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EFFICACY OF PIEZOELECTRIC SURGERY ON POSTOPERATIVE COMPLICATIONS AFTER SURGICAL EXTRACTION OF IMPACTED MANDIBULAR THIRD MOLAR

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KEYWORDS

Impacted mandibular third molar, Osteotomy, Piezosurgery.

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ABSTRACT

Introduction: Piezoelectric surgery is an osteotomy technique that can help to minimize tissue trauma and its complications. It is a safe technique since it only works on the mineralized tissues, leaving the surrounding tissues' perfusion and innervation unaffected. It reduces tissue thermal damage and prevents osteonecrosis. **Aim:** The aim of study was to evaluate the effect of using Piezosurgery on pain, swelling, and trismus after surgical extraction of impacted mandibular third molar. **Patients and methods:** This study was conducted on healthy patients classified as ASA class I patients. Fifteen patients with bilateral, symmetrical, mandibular impacted third molars that needed surgical extraction were selected and divided randomly into two equal groups 15 teeth for each group. The same patient is considered as control and study group. Group A: Underwent surgical extraction of impacted mandibular third molar with a conventional rotary device. Group B: Underwent surgical extraction of impacted mandibular third molar with piezoelectric device. Pain, edema, and trismus were evaluated after 2 and 7 days postoperatively, and the total number of analgesic tablets taken by the patient till day 7 was counted. **Results:** The results showed there was significantly less pain, edema, and trismus with piezosurgery compared to rotary instruments after 2 days and 7 days postoperatively. The total number of analgesics taken by the patients was significantly less with piezosurgery compared to conventional group. **Conclusion:** The use of piezoelectric surgery for bone removal during the extraction of impacted mandibular third molar reduces postoperative pain, edema, and trismus.

INTRODUCTION

One of the most common procedures done by oral and maxillofacial surgeons is third molar surgery. Depending on mandibular third molar location, depth, angulation, and bone density, extraction can be easy or extremely difficult. Surgical extraction is to gain adequate access to the underlying alveolar bone and tooth using the least amount of force possible through a properly designed and reflected soft tissue flap. Alveolar bone should be removed with using an atraumatic, aseptic, non-heat–producing technique [(1)].

The procedure for removing alveolar bone causes tissue trauma, which influences the postoperative complications. When a handpiece is used to remove alveolar bone, heat is generated, which can cause

marginal osteonecrosis and impair regeneration and healing[2]. Post-operative complications after surgical removal of an impacted third molar such as oedema, pain, or trismus affect the patients' facial appearance and limit their social and work activities[3].

Removal of alveolar bone to gain access to the impacted tooth is done by several techniques, such as the use of chisels, handpieces, and ultrasonic devices [4]. The use of manual tools for bone removal in oral and maxillofacial surgery has a long history. Air pressure or electrical energy motorized systems have recently been used, but they have some disadvantages, such as thermal osteonecrosis, lack of fine-touch sensitivity, difficulties determining cutting depth, and the risk of vital soft tissue injury[5].

Piezoelectric surgery is an osteotomy technique that can help to minimize tissue trauma and its complications. It is a safe technique since it only works on the mineralized tissues, leaving the surrounding tissues' perfusion and innervation unaffected. It reduces tissue thermal damage and prevents osteonecrosis[6]. Clinically, removal of bone with the ultrasonic tips were found to be easy and precise. With minimal bleeding from surgical sites and better healing of tissue. During and after the surgical use of these tips, patients report limited discomfort[4]. Morphologically, surfaces have been found extremely porous, clean without fragments, which permits immediate bonding with the fibrin. No signs of necrosis or the presence of vital osteocytes were observed at the cut surface during histological examination. Piezoelectric bone cutting does not influence bone remodelling or cell viability[7].

The aim of the study was to evaluate the effect of using Piezosurgery on pain, swelling, and trismus after surgical extraction of an impacted mandibular third molar.

