



Comparative Evaluation of Postoperative Healing Following Surgical Removal of Impacted Mandibular Third Molars using Piezoelectric Surgery Versus Conventional Rotary Instruments: A Clinical & Radiological Study

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KEYWORDS

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ABSTRACT:

Introduction: Bone removal is an essential component of third molar extractions, particularly in cases involving erupted, partially erupted, or fully impacted teeth. Therefore, selecting a surgical technique & instruments that respect anatomical boundaries & adhere to physiological principles is critical. This study aimed to evaluate & compare the postoperative healing outcomes of third molar extractions performed using piezoelectric surgery versus traditional rotary instruments.

Materials & Methods: This interventional study was carried out over a one-year period in the departments of Oral & Maxillofacial Surgery & Radiology at a dental hospital. A total of 50 patients requiring extraction of impacted third molars were enrolled & randomly divided into two groups. Evaluated parameters included procedure duration, postoperative pain levels, degree of trismus, & bone density.

Results: The average surgical time was significantly greater in the piezoelectric group (Group I: 48.2 ± 5.6 minutes) compared to the rotary group (Group II: 36.5 ± 4.9 minutes), with a statistically significant difference ($p < 0.05$). Over the 7-day postoperative period, both groups experienced a reduction in pain, but Group I consistently reported lower VAS scores than Group II, which was statistically significant ($p < 0.05$). Trismus was also significantly less in Group I by day 7 ($p < 0.05$), indicating better functional recovery. Radiographic assessment showed progressive improvement in bone density for both groups; however, Group I demonstrated significantly greater bone regeneration at 3 & 6 months postoperatively ($p < 0.05$).

Conclusion: Within the scope of this study, piezoelectric surgery was found to minimize postoperative pain, trismus, & swelling. It also appeared to promote enhanced bone healing in the extraction site & potentially reduce bone loss adjacent to the mandibular second molar. Compared to conventional rotary techniques, piezosurgery was associated with fewer postoperative complications.



Introduction

Impacted third molars are a frequent clinical finding, with prevalence rates reported between 33% & 58.7%. These teeth, whether fully or partially impacted, are known to be associated with numerous complications such as pericoronitis, localized pain, dentoalveolar abscesses, limited mouth opening, caries on the distal surface of the second molars, as well as the development of cysts, tumors, & crowding within the dental arch. As a result, both symptomatic & asymptomatic impacted third molars are often removed to mitigate these issues.[1] The technique of split bone removal was first introduced by Ward in 1956, utilizing chisels as the primary tool for bone cutting. However, subsequent studies highlighted the discomfort associated with this approach, especially since many patients could not tolerate the mechanical shock of chisel & mallet use under local anesthesia.[2,3] Consequently, rotary instruments became the preferred alternative for bone removal & tooth sectioning under such conditions. Despite their advantages, rotary & oscillating devices can result in rough bone surfaces & localized bone death due to heat generation during use.[4,5] Piezoelectric surgery has emerged as a significant advancement in the fields of osteotomy, osteoplasty, & tooth extraction within oral & maxillofacial surgery. This technique offers precise, micrometric incisions that minimize trauma to adjacent soft tissues. Additionally, the cavitation effect created during the procedure improves visibility & helps maintain a clear, blood-free surgical field. Piezosurgery, as a modern approach, addresses many of the limitations associated with traditional rotary instruments. It employs a specialized device that uses ultrasonic microvibrations to cut bone, based on the piezoelectric properties of certain crystals & ceramics. When electrically stimulated, these materials generate vibrations at frequencies between 25 & 30 kHz, allowing for controlled & selective bone cutting with specialized inserts.[6,7] Therefore, the present study aimed to evaluate & compare postoperative healing following third molar extraction using piezoelectric instruments versus conventional rotary tools.

Material & Methods

The present interventional study was conducted at department of oral maxillofacial surgery & department

of radiology of a dental hospital for a time period of one year. Ethical clearance for conducting the research was taken from institutional ethics committee of a dental college & patients were asked to sign an informed consent form after explaining them the procedure of the study. Consecutive sampling was done & a total of 50 patients who visited to dental college for extraction of impacted third molar were selected on the basis of inclusion & exclusion criteria.

