Comparison of post-operative complications following surgical removal of impacted mandibular third molars using rotary instruments and piezosurgery

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ABSTRACT

Introduction: The surgical exodontia of mandibular third molar are often associated with a range of postoperative complications like pain, swelling, bleeding, trismus (reduced mouth opening), and in more severe cases, nerve damage and dry socket that can significantly impact a patient's quality of life. This study was aimed to evaluate and compare the complications associated with surgical removal of impacted mandibular third molar with rotary and piezosurgery devices. **Methods:** The prospective comparative study was conducted among total 48 patients who required surgical removal of impacted mandibular third molars of varying depth and angulations. Patients were selected and divided alternately into two equal groups of 24 each. Group I underwent surgery with a conventional rotary instrument, while Group II was treated using a piezosurgery unit. Post-operative assessment for complications was done on Days 1, 3, and 7. Continuous variables were compared using independent sample t-tests and ANCOVA, whereas, categorical variables were presented as frequencies and percentages and analyzed using Chi-square test. A p-value of less than 0.05 was considered statistically significant. Results: The comparison of pain scores revealed no significant difference between the groups on postoperative Day 1, however, patients treated with piezosurgery experienced significantly less pain on Day 3 and Day 7 compared to the rotary group. Patients in the piezosurgery group consistently showed lower values when swelling was compared and the differences were statistically significant on Days 1 and 3 ($p<0.05$). **Conclusions:** The surgical removal of impacted mandibular third molars demonstrated that piezosurgery offers several post-operative advantages. Patients treated with piezosurgery experienced significantly less pain, swelling, and trismus compared to those treated with rotary instruments, particularly during the early recovery phase.

Keywords: Complications, impaction, piezosurgery, third molar.

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INTRODUCTION

The surgical removal of impacted third molar is a common oral and maxillofacial procedure encountered in day to day clinical practice with prevalence of 33 to 58.7%.[1-3] This surgical exodontia of mandibular third molar are often associated with a range of postoperative complications like pain, swelling, bleeding, trismus (reduced mouth opening), and in more severe cases, nerve damage and dry socket that can significantly impact a patient's quality of life.[4,5] During impaction surgery, bone cutting or osteotomy is one of the vital steps which if not used judiciously can be dangerous.[6]

Since long, the conventional rotary instrument has been gold-standard instrument for osteotomy and teeth sectioning during procedure, however, due to its high speed it generates significant heat and can lead to inadvertent damage to surrounding soft tissues like marginal bone necrosis and can impair further bone regeneration

and healing.[7,8]

Recently, piezosurgery has emerged as a promising alternative to rotary instruments in oral and maxillofacial surgery which utilizes high-frequency ultrasonic vibrations to precisely cut hard tissue with sparing soft tissues like nerves and blood vessels unharmed.[7] The selective and minimally invasive nature of piezosurgery has raised several questions about its effectiveness and its impact on post-operative outcomes compared to conventional rotary method.[9]

The piezoelectric instrument selectively works on hard tissue, thus reducing the likelihood of inflicting iatrogenic trauma to surrounding tissues, including the mucosa and neurovascular structures. Literatures revealed piezosurgery devices as a safer and preferred alternative to conventional bur for ostectomies leading to favorable osseous response and facilitating speedy recovery.[7,9,10] This study was aimed to evaluate and compare the complications associated with surgical removal of impacted mandibular third molar with rotary and piezosurgery devices.

METHODS

The prospective comparative study was conducted in the Department of Oral and Maxillofacial Surgery, UCMS College of Dental Surgery, Bhairahawa, Rupandehi, Nepal. The study was approved by the Institutional Review Committee of Universal College of Medical Sciences, Bhairahawa, Nepal. (Ref. No. UCMS/IRC/046/22). All patients were informed about the study procedure and written informed consent was obtained.

Total 48 patients who required surgical removal of impacted mandibular third molars of varying depth and angulations were selected and divided alternately into two equal groups of 24 each. Group I underwent surgery with a conventional rotary instrument, while Group II was treated using a piezosurgery unit. Only patients between 18 and 40 years of age, medically fit, and able to attend during follow-up period were included. Patients with acute infections, uncontrolled systemic illness, pregnancy, chronic smokers, or known drug allergies were excluded from the study. A detailed medical and dental history was recorded preoperatively followed by routine baseline blood investigations, radiographic evaluation with an orthopantomogram (OPG) and intraoral periapical radiograph (IOPAR). The purpose of the study and possible complications were explained in details, and informed written consent was obtained from all participants. Although the operating surgeon was aware of the method used, the patients and the postoperative evaluator during follow up period were kept blinded.

