Journal of Oral Biology and Craniofacial Research 10 (2020) 615–618

Contents lists available at ScienceDirect

Journal of Oral Biology and Craniofacial Research

journal homepage: www.elsevier.com/locate/jobcr

Original Article

Comparison of piezosurgery and conventional rotatory technique in transalveolar extraction of mandibular third molars: A pilot study

Nouman Rashid[a,*], Vivekanandhan Subbiah[b], Padmanidhi Agarwal[a], Shailesh Kumar[a], Adity Bansal[a], Neeraj[a], Srinivas Gosla Reddy[a], Ashi Chug[a]

[a] Department of Dentistry, Oral and Maxillofacial Surgery, All India Institute of Medical Sciences (AIIMS), Virbhadra Road, Rishikesh, Uttarakhand, India
[b] Department of Biochemistry, All India Institute of Medical Sciences (AIIMS), Virbhadra Road, Rishikesh, Uttarakhand, India

ARTICLE INFO

Keywords:
Impacted tooth
Osteotomy
Piezo-electric surgery
Cortisol
Third molar

ABSTRACT

Objectives: To compare the postoperative outcomes in impacted mandibular third molar extraction using piezosurgery and conventional rotary technique; and to assess the stress levels in both the techniques by measuring salivary cortisol levels.

Methods: Ten patients with symmetrical impacted lower third molars were included in this split mouth pilot study. Measurements for mouth opening and swelling were taken preoperatively on the day of surgery and 1 week after surgery. Pain was evaluated using Visual Analog Scale (VAS) from first postoperative day for six consecutive days. Saliva collection for analysis of cortisol levels was done at four time intervals – before starting the procedure, immediately after the procedure, 20 min and 1 week later. The mean in two groups was compared using paired t-test/Wilcoxon signed rank test as applicable. Friedman test was used to compare multiple readings of pain and salivary cortisol.

Results: Reduction in mouth opening was more in rotary group than piezosurgery group but was not statistically significant ($p = 0.092$). Increase in facial swelling was more in the rotary group than piezosurgery group with statistically significant values ($p = 0.020$). Rotary group had higher values for postoperative pain as compared to piezosurgery on all the days and the difference was statistically significant on each day except second postoperative day. Salivary cortisol levels were elevated in both the groups with the mean values higher in group I (rotary) than in group II (Piezosurgery).

Conclusion: Extraction of impacted lower third molar results in more favourable outcome when carried out by piezosurgery technique. Further studies are needed to compare the salivary cortisol response in rotary and piezosurgery techniques.

1. Introduction

Extraction of impacted third molars is one of the most common oral surgical procedure done under local anesthesia.[1] The transalveolar extraction of impacted lower third molars produces a significant degree of trauma to the surrounding hard and soft tissues, which results in inflammation manifesting as pain, edema and reduced mouth opening.[2] Osteotomy is one of the most critical steps involved and various methods have been described.

When conventional rotary bur technique is used for osteotomy, marginal osteonecrosis is produced due to high temperature during the procedure due to which continuous irrigation of saline is required.[3]

Recently, piezoelectric surgery technique has been used to overcome the disadvantages associated with conventional rotatory technique. Piezoelectric technique (Piezotome) uses an alternating current, which when applied results in alternate expansions and contractions of the crystal.[4] Its handpiece has an oscillation frequency of 28–36 KHz with the following advantages: microsurgical precision and selective hard tissue cutting action, which reduces the chances of inferior alveolar or lingual nerve damage.[5]

Increased patient stress during tooth extraction results in the stimulation of adrenal cortex to increase the secretion of cortisol.[6] It has

* Corresponding author. Department of Dentistry, Oral and Maxillofacial Surgery, All India Institute of Medical Sciences (AIIMS), Virbhadra Road, Rishikesh, Uttarakhand, 249203, India.
E-mail addresses: noumankmr@gmail.com (N. Rashid), svivek_aiims@yahoo.com (V. Subbiah), padmanidhi.agarwal@gmail.com (P. Agarwal), way2shailesh@gmail.com (S. Kumar), aditybansal@rediffmail.com (A. Bansal), ntekaria1@gmail.com (Neeraj), goslareddy@gmail.com (S.G. Reddy), ashichug@gmail.com (A. Chug).

https://doi.org/10.1016/j.jobcr.2020.08.021
Received 24 July 2020; Received in revised form 27 August 2020; Accepted 28 August 2020
Available online 31 August 2020

been suggested that reduced noise and vibrations produced by the piezoelectric unit can help reduce such stress and hence be more psychologically comfortable for the patient. However, no objective data exists to support this claim.[7] Also it is a fact that salivary cortisol concentrations reflect the physiologically unbound fraction of blood cortisol that is biologically active.[6]

Due to multiple advantages associated with piezoelectric surgery, we compared its surgical outcomes of pain, trismus and swelling with the widely popular rotatory technique using a split mouth study in transalveolar extraction of mandibular third molars.

We also measured changes in salivary cortisol levels for evaluation of stress response to the surgical procedure, as it is an acceptable and non-invasive method.