Inclusion Criteria

1. Healthy individuals aged 18 years or older.
2. Patients exhibiting vertical, mesioangular, or horizontal mandibular third molar impactions confirmed through radiographic evaluation.

Exclusion Criteria

1. Patients with systemic conditions that could impair wound healing.
2. Individuals unwilling to provide informed consent.

Patients who had taken antibiotics within the past six weeks or required prophylactic antibiotic coverage prior to extraction. Those presenting with acute localized infections involving the impacted molars. Participants were randomly allocated into two study groups, with an equal number (n=25) assigned to each group. Efforts were made to match the surgical difficulty between the groups to minimize procedural variability.

Group I: Treated with piezoelectric osteotomy techniques.

Group II: Treated with conventional rotary osteotomy methods.

In Group II, rotary instruments operated at approximately 35,000 rpm, employing burs #702 & #703. For Group I, the piezoelectric system consisted of a hand piece connected to a footswitch & power source. It operated at frequencies between 25–29 kHz with micro-vibrations ranging from 60 to 200 $\mu\text{m}/\text{sec}$ in an enhanced surgical mode. SL1, SL2, & SL3 piezo burs were used. All patients underwent surgical removal of impacted mandibular third molars under local anaesthesia using 2% lignocaine with 1:200,000 adrenaline, administered via inferior alveolar, lingual, & long buccal nerve blocks. Postoperative management included the prescription of amoxicillin 500 mg &



diclofenac sodium 50 mg, both administered three times daily for three days. Standard postoperative care instructions were provided, & sutures were removed on postoperative day 7.

The parameters evaluated were:

Duration of the procedure: Time from the initiation of bone guttering to the successful extraction of the tooth. Postoperative pain: Monitored daily over seven days using the Visual Analogue Scale (VAS). Trismus: Measured in millimetres on postoperative days 3, 5, & 7. Bone density: Assessed using standardized periapical radiographs at baseline (day of surgery), three months, & six months postoperatively. A descriptive statistical analysis was performed. Data were expressed as mean \pm

standard deviation (minimum – maximum), or as absolute numbers & percentages where appropriate. A significance level of 5% ($p < 0.05$) was adopted with a 95% confidence interval. Unpaired t-tests were used for quantitative comparisons, & Fisher's exact test was employed for qualitative data analysis. All statistical computations were conducted using SPSS version 25.0.

Results

Table 1 shows comparison of duration of surgical procedure (minutes). The mean duration of surgery was significantly longer in Group I (48.2 ± 5.6) compared to Group II (36.5 ± 4.9) & results were statistically significant with p value < 0.05 .

Table 1. Comparison of Duration of Surgical Procedure (minutes)

Group	Mean \pm SD	p-value
Group I (Piezoelectric)	48.2 ± 5.6	$< 0.05^*$
Group II (Rotary)	36.5 ± 4.9	

Table 2 shows comparison of Postoperative VAS Scores Over 7 Days. Pain scores decreased over time in both groups, but Group I consistently reported significantly

lower VAS scores than Group II across all days ($p < 0.05$).

Table 2. Comparison of Postoperative VAS Scores Over 7 Days

Day	Group I (Piezoelectric)	Group II (Rotary)	p-value
1	6.5 ± 0.8	7.2 ± 0.7	$< 0.05^*$
2	5.8 ± 0.7	6.6 ± 0.6	$< 0.05^*$
3	4.7 ± 0.6	5.9 ± 0.5	$< 0.05^*$
4	3.9 ± 0.5	4.8 ± 0.4	$< 0.05^*$
5	3.0 ± 0.4	4.0 ± 0.3	$< 0.05^*$
6	2.1 ± 0.3	3.2 ± 0.4	$< 0.05^*$
7	1.2 ± 0.3	2.3 ± 0.4	$< 0.05^*$

Table 3 shows comparison of Trismus (Mouth Opening in mm). Trismus was significantly ($p < 0.05$) less severe in Group I, with patients recovering a greater range of

mouth opening by postoperative day 7 compared to Group II.