PATIENTS AND METHODS

The present research was waived from the approval of the Research Ethics Committee (REC) of the Faculty of Dentistry, Suez Canal University (no 195/2019). This study was conducted on adult healthy patients classified as ASA class I patients. Fifteen patients with bilateral, symmetrical, mandibular impacted third molars that needed surgical extraction were selected and divided randomly into two equal groups, with 15 teeth for each group. The same patient is considered as a control and a study group at the same time. Group A: Underwent surgical extraction of an impacted mandibular third molar with a conventional rotary device (Control group). Group B: Underwent surgical extraction of an impacted mandibular third molar with a piezoelectric device (Study group).

The patients were selected from the outpatient clinic of the Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Suez Canal University, who required surgical extraction of an impacted mandibular third molar with the following criteria:

Inclusion criteria:

Fifteen middle-aged (20–25 years old) healthy patients with bilateral impacted mandibular third molars that needed surgical extraction were selected. The anticipated degree of difficulty of the impacted molars as evaluated by the clinical and radiographic findings was the same degree for all patients.

Exclusion criteria:

Patients with any contraindicated diseases for any surgical procedure, patient who allergic to any drugs, pregnant, lactating.

All patients were informed about all the details of the surgical procedures and the expected complications. Then they signed informed consent.

Medical and dental examination sheets were performed for all patients in the study. A digital panoramic radiograph was taken before the surgical extraction of the mandibular impacted third molar to evaluate the depth and angulation of impaction. Figure (1)

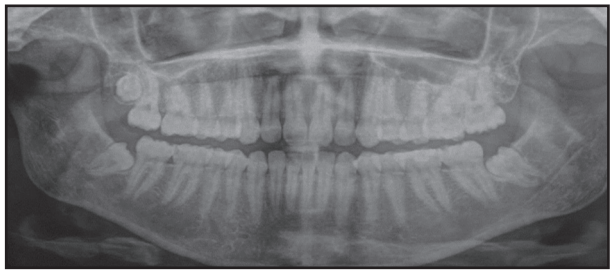

Fig. (1) Preoperative panoramic radiograph shows bilateral impacted lower third molars.

Surgical procedure:

All the surgical procedures were done under strict aseptic conditions. All patients were anaesthetized by inferior alveolar, lingual, and long buccal nerve block techniques. Local anaesthesia was injected by using Articaine 4 % with epinephrine 1:100,000 as a vasoconstrictor presented in a carpule of 1,8 ml with the trade name Artinibsa (Articaine 4% Inibsa®, Inibsa, Barcelona, Spain). An incision was made a full mucoperiosteal triangular flaps were raised starting from the anterior ramus and extending with a sulcular incision and a vertical relieving incision from the mesial aspect of the second molar. The osteotomy was performed around the impacted tooth under constant irrigation with saline solution. Guttering at the buccal and distal aspect of impacted third molar in the control group was done by no. 6 carbide round bur in a straight handpiece at 35,000 rpm. In the study group, Piezomed device (woodpecker RTA surgic touch LED; Guilin Woodpecker Instrument CO., Guilin, China) and tips with the codes US1 and US2 were used for buccal and distal guttering. The vibration frequency was maintained between 28 and 36 kHz and the microvibration amplitude between 30 and 60 µm/s. A straight fissure bur was used to section the tooth if needed. Curettage of the socket was done by using a bone curette after the tooth delivery. The flap was sutured using black silk suture (3–0 Silk) and a sterile gauze pack was placed over the surgical site intraorally. The sutures were removed at the seventh day postoperative Figure (2).