2. Material and methods

This split mouth study was conducted from December 2018–March 2020 in patients with presence of bilateral symmetrical impacted lower third molars with a similar extraction difficulty (as per Pederson difficulty index[8]) and with an age ranging from ≥18 years to ≤ 40 years. Patients were randomly allocated into the two said groups via computer generated random allocation method.

Patients with the following conditions were excluded from the study: teeth affected with acute infections, such as pericoronitis, an acute alveolar abscess, patients on steroid therapy, patients with conditions in which there is probable altered cortisol levels, patients affected with conditions in which there is decreased salivary secretion (e.g; patients taking atropine, antidepressants, calcium channel blockers, antihistamines, Sjogren's syndrome, and radiotherapy), a known case of diabetes mellitus and/or hypertension, alcoholic patients, patients with smoking habits, pregnant patients, lactating mothers and patient allergic to penicillin or other drugs used in the postoperative period.

This study followed the statement of ethical principles for medical research involving human subjects as per 'Declaration of Helsinki'. All patients were informed about the procedure and possible complications involved and signed a detailed informed and written consent form. Treatment began after obtaining full medical history and after radiologic investigations i. e; orthopantomograms (OPG).

2.1. Surgical technique

Following local anesthesia (2% lignocaine with 1:2,00,000 adrenaline), a conventional 'Ward's incision' was made and reflection of a mucoperiosteal flap was done with a periosteal elevator (Molt no 9) to expose the underlying tooth and bone. Bone overlying the tooth was removed by standard 'Moore-Gillbe Collar' technique. In group I, conventional rotary method was used with a carbide fissure bur under copious irrigation with normal saline while in group II, osteotomy was carried out using piezotome surgical kit. Tooth sectioning was done using bur while taking care to avoid contact with bone. Tooth was removed and closure done with 3–0 non-absorbable black braided silk suture. Pressure pack was then placed over the extraction site following which standard postoperative instructions were given.

2.2. Variables assessed

Pain was evaluated on postoperative days 1, 2, 3, 4, 5 and 6 using Visual Analog Scale (VAS). Mouth opening and swelling were evaluated immediately before starting the surgery and on 7th postoperative day. Mouth opening was evaluated by measuring the interincisal distance (millimeters) with a ruler at maximum mouth opening position from mesioincisal angle of upper right central incisor to mesioincisal angle of lower right central incisor.

Swelling was evaluated by a method described by Schultze-Mosgau et al.[9] Measurements were taken using a flexible scale in closed mouth position by marking five fixed points and three surgical base lines connecting the said fixed points as depicted in Fig. 1.

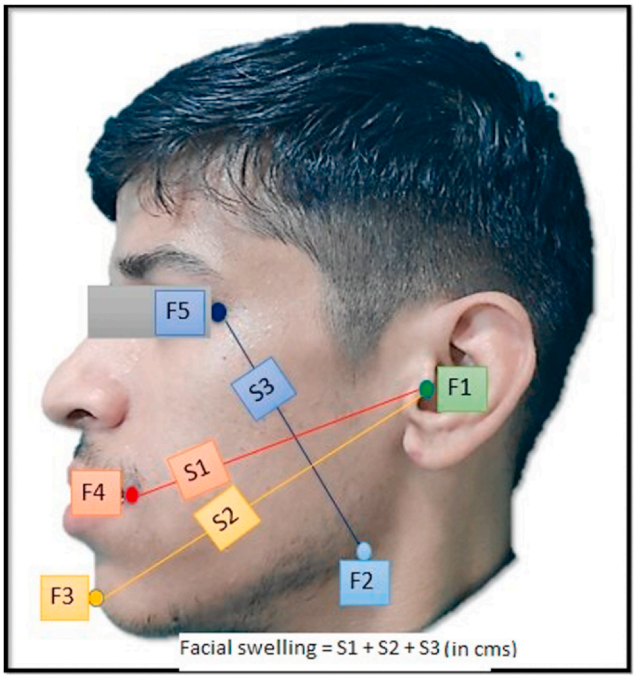

Fig. 1. Measurement of facial swelling, Showing 5 fixed points (F1 – tragus of ear, F2 – angle of mandible, F3 – soft tissue pogonion, F4 – Corner of mouth, F5 – lateral canthus of eye) and 3 surgical base lines (S1 – from tragus of ear to corner of mouth, S2 – from tragus of ear to soft tissue pogonion, S3 – from lateral canthus of eye to angle of mandible).

Estimation of salivary cortisol levels was done by collecting saliva from the patients at four fixed intervals of time: before starting the surgery, immediately after surgery, twenty minutes later and after 1 week. Patients were asked to refrain from vigorous exercise for two hours prior to the collection of saliva. Sample collection was done between 10.00 am and 2.00 pm to standardize the diurnal variations in the secretion of cortisol. Patient were asked to collect the saliva by passive drooling into a sterile sample container. Samples were discarded if there was any evidence of blood contamination. Each sample was labelled and frozen at −20 °C in a freezer until analysis. Salivary cortisol analysis was done using a Salivary Cortisol ELISA kit (DBC Salivary Cortisol ELISA Kit).

