Piezosurgery versus Rotatory Osteotomy in Mandibular Impacted Third Molar Extraction

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Abstract

Aim: The aim of this study is to compare piezoelectric surgery versus rotatory osteotomy technique in removal of mandibular impacted third molar. Materials and Methods: Sample size of 30 patients 18 males, 12 females with a mean age of 27.43 ± 5.27. Bilateral extractions were required in all patients. All the patients were randomly allocated to two groups in one group, namely control group, surgical extraction of mandibular third molar was done using conventional rotatory osteotomy and in the other group, namely test group, extraction of lower third molar was done using Piezotome. Results: Parameters assessed in this study were – mouth opening (interincisal opening), pain (visual analog scale VAS score), swelling, incidence of dry socket, paresthesia and duration of surgery in both groups at baseline, 1st, 3rd, and 7th postoperative day. Comparing both groups pain scores with \( P < 0.05 \) a statistically significant difference was found between two groups. Mean surgical time was longer for piezosurgery group (51.40 ± 17.9) minutes compared to the conventional rotatory group with a mean of (37.33 ± 15.5) minutes showing a statistically significant difference \( P = 0.002 \). Conclusion: The main advantages of piezosurgery include soft tissue protection, optimal visibility in the surgical field, decreased blood loss, less vibration and noise, increased comfort for the patient, and protection of tooth structures. Therefore, the piezoelectric device was efficient in decreasing the short-term outcomes of pain and swelling although taking longer duration than conventional rotatory technique it significantly reduces the associated postoperative sequelae of third molar surgery.

Keywords: Impacted, molar, piezosurgery, surgery, third

Introduction

Third molars are, directly or indirectly, the underlying cause of numerous disorders in the mouth, jaw and facial regions. Impacted or semi-impacted third molars in the mandible may have several consequences. These include pericoronitis, regional pain, abscess, trismus, distal caries, periodontal pocket of the second molar, development of follicular cysts, and crowding of lower incisors. As a result, their removal is often necessary, and their surgical removal is the most frequently undertaken oral surgical procedure.\(^1\)

One of the most critical steps in disimpaction is cutting the bone or osteotomy, for which many techniques are used, and if they are used injudiciously, they can be dangerous.\(^2\) However, rotary cutting instruments are potentially injurious because they produce excessively high temperatures during cutting of the bone, which can produce marginal osteonecrosis and impair regeneration and healing.\(^3\)

Horton et al. (1970) were the first to propose the clinical application of ultrasonics in oral surgery and found its results superior than conventional methods of osteotomies. Piezosurgery was developed by Italian oral surgeon Vercellotti in 1988 to overcome the limits of traditional instrumentation in oral bone surgery by modifying and improving conventional ultrasound technology.\(^4\)

Piezosurgery is an osteotomy technique using microvibrations at an ultrasonic frequency to perform efficient bone cutting.\(^5\) The piezoelectric device has been useful for application in complex surgical sites, such as the posterior mandible, where

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the osteotomy lines are of necessity close to vulnerable structures such as nerves and blood vessels; ultrasonic vibrations allow a selective and defined cutting action, leading to a higher level of precision and safety and less tissue damage than using common rotating instruments (burs).6,7

Therefore, the purpose of the present split-mouth controlled study was to compare the cutting efficacy and postoperative sequelae of piezosurgery and conventional instruments during osteotomy for removal of mandibular impacted third molar.

**Materials and Methods**

To address the research purpose, a single-center, randomized, split-mouth study was designed and implemented. The study population was composed of all patients attending the Department of Oral and Maxillofacial Surgery at I.T.S Dental College, Muradnagar, Ghaziabad, Uttar Pradesh, India, for evaluation of surgical removal of bilateral mandibular third molar teeth. This study was carried out for 2 years, i.e., from September 2013 to September 2015.