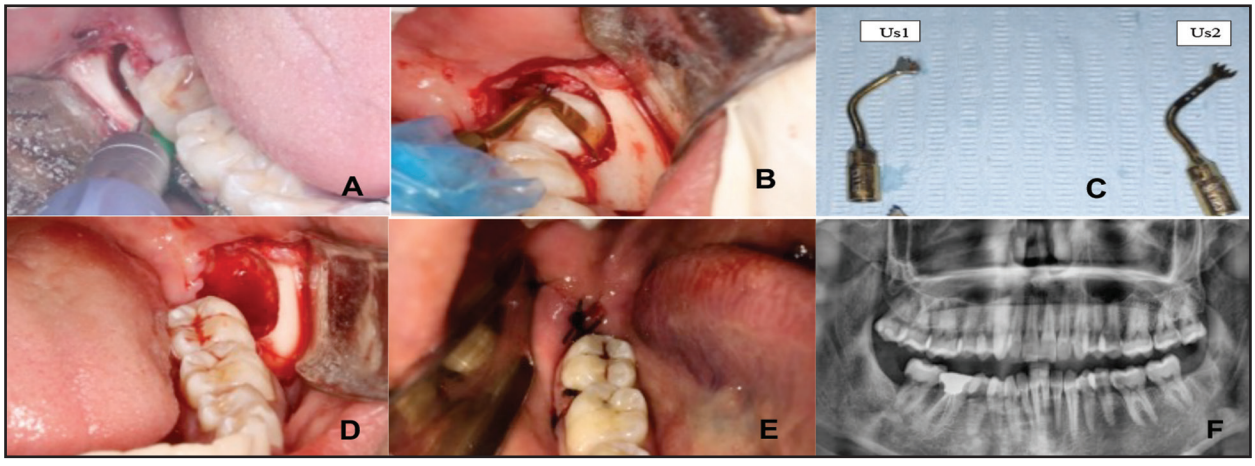

Fig. (2) surgical procedure showing: (A) photograph shows osteotomy by round bur in straight low speed handpiece (control group). (B) photograph shows osteotomy by US1 tip in ultrasonic handpiece (study group). (C) Illustration of ultrasonic tips. (D) photograph taken after tooth extraction. (E) photograph after suture. (F) postoperative panoramic radiograph

Postoperative instructions and medications included: all the patients were advised to bite over the pack for one hour. Avoid rinsing or spitting for 24 hours after surgery. Avoid hot drinks, hot foods, hard foods, and eating on the operating side. Every 12 hours for 7 days, amoxicillin with clavulanic acid 1 gm tablets. Every 12 hours for 7 days, Metronidazole 500 mg tablet. As required, Ibuprofen 400 mg tablets. Chlorhexidine 0.12% MW twice daily, starting 8 hours after surgery for one week.

Facial contour was measured by using the method described by **Amin and Laskin** [8]. The patient was seated in an upright position with the teeth in occlusion. Four points were marked on the skin surface with a pen marker: the ear tragus, corner of the mouth, gonion, and external canthus of the eye. The amount of facial contour was recorded in (cm) by measuring the two distances between the ear tragus and lip commissure and between the gonion and external canthus of the eye. The average of the sum of the two distances was considered as the baseline measurement.

The amount of mouth opening was recorded by measuring the maximum interincisal distance between the upper and lower central incisors in (mm) using a digital calliper before surgery. The level of pain was recorded by using a 10-cm visual analogue scale (VAS), and the total number of analgesic tablets taken till day 7 postoperatively was counted.

Pain, edema, and trismus were evaluated after 2 and 7 days of surgery by measuring the same methods that were described in the preoperative assessment.

Statistical analysis

Analysis of the data was performed with IBM® SPSS® (SPSS Inc., IBM Corporation, NY, USA) Statistics Version 25 (2017) for Windows. All statistical tests were 2-tailed and a p-value less than 0.05 was considered statistically significant. The confidence interval was estimated at 95%. Continuous variables such as age were expressed as mean ± standard error (SE). Two-way repeated analysis of variance (ANOVA) followed by a paired sample t-test was used for testing relations between related samples. An independent sample t-test was used to compare between two groups of the total number of analgesics.

