Original Research Paper

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"Refining the cut: A glimpse at piezosurgery and conventional rotary techniques in third molar surgery." A pilot study.

Abstract:
Piezosurgery is a surgical method that employs ultrasonic vibrations to accurately slice through bone tissue. It is frequently utilized in dental and maxillofacial operations for tasks such as bone extraction, bone reshaping, and implant insertion, providing advantages such as minimal soft tissue damage, decreased bleeding, and enhanced patient comfort.This pilot study includes ten subjects, it is a split mouth study in which bilateral third molar impactions are treated with piezosurgery and conventional rotary technique.For osteotomy, piezosurgery has been demonstrated to be a safe and efficient technique that maintains soft tissue integrity while reducing postoperative problems. Better postoperative healing is taken into consideration while compensating for the longer operating duration.The study concludes that piezosurgery is more efficient and minimally invasive advancement for maxillofacial surgeons, it needs precision and expertise.

Key-words: Piezosurgery, Osteotomy, Conventional Rotary, Advances In Maxillofacial Surgery

Introduction:

A simple and efficient way to remove enough bone is to use electricity-driven drills that rotated between 22,000 and 25,000 rpm. Additionally, they provided a reasonable amount of control over the amount of bone extracted. Conventional rotary techniques have several disadvantages, including the potential for excessive heat generation, the risk of tissue damage from aggressive cutting, the inability to navigate complex anatomy, the high dependence on equipment functionality, the limited tactile feedback, and the possibility of instrument failure in difficult formations. These issues frequently necessitate the use of specialised techniques for delicate surgical procedures or complex geological conditions.

The Greek word "Piezien," which denotes pressure, is the root of the English word "piezo." The formation of an electric charge across specific crystals under mechanical pressure is known as the piezoelectric effect, and it was initially explained by Jacques and Pierre Curie in 1880. On the other hand, they distort when an electric current is passed through them. Microvibrations or ultrasonic frequency oscillations are produced by this deformation process when alternating current is applied.

Piezosurgery was initially created by Tomaso Vercellotti (1988) as an alternative method to bone guttering in order to overcome the drawbacks of the rotary cutting instrument. This technology, which has demonstrated superior bone

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formation and wound healing capabilities, improved and refined the conventional ultrasonic approach.

Peizosurgery has several advantages, including high precision, a design that facilitates curvilinear osteotomy, less soft tissue stress, preservation of the neurological and circulatory systems, reduced bleeding, less heat damage to the bone, and an overall increase in healing. The sterile irrigation system and light-emitting diode (LED) light on the instrument's handpiece improve visibility and overall safety. Especially useful is piezoelectric surgery for delicate bone surgeries such as endodontic or periodontal surgery.

Aim & Objective:

This study aims to compare the duration of operation and the severity of postoperative complications, such as pain, oedema, and trismus, between piezosurgery and rotational osteotomy procedures.

Methodology:

The current study was conducted in the Department of Oral and Maxillofacial Surgery at Maharana Pratap College of Dentistry and Research Center, Gwalior.
After obtaining complete history, patients were examined clinically and were explained about the procedure, its complication and follow up period involved in the study. Ten subjects were taken in this split mouth study.Informed consent was taken prior to the procedure.

Inclusion Criteria:

Patient age 18 to 60 years.
Patient either male or female.
Surgical site is free of active infection.
Patient is free of significant systemic disease.

Exclusion Criteria:

Poor oral hygiene.
Medically compromised patient.
Pregnant or lactating women.
HIV infection/HBS infection
History of irradiation in head and neck

Procedure:

All procedures were performed by the same surgeon. Patients washed their mouths for one minute with 10% povidone-iodine mouthwash before to surgery. An inferior alveolar block and buccal anaesthesia were administered using 2 mL of 2% lignocaine HCl and 1:80000 epinephrine solution. A full-thickness envelope flap with a vertical release incision was reflected. In the control group, the overlaying bone was removed using a standard rotary handpiece and tungsten carbide burs while being thoroughly irrigated. In the experimental group, piezosurgery (DTE Woodpecker Ultrasurgerypiezosurgical equipment) was used for the same reason. The extraction incisions were repaired using 3-0 silk sutures. The period from flap elevation to suturing was documented as the "duration of the operation" (DO). Obtain written consent from patients included in the study.