A sample size of 30 patients 18 males, 12 females with a mean age of 27.43 ± 5.27. Bilateral extractions were required in all patients [Figure 1]. All the patients were randomly allocated in two groups in one group, namely control group, surgical extraction of mandibular third molar was done using conventional rotatory osteotomy and in the other group, namely test group, extraction of lower third molar was done using Piezotome. According to Pell and Gregory classification, the third molar was classified in test group as 12-mesial, 6-distoangular, 7-horizontal, and 5-vertical.

Routine blood investigation was done for all patients. Orthopantomographic radiographs and intraoral periapical radiograph was obtained to ensure the similarity of the type of impaction. The inclusion and exclusion criteria for the present study are defined as follows:

**Criterion for inclusion**

Patients requiring surgical removal of impacted mandibular third molars and who willingly will take part in the study.

**Criterion for exclusion**

1. History of systemic disease like uncontrolled diabetes, blood dyscrasias
2. Alcoholism
3. Drug abuse
4. Heavy smokers
5. Acute infections, for example, pericoronitis acute alveolar abscess
6. Oral submucous fibrosis.

All patients were informed about surgery, postoperative time, and possible complications. The protocol design was approved by the I.T.S Centre for Dental Studies & Research, India, on 12th November 2013 under protocol no. 2(1). The participants signed an informed consent agreement.

**Surgical technique**

**Instruments**

Surgical instruments for ultrasound osteotomies, the Mectron Piezosurgery Device (Mectron Medical Technology, Carasco, Italy) was used according to the manufacturer’s instructions (water flow set at maximum) using a special application tip designed for osteotomy.

The osteotomies using the conventional rotating bur were carried out with a round stainless steel bur mounted on an NSK surgical high-speed straight handpiece was used at 35,000 rpm.

**Procedure**

All the surgical procedures were performed by the same surgeon and assistant with patients under local anesthesia. Lignocaine 2% with 1:200,000 adrenaline was used for inferior alveolar nerve block along with long buccal nerve block and lingual nerve block. In both groups, a full-thickness flap was raised on the buccal aspect of the third molar with a periosteal elevator to expose the bone. In control group, a round bur in a straight handpiece was used for bone removal. Where necessary, the crown and root sectioning was performed with a high-speed handpiece and fissure burs [Figure 2a-c].

In the test group (piezosurgery) after flap elevation, bone removal was done with piezoelectric handpiece with osteotomy tip and to complete the necessary tooth/root sectioning with the use of fissure burs. Thereafter, the tooth/root fragments were removed with an elevator in both groups. After tooth removal, the extraction sockets were inspected, curetted for granulation tissue removal, and flushed with sterile saline solution. 3-0 silk sutures were used for wound closure [Figure 3a-c].

All patients in the study routinely received postoperative dose of oral antibiotics in the form of capsule ampicillin 250 mg plus cloxacillin 250 mg and tablet metronidazole 400 mg three times daily for 5 days and analgesics in a combination of tablet ibuprofen 400 mg and paracetamol 325 mg three times daily for 3 days. The patients were recalled on the 1st, 3rd, and 7th postoperative days for follow-up.

**Evaluation**

The parameters noted and analyzed on preoperative visit, 1st, 3rd, and 7th day postoperatively where pain, swelling, trismus, paresthesia was evaluated. The incidence of dry socket evaluated 3rd day onward and duration of surgery was calculated from incision to finish of suturing.

Postoperative pain was assessed with a visual analog scale (VAS) of 10 units together with a graphic rating scale.8 Trismus was evaluated by measuring the interincisal distance at maximum mouth opening (cm) with a ruler. Facial measurements were collected at baseline preoperatively and on 1st, 3rd, and day 7 after suture removal to evaluate any swelling. This was achieved using a 3-0 silk suture to measure the distance between the angle of lower jaw (G) and each of 4 facial reference point-linear distances to tragus, lateral canthus, alar, and pogonion was recorded.9
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Nerve paresthesia was be evaluated by light touch (cotton wisp) and two point discrimination.\[10\]

The presence of dry socket was assessed as per the criteria set out by Blum.\[11\]

**RESULTS**

Parameters assessed in this study were – mouth opening (interincisal opening), pain (VAS), swelling, incidence of dry socket, paresthesia, and duration of surgery in both group at baseline, 1\textsuperscript{st}, 3\textsuperscript{rd}, and 7\textsuperscript{th} postoperative day.

