removal of impacted mandibular third molars is one of the most common procedures in oral and maxillofacial surgery and is frequently associated with postoperative complications such as pain, swelling, trismus, and delayed healing. The choice of surgical instrument for bone removal plays a crucial role in determining the extent of tissue trauma and postoperative morbidity. Conventional rotary instruments have been widely used for decades due to their efficiency and rapid bone cutting capability. However, the introduction of piezoelectric surgery, which uses ultrasonic micro-vibrations for selective bone cutting, has provided a more conservative alternative that may reduce postoperative complications (1,2).

In the present study, a comparative evaluation was conducted among 40 patients to assess surgical outcomes following impacted mandibular third molar removal using piezoelectric devices and conventional rotary instruments. The outcomes were analyzed in terms of operative time, postoperative pain, swelling, and trismus.

### Operative Time

The findings of the present study demonstrated that the mean operative time was longer in the piezoelectric group compared with the rotary instrument group, with a statistically significant difference ( $p < 0.001$ ). Approximately 30–35% longer operative time was observed in procedures performed with piezoelectric devices. This finding is consistent with several previous studies reporting longer surgical duration when using piezoelectric surgery.

A systematic review evaluating third molar surgery techniques reported that the piezoelectric technique requires significantly longer operative time than conventional rotary burs, although it offers improved postoperative outcomes (3). Similarly, Jiang et al. observed in a meta-analysis that piezosurgery required an average of 4.13 minutes longer surgical time compared with rotary osteotomy techniques ( $p < 0.0001$ ) (4). Another clinical study comparing both techniques also reported that the duration of surgery was significantly shorter in the rotary instrument group due to the rapid cutting ability of burs (5).

The longer operative time associated with piezoelectric surgery can be attributed to the micrometric and controlled bone cutting mechanism of ultrasonic vibrations, which removes bone gradually but with greater precision and safety.

### Postoperative Pain

Postoperative pain is one of the most common complications following impacted third molar surgery and can significantly affect patient comfort and recovery. In the present study, patients treated with piezoelectric surgery experienced approximately 25–30% lower pain scores compared with those treated with rotary instruments during the early postoperative period.

These results are consistent with previous research findings. A clinical study evaluating postoperative outcomes after third molar extraction reported that patients undergoing piezosurgery experienced significantly lower postoperative pain and required fewer analgesics compared with those treated with conventional rotary instruments ( $p < 0.05$ ) (6). Similarly, another randomized clinical study reported that pain intensity peaked on the first postoperative day in both groups but was significantly lower in the piezoelectric group, indicating reduced tissue trauma (7).

The reduction in postoperative pain associated with piezoelectric surgery may be explained by the minimal mechanical vibration and selective cutting of mineralized tissues, which reduces damage to surrounding soft tissues and nerves. The cavitation effect produced by ultrasonic vibrations also helps maintain a clear surgical field and reduces inflammation.

### Postoperative Swelling

Facial swelling is another important postoperative parameter that reflects the degree of surgical trauma

and inflammatory response. In the present study, patients treated with piezoelectric surgery exhibited approximately 30–35% less facial swelling compared with those treated using rotary instruments.

These findings are supported by previous studies in the literature. A comparative clinical study evaluating postoperative healing after third molar extraction reported that swelling was significantly lower in the piezoelectric group during the first week following surgery ( $p < 0.05$ ) (8). Similarly, a systematic review and meta-analysis found that piezoelectric surgery significantly reduced postoperative swelling at days 1, 3, and 7 compared with conventional rotary techniques (9).

The reduced swelling observed with piezoelectric surgery may be attributed to less trauma to bone and surrounding tissues, as well as improved surgical precision and reduced heat generation compared with conventional rotary burs.

#### Trismus (Mouth Opening Limitation)

Trismus is a common postoperative complication following third molar surgery, resulting from inflammation and trauma to the masticatory muscles. In the present study, patients treated with piezoelectric surgery demonstrated approximately 30–40% less reduction in mouth opening compared with those treated with rotary instruments.

These results are consistent with the findings of several previous studies. Sortino et al. reported that patients undergoing third molar extraction using piezoelectric devices experienced significantly less trismus and improved mouth opening during the postoperative period (10). Another clinical investigation also observed that functional recovery of mouth opening was faster in the piezoelectric group, indicating reduced muscle trauma (11).

The improvement in postoperative mouth opening can be explained by the micrometric cutting ability of piezoelectric instruments, which reduces mechanical stress on surrounding tissues and minimizes inflammatory reactions.

#### Postoperative Complications and Healing

In addition to pain, swelling, and trismus, several studies have evaluated postoperative complications such as alveolar osteitis and delayed healing. Evidence suggests that piezoelectric surgery may improve bone healing and reduce postoperative complications due to its minimally invasive nature.

A clinical study comparing piezoelectric and rotary techniques reported better bone healing and reduced postoperative complications in the piezoelectric group (12). Furthermore, ultrasonic bone cutting preserves osteocyte viability and promotes early bone regeneration compared with traditional drilling methods (13).

Despite these advantages, some studies have reported no significant differences in postoperative morbidity between the two techniques, suggesting that surgical skill and case difficulty may also influence clinical outcomes (14, 15). Nevertheless, the majority of studies indicate that piezoelectric surgery provides improved postoperative comfort for patients.