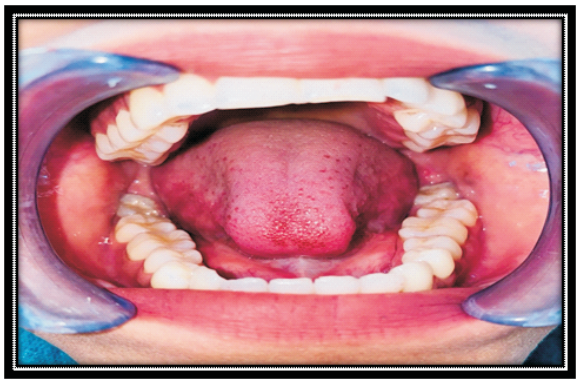

Figure 1, Intraoral Clinical photograph showing bilateral impacted third molar.

According to group A:

Patient has been operated under local anesthesia.
Extraction of impacted or partially erupted third molar is done using piezoelectric unit.
Gently handle extraction site for clot formation and pack the wound site with gauze piece and post operative instructions given to patient.
Patient were medicated for 5 days and follow up done – 1 day, 7 days, 14 days.

Figure 2, Extraction of partially erupted third molar will be done using Peizoelectric unit.

According to group B:

Patient has been operated under local anesthesia.
Extraction of impacted or partially erupted third molar is done using conventional rotary technique.
Gently handle extraction site for clot formation and pack the wound site with gauze piece and post operative instructions given to patient.
Patient were medicated for 5 days and follow up done – 1 day, 7 days, 14 days.

Figure 3 Extraction of partially erupted third molar will be done using Conventional Rotary Unit.

Results:

The present split mouth study included 10 patients with a mean age of 27.1 ± 6.573 years (minimum age= 18 years and maximum age= 40 years). There were equal number of male and females (5 each). The duration of surgery was significantly longer in Group A compared to Group B (36.6 + 2.319 minutes vs. 26.0 + 1.563 minutes) (p-value<.05). [Figure 1]

At first follow up, the swelling was significantly more in Group B compared to Group A with significantly greater number of subjects with severe swelling in Group B compared to Group A (p-value= .012). At second follow up, the severity of swelling was still more in Group B compared to Group A, however, the difference was statistically non-significant (p-value= .132). [Table 1]

At first follow up, the VAS score was significantly more in Group B compared to Group A (p-value= .012). At second follow up, the pain score was non-significantly different between the groups (p-value= .340). [Table 2]

At first follow up, the healing was non-significantly different between Group A and Group B (p-value>.05). Similarly, at second follow up, the healing was non-significantly different between Group A and Group B (p-value>.05). [Table 3]

Figure 1. Duration of surgery in Group A and Group B.

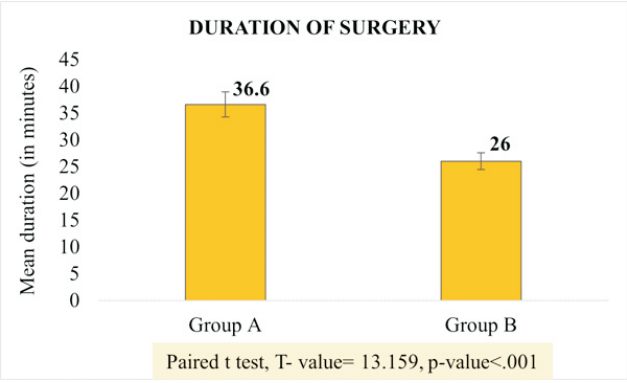

Table 1. Inter-group comparison of swelling at 1st and 2nd follow-up.

Time interval	Swelling	Group A (n=10)	Group B (n=10)	Standard MH statistics	p-value
1st follow up	Absent	0 (0.0%)	0 (0.0%)	-2.50	.012*
	Mild	7 (70.0%)	1 (10.0%)		
	Moderate	3 (30.0%)	5 (50.0%)		
	Severe	0 (0.0%)	4 (40.0%)		
2nd follow up	Absent	8 (80.0%)	4 (40.0%)	-1.508	.132
	Mild	2 (20.0%)	5 (50.0%)		
	Moderate	0 (0.0%)	1 (10.0%)		
	Severe	0 (0.0%)	0 (0.0%)		

Marginal homogeneity test. *Statistically significant.

Table 2. Inter-group comparison of VAS score at 1st and 2nd follow-up.

Time interval	Group A		Group B		Z value	p-value
	Median (IQR)	Mean rank	Median (IQR)	Mean rank		
1st follow up	4.0 (3.0- 5.25)	0.00	6.0 (5.0- 7.25)	5.00	-2.699	.007*
2nd follow up	1.0 (0.0- 1.25)	4.35	1.0 (0.0- 1.0)	3.90	-.954	.340

Wilcoxon sign rank test. *Statistically significant.

Table 3. Inter-group comparison of soft tissue healing at 1st and 2nd follow-up.