The preoperative values for both groups in term of facial dimension, mouth opening and pain were compared and were found to be nonsignificant. The $P$ values for facial dimension was $P = 1$ (not significant) for mouth opening was $P = 0.531$ (not significant) and for pain was $P = 0.185$ (not significant). This showed that both groups were homogeneous.

In test group, mouth opening was recorded at baseline mean (45.20 ± 0.74) which decreased to mean (33.93 ± 10.17) on the 1\textsuperscript{st} postoperative day and 7\textsuperscript{th} postoperative day mean (41.10 ± 10.2). In control group baseline mean (44.10 ± 5.9) decreased to mean (31.00 ± 9.10) on 1\textsuperscript{st} postoperative day to 7\textsuperscript{th} day mean (39.27 ± 7.82) when comparing both groups although similar trends were seen control group showed greater decrease in mouth opening on all postoperative days compared to test group, but statistically no significant difference was found between two groups ($P > 0.05$) [Table 1 and Graph 1].

The assessment of swelling was done, control group showed increase in swelling from baseline facial dimension mean (9.00 ± 0.83) to mean (9.67 ± 0.80) on the 1\textsuperscript{st} postoperative day increasing till 3\textsuperscript{rd} day and gradually decreasing to near-normal baseline values on the 7\textsuperscript{th} day mean (8.97 ± 0.80) similar observation were seen in control group where baseline facial dimension mean (9.00 ± 0.64) reached mean (9.73 ± 0.78) on 1\textsuperscript{st} day and progressively returning to near normal on 7\textsuperscript{th} day mean (9.03 ± 0.61) with statistically no significant difference was found [Table 1 and Graph 2].

Pain in test group as compared to baseline mean (0.27 ± 0.78), 1\textsuperscript{st} and 3\textsuperscript{rd} postoperative day showed significantly increased VAS mean (3.73 ± 1.76) and (1.97 ± 1.62) respectively returning to near-normal baseline on 7\textsuperscript{th} postoperative day mean (0.07 ± 0.25).

In control group, similar variation from baseline mean (0.63 ± 1.2) was seen in VAS showing an increase on 1\textsuperscript{st} and 3\textsuperscript{rd} postoperative day mean (4.83 ± 1.72) and (3.27 ± 2.11) respectively and gradually returning to near normal on 7\textsuperscript{th} postoperative day mean (0.90 ± 1.32).

Comparing both groups pain scores with ($P = 0.018$), ($P = 0.01$) and ($P = 0.010$) on 1\textsuperscript{st}, 3\textsuperscript{rd}, and 7\textsuperscript{th} day respectively a statistically significant difference was found between two groups [Table 1 and Graph 3].

The incidence of paresthesia in the test group was reported by two patients (6.7%) (mean 0.07 ± 0.25) compared to only one case (3.3\%) of inferior alveolar nerve paresthesia in control group (mean 0.03 ± 0.18) [Table 2 and Graph 4].

Mean surgical time was longer for piezosurgery group (51.40 ± 17.9) min compared to the conventional rotatory group with a mean of (37.33 ± 15.5) min showing a statistically significant difference ($P = 0.002$) [Table 3].
No case of the dry socket was observed in either group.

**Discussion**

This study was conducted to investigate the performance of piezosurgery in comparison to rotatory osteotomy in impacted mandibular third molar extraction. Results of our comparative study showed that although piezosurgery takes a longer duration of time but reduces the pain associated with third molar surgery. The sample size for study was small but homogeneous in age (18–35 year) and in surgical extraction, which is related to tooth anatomy and position.