All procedures were carried out by the same surgeon under local anaesthesia with 2% lignocaine hydrochloride containing 1:2,00,000 adrenaline. Under strict aseptic condition, a standard Ward's incision was placed and a mucoperiosteal flap reflected. In the rotary group, bone removal and tooth sectioning were carried out with rotary instrument and carbide bone cutting bur at speed of 30000 rpm under continuous saline irrigation. In the piezosurgery group, osteotomy and teeth sectioning was performed using a piezosurgery device with appropriate tip at frequency range of 25 to 29 kHz. Following tooth removal, the socket was gently curetted followed by 0.9% saline irrigation and wound closure was done using 3-0 silk sutures. The duration of surgery in minutes was calculated from start of incision till completion of suture, and any intraoperative events such as root fracture or lingual plate fracture were noted. All patients received a same standard course of antibiotics and analgesics postoperatively, along with written postoperative instructions.

Following surgical tooth removal, postoperative assessment was done on Days 1, 3, and 7 by an independent examiner unaware of the surgical technique used. The main study variables were pain, swelling, duration of surgery, trismus, bleeding, dry socket, and paresthesia. Pain was measured by using a 10-point Visual Analogue Scale (VAS).[11] Swelling of face was measured using measuring tape by taking mean of distance from three facial reference points i.e, from the lateral corner of eye to angle of the mandible, tragus to the corner of the mouth and tragus to the soft tissue pogonion.[9] Trismus was assessed by measuring the maximal interincisal distance with a ruler in millimeter. Intra-operative and post-operative bleeding was recorded clinically, while dry socket was diagnosed from the third postoperative day onwards based on patient's complaint and clinical observation. Neurosensory disturbance was assessed by light-touch and cotton-wool testing in the areas supplied by the inferior alveolar and lingual nerves. Sutures were removed on the seventh day.

All the documented findings were compared between two groups by performing statistical analysis using Statistical Package for the Social Sciences(SPSS) version 25.0. Continuous variables such as pain, swelling, operating time, and trismus were compared using independent sample t-tests or analysis of covariance (ANCOVA) where baseline values were considered control. Categorical variables like bleeding, dry socket, and paresthesia, were presented as frequencies and percentages and analyzed using Chi-square test. A p-value of less than 0.05 was considered statistically

significant.

RESULTS

A total of 48 patients were included in the study, with an equal distribution of males and females across both groups. The comparison of pain scores revealed no significant difference between the groups on postoperative Day 1 (p=0.947), however, patients treated with piezosurgery experienced significantly less pain on Day 3 and Day 7 compared to the rotary group (p=0.002 and 0.048 respectively). Patients in the piezosurgery group consistently showed lower values when swelling was compared and the differences were statistically significant on Day 1 and Day 3 (p=0.037 and 0.041 respectively), The mean operating time was longer for the piezosurgery group (32.69±4.56 min) compared to the rotary group (23.95±3.10 min) and the difference was not statistically significant. (Table 1)

The mean mouth opening on days 1, 3 and 7 in the piezosurgery group had significantly higher mouth opening compared to those in the rotary group (p<0.001). (Table 2)

Bleeding occurred in 16.7% of patients in the rotary group and 12.5% in the piezo group. Dry socket was observed in 16.7% of patients in both groups. Paresthesia was slightly more frequent in the rotary group (12.5%) compared to the piezo group (4.2%). Overall, the incidence of complications was low and did not differ significantly between the two groups. (Table 3)

Table 1: Comparison of pain, swelling, and operating time between rotary and piezo groups

Variable	Group	Mean±SD	p-value
Pain D1	Rotary	6.46±1.021	0.947
	Piezo	4.29±0.999	
Pain D3	Rotary	4.42±1.018	0.002*
	Piezo	3.21±0.509	
Pain D7	Rotary	2.33±0.761	0.048*
	Piezo	1.38±0.495	
Swelling D1	Rotary	8.09±1.68	0.037*
	Piezo	5.70±1.10	
Swelling D3	Rotary	6.17±1.39	0.041*
	Piezo	4.69±0.95	
Swelling D7	Rotary	2.98±0.84	0.086
	Piezo	2.03±0.57	
Time (minutes)	Rotary	23.9±53.10	0.064
	Piezo	32.69±4.56	

*p<0.05 denotes statistical significance

Table 2: Comparison of mouth opening between rotary and piezo groups

Variable	Group	Mean±SD	F-value	p-value
Pain D1	Rotary	33.77±3.76	63.84	<0.001*
	Piezo	37.84±3.65		
Pain D3	Rotary	36.07±3.30	139.15	<0.001*
	Piezo	40.31±4.87		
Pain D7	Rotary	39.45±3.40	43.70	<0.001*
	Piezo	41.79±4.03		