**Table 3. Comparison of Trismus (Mouth Opening in mm)**

Postoperative Day	Group I (Piezoelectric)	Group II (Rotary)	p-value
Day 3	32.5 ± 3.4	26.8 ± 3.1	<0.05*
Day 5	36.2 ± 3.2	30.4 ± 3.0	<0.05*
Day 7	39.8 ± 2.9	34.1 ± 2.8	<0.05*

Table 4 shows bone density comparison (in Hounsfield Units). Both groups showed an increase in bone density over time, but Group I exhibited a significantly higher

rate of bone regeneration at both 3 & 6 months postoperatively (p<0.05).

Table 4. Bone Density Comparison (in Hounsfield Units)

Time Point	Group I (Piezoelectric)	Group II (Rotary)	p-value
Baseline	320 ± 18	318 ± 19	0.742
3 months	412 ± 22	368 ± 24	<0.05*
6 months	487 ± 20	429 ± 21	<0.05*

Discussion

The extraction of impacted mandibular third molars remains one of the most commonly performed procedures in oral surgery. Indications for their removal include recurrent episodes of pericoronitis, facial cellulitis, abscess formation, cystic or tumorous lesions, non-restorable dental caries, periodontal deterioration, & prophylactic extractions.[8] Despite its routine nature, the procedure may result in several complications such as postoperative pain, swelling, & limited mouth opening (trismus). Less frequent yet notable complications include infection, alveolar osteitis (dry socket), injury to branches of the trigeminal nerve, & in rare instances, mandibular fracture. A recent investigation by Mantovani et al. introduced the application of piezoelectric ultrasonic vibrations for performing safe & precise osteotomies.[9] This study, therefore, aimed to compare the postoperative healing outcomes between piezoelectric & conventional rotary surgical techniques in third molar extractions. The mean operative time was significantly longer in the piezosurgery group compared to the group where conventional rotary instruments were used. These findings are consistent with previous studies[10,11], which reported that the use of rotary tools significantly

reduced the duration of third molar surgeries when compared to piezoelectric approaches. Pain evaluation in this study revealed that the group undergoing piezoelectric surgery experienced significantly lower postoperative pain scores. These findings are consistent with those reported by Goyal et al.[10], Mantovani et al.[9], & Piersanti et al.[12], all of whom concluded that patients operated on with piezosurgical devices experienced less postoperative discomfort, as measured by standardized pain scales. In terms of postoperative trismus, Group I (piezosurgery) demonstrated significantly less limitation in mouth opening by day seven when compared to Group II (rotary instruments), with results reaching statistical significance (p<0.05). These findings are in agreement with the work of Sortino et al., who studied 100 patients—half treated with rotary burs & the other half with piezosurgery—& reported less severe trismus in the piezosurgery group.[13] Further support is provided by Mozzati et al.[14], who documented greater improvements in postoperative mouth opening in patients treated with piezosurgery. Similarly, Goyal et al.[9] observed markedly reduced trismus in the piezotome group, despite the longer operative time. Additionally, our findings showed a significant enhancement in bone density at the surgical site from the immediate



postoperative period to six months following piezoelectric surgery. These results are consistent with those of Vercelotti et al.[15], who demonstrated superior bone healing in both quantity & quality when piezosurgery was used for ostectomy & osteoplasty compared to rotary burs. Rullo et al.[16] also supported these outcomes, noting marked differences in bone histology: piezoelectric devices preserved the integrity of the bony architecture, facilitated cleaner osteotomy margins, & did not induce thermal osteonecrosis, unlike rotary instruments.

Conclusion

The current investigation determined that piezosurgery diminishes postoperative pain, trismus, & oedema within the established constraints. Furthermore, it may significantly contribute to enhancing bone density within the extraction socket & reducing bone loss in the neighbouring mandibular second molar. Piezosurgery exhibits less postoperative problems compared to traditional rotational techniques.

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