Postoperative pain was evaluated by VAS on 1st, 3rd, and 7th day, the present study showed that despite a minimally extended operating time, the pain VAS was lower in the piezosurgery than in the rotatory group. Postoperative pain is in response to manipulation of tissues and aggressiveness of surgery such as slippage of rotatory burr on other hand the reason which can be attributed to reduced pain in piezosurgery group is ultrasonic vibrations allow a selective and defined cutting action, leading to a higher level of precision and safety and less tissue damage than using common rotating instruments (burs).5,6

Sortino et al.,11 Piersanti et al.,12 Mantovani et al.,13 Barone et al.,17 in their study found a significant difference in facial swelling in postoperative period with piezosurgery group showing less facial swelling than rotatory group. In our study, clinically piezosurgery group demonstrated less swelling, but no significance was found statistically between two groups.

Similarly, trismus which was evaluated by measuring interincisal opening showed better results in piezosurgery group at all postoperative days.

Operating time was calculated from start of incision till completion of suture. Our study showed a significantly longer operating time in piezosurgery group. Several investigator showed a significantly increased duration of operation in piezosurgery group.13,15 Duration of surgery depends on variable like operator experience, difficulty of extraction, and age of sample population. A study done by Mantovani et al.12 showed that the surgeon with 5 years of experience with piezosurgery performed the two different interventions without variance (P = 0.11). Sivolella et al.15 performed germectomy in a patient with mean age of 15 years germectomy requires extensive osteotomy taking longer duration in piezosurgery group, Rullo et al.16 showed that in “complex extractions” lower pain evaluation and significantly shorter surgery times were recorded when rotatory instruments were used. In “simple extractions,” similar surgery times were observed for both techniques.

Paresthesia in both groups was evaluated by pinprick and two-point discrimination test two patients (6.7%) in piezosurgery group and one patient (3.3%) in rotatory group reported with inferior alveolar nerve paresthesia which resolved within 6 months.

Both groups had no incident of dry socket.

The surgical removal of mandibular third molars is one of the most common interventions in oral surgery. This procedure is frequently accompanied by significant postsurgical sequelae, especially pain and swelling, which may have social and biological effects and can impair quality of life.15

A study done Rashad et al.16 showed that ultrasound energy and copious water irrigation can contribute to cell viability in an osteotomy. During operation the Piezotome allows easy control of the entire cutting procedure, and increases tactile control and precision of cutting, therefore, the preservation of the bone structure, observed after the use of the ultrasonic technique,
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seems to improve cellular reactivity thus favouring the healing process of the traumatized mineralized tissues thereby reducing the postoperative sequelae of third molar surgery.[17]

Schoen et al.[18] did a prospective clinical study evaluate the influence of third molar surgeries on the functioning of the patient during the first postsurgical week. They found that due to complaints following the removal of the mandibular third molar, the mean absence from work was 1½ day and work was generally resumed with decreased perceived efficiency.

In another study by Liedholm et al.[19] where the aim of their study was to make estimates from a dental care and societal perspective on costs of mandibular third molar surgery their results showed that base case average direct cost of surgery was 217 Euro. Adding the patient’s average cost due to absence from work and transportation of 333 Euro increased overall costs to 550 Euro per patient. About 86% of the patients reported some absence following surgery, and they concluded that indirect costs were on average higher than the direct costs, i.e., the patient’s loss of time caused higher costs than the intervention per se.

**Conclusion**

The main advantages of piezosurgery include soft tissue protection, optimal visibility in the surgical field, decreased blood loss, less vibration and noise, increased comfort for the patient, and protection of tooth structures. Therefore, the piezoelectric device was efficient in decreasing the short-term outcomes of pain and swelling although taking longer duration than conventional rotatory technique it significantly reduces the associated postoperative sequelae of third molar surgery and hence improves the postoperative quality of life of patient which in turn reduces the mean absence from work and indirect cost associated with the surgery thereby adding to both postoperative comfort of the patient and economic loss to the community.

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**Conflicts of interest**

There are no conflicts of interest.

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