Time interval	Soft tissue healing	Group A (n=10)	Group B (n=10)	p-value
1st follow up	Satisfactory	7	4	.250
	Unsatisfactory	3	6	
2nd follow up	Satisfactory	10	9	.100
	Unsatisfactory	0	1	

McNemar test.

Discussion:

In recent years, piezosurgery has drawn a lot of attention because it can precisely cut bone while maintaining the integrity of soft tissue. With regard to operative time, postoperative pain, oedema, soft tissue healing, mouth opening, and changes in mesiodistal width, the current study sought to compare the effectiveness of piezosurgery with traditional rotational osteotomy.

The findings of this study show that, although piezosurgery may require more time to perform, it offers significant advantages by reducing trismus, discomfort, and oedema following surgery, as well as enhancing soft tissue recovery and preserving mesiodistal width. Because of these benefits, it is a significant substitute for conventional rotational osteotomy, particularly when exact bone preservation is required. To assess bone remodelling and healing over an extended period of time, long-term follow-up investigations are required.

For osteotomy, piezosurgery has been demonstrated to be a safe and efficient technique that maintains soft tissue integrity while reducing postoperative problems. Better postoperative healing is taken into consideration while compensating for the longer operating duration. For a number of surgical operations requiring accuracy and little tissue injury, piezosurgery may emerge as the method of choice as operator experience and technological advancements increase.

Duration of Operative Procedure:

Present study conclude showed that on average, piezosurgical patients (Group A) had a notably longer surgery time than those having a conventional rotary osteotomy (Group B)

These results correspond with research carried out by E Mantovani et al in 2014 and Qian Jiang et al. in 2015 noting that its micrometric cutting approach causes significant prolongation of operation, piezosurgery is greatly used. Still, the accuracy and lowered damage to surrounding tissues support its longer duration. In much the same direction, Troedhan and coauthors. Although piezosurgery requires longer, reduced postoperative morbidity was the conclusion.

Postoperative Swelling:

The present study showed significantly less swelling in the piezosurgery group at both follow-ups compared to the conventional osteotomy group. These findings similar with the results of studies by Sortino et al. (2012), Barone et al. (2013), and Troedhan et al. (2010), who found a 50% reduction in swelling when piezosurgery was employed. The cavitation effect, which enhances hemostasis and reduces edema, is responsible for this lesser post operative swelling. In contrary to study of Sivolella et al. (2011)which did not find significant differences in swelling on postoperative days 7 and 30.

Postoperative Pain:

Pain was assessed using the Visual Analog Scale (VAS) at different follow-ups. At the first follow-up, pain scores were significantly lower in the piezosurgery group, whereas at the second follow-up, no significant difference was observed. Our findings were similar with those of Rullo et al. (2013) and Mantovani et al. (2018), who reported that piezosurgery results in reduced s postoperative pain, due to its selective bone cutting and reduced trauma to surrounding tissues. While , some studies, such as those by Barone et al. (2013) and Sivolella et al. (2011), did not observe significant differences in pain scores.

Soft Tissue Healing:

Soft tissue healing was assessed at different follow-ups. Although less significant difference was noted between the groups at the first follow-up, by the second follow-up, both groups demonstrated similar healing pattern. These findings are as similar as Piersanti et al. (2016), who reported that piezosurgery induces an earlier increase in bone morphogenetic proteins (BMPs), thereby facilitating faster healing.

Conclusion:

In oral and maxillofacial surgery, piezoelectric bone surgery is a new and exciting field. Compared to hand tools, a surgical bur, or an oscillating saw, it provides substantial advantages in a surgical location with limited access or close to critical neurovascular systems. Collateral damage is less likely with piezoelectric bone cutting since it requires less force. Compared to other instruments, the high luminosity LED lights, the improved visibility of the sterile irrigation system, the ability to perform curvilinear osteotomy lines with precision, the selective cutting of mineralised tissue, the effect of sparing neurovascular structures, the reduction in bleeding, and the improved visibility more than make up for a slightly longer cutting time.

Piezosurgery can benefit the operator by allowing precise, clear osteotomies to be performed in a transparent, bloodless field without putting soft tissues and nerves at risk. Piezosurgery can also benefit the patient by reducing postoperative oedema and trismus and speeding up the healing process.

Furthermore, because of its positive effects on bone healing and osteogenesis as well as its capacity to prevent osteonecrosis, piezosurgery is a valuable addition to the dental implant inventory. Piezosurgery appears to be a very advanced and conservative procedure in comparison to the methods used today to treat soft tissues and bone.

According to our research, using piezosurgeryis a fantastic method to improve the recovery period and reduce the likelihood of complications.

For efficient surgical preparation, appropriate preoperative patient evaluations are also essential.

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