RESULTS

A total of 15 patients were used for the analysis. Nine female patients (60%) and six male patients (40%) with an age range of 20–25 years and a mean age of 22.53±0.41 years were included in our study. Moreover, the type of impaction for most patients was more than half (1/2) of the sample was mesioangular (53.3%), 26.7% of the sample was vertical, and 20% of the sample size was horizontal.

Pain

There was a statistically significant difference between the two groups regarding postoperative pain when using a VAS from 0 to 10. There was a statistically significant difference between the two groups regarding postoperative pain when using a VAS from 0 to 10. The mean value of pain on the 2nd postoperative day was 5.44 ± 0.19 in the piezosurgery group and 6.69 ± 0.22 in the control group), where p = 0.001. On the 7th postoperative day, it was 2 ± 0.4 in the piezosurgery group and 2.98 ± 0.19 in the control group, where p= 0.001. (Table 1)

There were statistically significant differences in the mean total number of analgesics taken till day 7 between the two groups, as it was 7.47 ± 0.49 in group (A) and 4.73 ± 0.39 in group (B), where P-value = 0.001.

Edema

There were statistically significant differences in the mean facial contour measurement between the two groups, as on the 2nd postoperative day it was 10.66 ± 0.04 in the piezosurgery group and 10.92 ± 0.10 in the control group, where P-value = 0.03. On the 7th postoperative day, it was 10.37 ± 0.09 in the piezosurgery group and 10.59 ± 0.10 in the control group, where P-value = 0.03. (Table 1)

Trismus

There was a statistically significant difference in the mean of maximum mouth opening measurements between the two groups, as on the 2nd postoperative day it was 32.41 ± 0.93 in the piezosurgery group and 28.99 ± 0.73 in the control group, where P- value = 0.001. On the 7th postoperative day, it was 43.81 ± 0.43 in the piezosurgery group and 42.92 ± 0.33 in the control group, where P-value = 0.04. There was significantly less trismus with piezosurgery compared to rotary instruments after 2 days and 7 days postoperatively. (Table 1)

Table (1) *Showing VAS scores, facial contour (cm), and mouth opening (mm) comparing groups together.*

Variable	Time of assessment	(Mean ± SD)		P-Value	Sig.
		Group A	Group B		
VAS scores	Preoperative	1.74 ± 0.12	1.67 ± 0.09	0.62	NS.
	After 2 days	6.96 ± 0.22	5.44 ± 0.19	0.001***	Sig.
	After 7 days	2.98 ± 0.19	2.00 ± 0.01	0.001***	Sig.
Facial contour	Preoperative	9.99 ± 0.30	10.07 ± 0.13	0.82	NS.
	After 2 days	10.92 ± 0.10	10.66 ± 0.04	0.03*	Sig.
	After 7 days	10.59 ± 0.10	10.37 ± 0.09	0.03*	Sig.
Mouth opening	Preoperative	49.80 ±1.98	49.65 ± 0.83	0.94	NS.
	After 2 days	28.99 ± 0.73	32.41 ± 0.93	0.001***	Sig.
	After 7 days	42.9± 0.33	43.81 ± .32	0.04*	Sig.

** Significant at 0.05 percent, *** significant at 0.001 percent.*

DISCUSSION

Postoperative pain, trismus, and swelling are common sequelae of impacted lower third molar surgery. The severity of postoperative complications is related to the amount of tissue trauma occurring due to surgery. The present study aimed to evaluate the effect of using Piezosurgery on pain, swelling, and trismus after surgical extraction of impacted mandibular third molar. A lot of studies compared the effect of piezosurgery to the other osteotomy techniques[9,10].

In our study, the selected patients were free from any systemic diseases, and the mean age of the selected patients was found to be 22.53±0.39 years. This is accordant to **Blondeau** [11] who agreed that Surgical removal of impacted mandibular third molars should be carried out before the age of 24 years as the rate of postoperative complications increase with age. **Benediktsdo´ttir et al.**[12] reported that patients aged from 23.1 to 24.5 years had lower postoperative complications than the older age groups.