*p<0.05 denotes statistical significance

Table 3: Distribution of post-operative complications

Complications	Group	Absent n(%)	Present n(%)	p-value
Bleeding	Rotary	20(83.3%)	4(16.7%)	0.68
	Piezo	21(87.5%)	3(12.5%)	
Dry socket	Rotary	20(83.3%)	4(16.7%)	1.00
	Piezo	20(83.3%)	4(16.7%)	
Paresthesia	Rotary	21(87.5%)	3(12.55%)	0.30
	Piezo	23(95.8%)	1(4.2%)	

DISCUSSION

The surgical removal of mandibular third molar have various immediate postoperative complications include pain, swelling, bleeding and trismus which further have adverse impact over quality of life of an individual. To counteract these sequelae, one can use various pharmacological drugs, non-pharmacological means, improved instrumentations for bone cutting, flap design and wound closure technique.[12] Piezosurgery device has been considered an innovative osteotomy technique which involves micro-vibrations of the inserts at an ultrasonic frequency to selectively perform precise bone cutting, sparing the soft tissues and neurovascular structures.[13]

VAS was used for assessing pain on 1st, 3rd and 7th day postoperatively; the present study showed significant reduced pain on 3rd and 7th day in piezosurgery group when compared to rotary group. The pain after surgical removal of impacted mandibular third molar depends on several factors like tissue manipulation, slippage of instruments and rotary bone cutting burs whereas less pain in piezosurgery group may be due to ultrasonic vibrations which allow a selective and precise bone cutting action leading to less tissue injury.[9,14]

In our study, postoperative facial swelling was significantly less in piezosurgery group on when 1st and 3rd day but had disappeared on 7th day in both the groups when suture removal was done. Studies done by Sortino et al.[10], Barone

et al.[14], Mozatti et al.[15], Arakaji et al.,[16] showed similar results when compared to the present study. In contrast, the swelling after third molar surgery may be due to the type of incision given, trauma to investing soft tissues, amount of osteotomy performed and time taken to perform surgery.

In the present study, the mean intraoperative time was less with rotary as compared to piezosurgery but was statistically not significant. The time is a key factor as longer duration surgeries is directly proportional to the complications like reduced patient compliance, trauma to surrounding soft tissue due to prolonged retraction, fatigue, increased postoperative pain and swelling. Although piezosurgery required longer surgical time due to slower micrometric cutting action of the device, the associated reduction in postoperative morbidity may outweigh this limitation in routine practice.[17] The duration of surgery depends on various factors like surgeon experience, age of patient, type and difficulty level of impaction, etc.

Trismus which was evaluated by measuring interincisal opening showed significant better results in piezosurgery group at all postoperative follow up period when compared to rotary group. Variables like postoperative pain, swelling and amount of mouth opening directly affect quality of life of patient after mandibular third molar surgeries.

Other postoperative complications like incidence of bleeding and paresthesia were more in rotary group as compared to piezosurgery group but was statistically not significant. Bleeding was not severe and complete hemostasis was present when patient came for follow up on 3rd postoperative day. Bleeding is common after mandibular third molar surgery when post extraction instructions are not followed properly. Paresthesia was evaluated by pinprick test and two-point discrimination test and showed inferior alveolar nerve paresthesia in three patients (12.5%) of rotary group whereas one patient (4.5%) of piezosurgery group. Paresthesia was almost resolved when patients visited during three months follow up and the result was similar to study done by Bhati et al.[9] Four patients (16.7%) in both group had dry sockets on third and fourth postoperative days which resolved within a week after giving alternate day zinc oxide eugenol dressing. Various risk factors have been documented for dry socket like gender, age, trauma during surgery, inappropriate irrigation, infection, smoking and use of oral contraceptives.[4]

This study was conducted on a relatively small sample size of 48 patients from a single center, which may limit the generalizability of the findings. The follow-up period was short, focusing mainly on early postoperative outcomes without evaluating long-term bone healing and nerve recovery.

CONCLUSIONS

The present study compared rotary instruments and piezosurgery for the surgical removal of impacted lower third molars. Piezosurgery demonstrated several postoperative advantages, with patients experiencing significantly less pain, swelling, and trismus, especially during early recovery. Although the procedure took longer, complication rates such as bleeding, paresthesia, and dry socket were lower (though not statistically significant) compared to the rotary group. The selective bone-cutting and minimally invasive nature of piezosurgery likely contribute to reduced soft-tissue trauma and improved patient comfort and recovery. Despite being more time-consuming, piezosurgery's advantages in minimizing pain, swelling, and trismus support its role as a safer and more patient-friendly alternative for third molar surgeries. Larger multicenter studies with long-term outcomes are recommended to validate these findings and better establish the role of piezosurgery in routine third molar surgeries.

CONFLICTS OF INTEREST: None declared

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AUTHORS' CONTRIBUTIONS

The concept was designed by RM; the literature search was conducted by DY, RM, and LK; data were collected by DY, RM, LK, and ST; data analysis was performed by RM and SS; all authors contributed to drafting the manuscript and approved the final version, taking full responsibility for its content.

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