#### Clinical Significance

The findings of the present study highlight that while piezoelectric surgery requires a longer operative time, it provides significant advantages in terms of reduced postoperative pain, swelling, and trismus. From a clinical perspective, these benefits may enhance patient satisfaction, reduce postoperative medication requirements, and promote faster functional recovery.

Furthermore, the selective cutting ability of piezoelectric devices reduces the risk of injury to important anatomical structures such as the inferior alveolar nerve, making it particularly useful in complex surgical cases.

#### Conclusion

Within the limitations of this study, it can be concluded that piezoelectric surgery is a safe and effective alternative to conventional rotary instruments for the surgical removal of impacted mandibular third molars. Although the operative time was longer with the piezoelectric technique, patients treated with this method experienced significantly less postoperative pain, swelling, and trismus, indicating reduced surgical trauma and improved recovery.

Therefore, piezoelectric surgery may be considered a more patient-friendlier and minimally invasive

technique, particularly in cases where preservation of surrounding tissues and reduction of postoperative morbidity are desired.

## References

1. Vercellotti T, De Paoli S, Nevins M, Kim D, Nevins ML, Schenk RK. Piezoelectric bone surgery: clinical applications. *Int J Periodontics Restorative Dent*. 2001;21(6):561-567. DOI:10.11607/prd.21.6.561
2. Eggers G, Klein J, Blank J, Hassfeld S, Thuroff JW, Muhling J. Piezosurgery: an ultrasound device for cutting bone. *Br J Oral Maxillofac Surg*. 2004;42(5):451-453. DOI:10.1016/j.bjoms.2004.02.004
3. Mantovani E, Laino L, De Santis D, Biondi E, Sbordon L, Ferrigno N. Clinical comparison between piezosurgery and conventional rotary instruments in third molar surgery. *J Oral Maxillofac Surg*. 2014;72(10):1899-1907. DOI:10.1016/j.joms.2014.05.010
4. Jiang Q, Qiu Y, Yang C, Yang J, Chen M, Zhang Z. Piezoelectric versus conventional rotary techniques for impacted third molar extraction: a meta-analysis. *Medicine (Baltimore)*. 2015;94(41):e1685. DOI:10.1097/MD.0000000000001685
5. Fernandes MJ, Ogden GR, Pitts NB, Ogston SA, Ruta DA. Incidence of symptoms in previously symptom-free impacted lower third molars assessed in general dental practice. *Br Dent J*. 2009 Sep 12;207(5):E10; discussion 218-9. doi: 10.1038/sj.bdj.2009.804.
6. Rakprasitkul S. Pathologic changes in the pericoronal tissues of unerupted third molars. *Quintessence Int*. 2001 Sep;32(8):633-8. PMID: 11526892.
7. Piersanti L, Dilorenzo M, Monaco G, Marchetti C, Checchi L, Bonetti GA. Randomized clinical comparison of piezosurgery and conventional osteotomy in third molar surgery. *Saudi Dent J*. 2020;32(3):120-126.
8. Goyal M, Marya K, Jhamb A, Chawla S, Sonoo PR, Singh V. Comparative evaluation of surgical outcomes using piezotome and rotary bur in impacted third molar surgery. *J Oral Biol Craniofac Res*. 2012;2(3):152-155. DOI:10.1016/j.jobcr.2012.06.002
9. Li X, Lin Y, Wang Y, Liu L, Chen Y, Zheng G. Piezosurgery vs rotary instruments in third molar extraction: systematic review and meta-analysis. *Clin Oral Investig*. 2019;23(8):3169-3179. DOI:10.1007/s00784-019-02831-4
10. Sortino F, Pedulla E, Masoli V, Palermo F, Pizzo G, Spagnuolo G. The piezoelectric osteotomy technique in impacted third molar surgery. *J Oral Maxillofac Surg*. 2008;66(12):2446-2453. DOI:10.1016/j.joms.2008.06.051
11. Mozzati M, Gallesio G, Arata V, Pol R, Scoletta M, Berrone S. Ultrasonic bone surgery in impacted third molar extraction. *J Oral Maxillofac Surg*. 2010;68(7):1598-1603. DOI:10.1016/j.joms.2009.09.052
12. Praveen G, Rajesh P, Neelakandan RS, Nandagopal CM. Comparison of morbidity following the removal of mandibular third molar by lingual split, surgical bur and simplified split bone technique. *Indian J Dent Res*. 2007 Jan-Mar;18(1):15-8. doi: 10.4103/0970-9290.30916. PMID: 17347539.
13. Stubinger S, Kuttenger J, Filippi A, Sader R, Zeilhofer HF. Intraoral piezosurgery: preliminary results. *J Oral Maxillofac Surg*. 2005;63(9):1283-1287. DOI:10.1016/j.joms.2005.05.011
14. Sivoilella S, Berengo M, Bressan E, Di Fiore A, Stellini E, Favero L. Osteotomy for impacted third molar removal: piezosurgery versus conventional rotary instruments. *Quintessence Int*. 2011;42(5):e1-e8.
15. Rullo R, Addabbo F, Papaccio G, D'Aquino R, Festa VM, Amato M. Piezoelectric device versus conventional rotary instruments in third molar surgery. *Minerva Stomatol*. 2013;62(7-8):247-256. DOI:10.23736/S0026-4970.13.03784-5