Our results showed a statistically significant difference between the 2 different osteotomy techniques regarding postoperative pain using a VAS from 0 to 10. The mean value of pain on the second and seventh days was lower in the piezosurgery group than in the control group.

These results are consistent with those of **Rullo et al.**[13] and **Mantovani et al.** [14] who evaluated the pain by using the VAS and discovered that patients who underwent surgery with piezosurgery demonstrated significantly less pain than those who underwent conventional removal, with a statistical difference.

That disagreed with **Jiang et al.** [15] and **Kirli Topco et al.** [16] as they reported no significant difference in pain between the piezosurgery and the rotary groups. However, the piezosurgery group had less pain in the first few days after surgery than the rotary group; the difference was nominal but not statistically significant.

In the current study, the total number of analgesics taken by the patients was significantly less with the piezosurgery compared to conventional group. This agree with **Barone et al.** [17] and **Goyal et al.** [10] who reported that the number of analgesics taken in the piezoelectric surgery group was significantly lower when compared with the control group.

These results of reduced postoperative pain and the total number of analgesics taken by the patients in the piezosurgery group result from minor disruption to the soft tissues during osteotomy by reducing heat generation.

All investigators measured swelling using different scales and tools [9,14,17,18]. In our study, the swelling was measured as described by **Amin and Laskin** [8]. We used that method because it is simple, non-invasive, and applicable with flexible rulers or tape.

Our results confirm that there was a statistically significant difference between the two groups on days 2 and 7 postoperatively. The peak of swelling in both groups was on the second post-operative day, which gradually decreased to a minimum over the course of a week. The edema values in the piezo group were found to be numerically lower than the control group.

Arakji et al.[9] found a similar pattern of results, reporting significant differences between control and test sides at 1, 7, and 14 days postoperatively compared to the mean on the test side, with swelling being greater on the control side. **Mantovani et al.** [14] found that the facial swelling on the side treated with rotating instruments was greater than that following piezosurgery, especially on the 7th day postoperatively.

On the other hand, **Srivastava**[19] who used the same method and reported that there was no statistically significant difference in vertical distance on the 1st, 3rd, and 7th days, while in horizontal distance, there was a significant difference on the 1st day with statistically no significant difference on the 3rd and 7th days in the Piezotome side when compared to the conventional rotary side. That disagreement may be related to the different methodologies for edema measurement.

Our results showed there was significantly less trismus with piezosurgery compared to rotary

instruments after 2 days and 7 days postoperatively. It demonstrated that the piezosurgery has better values for mouth opening at the second and seventh post-operative days compared to the conventional method.

Those results matched with **Arakji et al.** [9] who used the same method and found statically significant differences in mean measurements between baseline and after 1, 7, and 14 days compared to the mean in the piezosurgery group. Also, **Sortino et al.** [20] reported better values in mouth opening after 24 hours postoperatively with piezosurgery surgeries when compared to rotary surgeries.

Contrary to our results, **Chang et al.** [21] reported that there was no significant difference in the mouth opening score between the piezosurgery and control groups.

From all our results we conclude that the piezoelectric surgical technique in third molar extraction is safe and had less postoperative complications, these findings are in accordance with findings reported by **Al-Moraissi et al.** [22] who concluded that there was a significant reduction in postoperative sequelae with the piezoelectric surgical technique in third molar extraction. Piezosurgery devices that generate micro vibrations provide a less traumatic and more precise way of bone cutting and cause little damage to the bone and adjacent tissues with minimal hemorrhaging. So that piezosurgery is helpful alternative technique for osteotomy in impacted third molars surgery.

CONCLUSION

From the outcome of the results, it can be concluded that the use of piezoelectric surgery for bone removal during the extraction of impacted mandibular third molars reduces postoperative pain, trismus, and edema.

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