Duration of surgery was also recorded between placement of incision and the placement of last suture. Patient was then recalled after 30 days for surgical extraction of the contralateral mandibular third molar with the other technique.

2.3. Data analysis

Data was arranged in Excel spread sheet while taking care to ensure that there was no data entry error. Continuous variables were described as mean ± standard deviation or median with interquartile range as applicable. The mean in two groups was compared using paired t-test/ Wilcoxon signed rank test as applicable. Repeated measures analysis using Friedman test was done to compare multiple readings of pain and salivary cortisol.

3. Results

Six patients were females and four were males with age range of 21–32 years (mean age of 24.7 years). On comparing the duration of time taken for surgery, the mean ± standard deviation was 37.3 ± 6.98 min in the rotary group, while in the piezosurgery group,

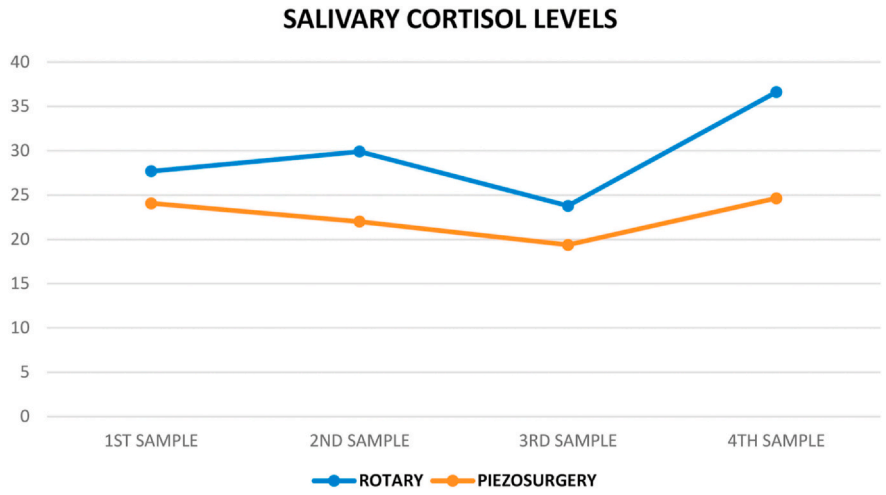

Fig. 2. Graph showing comparison of salivary cortisol levels between rotary group and piezosurgery group.

it was 44.6 ± 9.47 min. There was a statistically significant difference in the time duration of surgery between the two groups with a p value of 0.005857.

When the comparison was done between the 2 groups for post-operative pain, rotary group had higher mean values as compared to piezosurgery on all the days (Table 1). Increase in the facial swelling was more in the rotary group than the piezosurgery group with a p value of 0.020 (Table 2). Reduction of mouth opening was more in the rotary group as compared to the piezosurgery group in the post-operative period but the values were not statistically significant (P = 0.09218) (Table 3).

A comparison of salivary cortisol levels of the four samples in the rotary group revealed no statistically significant difference between the values with a p value of 0.1005. Also, third salivary sample had the lowest mean of the four samples (23.77 ± 11.77).

Intragroup comparison of salivary cortisol levels in piezosurgery group also revealed lowest value in the third salivary cortisol sample (19.36 ± 8.01) and no statistically significant difference was found between the values with a p value of 0.5164.

When the salivary cortisol levels were compared between the rotary and piezosurgery groups, no statistically significant difference was observed for salivary cortisol samples 1, 2, 3 and 4 (P value > 0.05). Fig. 2.

In our study, no patient presented with any nerve paresthesia like inferior alveolar or lingual nerve paresthesia in the postoperative period in either of the groups. Wound healing was satisfactory in both the groups. There was no incidence of dry socket or wound dehiscence in either of the two groups.

Table 1
Comparison of VAS pain score between rotary and piezosurgery groups.

Postoperative day	Group	Mean (SD)	Median	P value
1	Rotary	6.2 (3.04)	5.00	0.02475[a]
	Piezosurgery	4.6 (2.67)	4.00	
2	Rotary	4.8 (3.15)	4.00	0.07488[a]
	Piezosurgery	3.3 (1.88)	4.00	
3	Rotary	4 (3.65)	2.00	0.03351[a]
	Piezosurgery	2 (2.11)	2.00	
4	Rotary	3 (2.35)	2.00	0.05447[a]
	Piezosurgery	1.70 (1.88)	2.00	
5	Rotary	2.4 (1.83)	3.00	0.01966[a]
	Piezosurgery	1.2 (1.39)	1.00	
6	Rotary	2.2 (1.75)	2.00	0.01966[a]
	Piezosurgery	1 (1.05)	1.00	

[a] Wilcoxon signed rank test with continuity correction.

Table 2
Comparison of increase in swelling between rotary and piezosurgery techniques.

Group (N)	Median	Mean	P value
Rotary (10)	0.500	0.6526	0.02077[a]
Piezosurgery (10)	0.250	0.4571	

[a] Wilcoxon signed rank test with continuity correction.

Table 3
Comparison of reduction in mouth opening between rotary and piezosurgery groups.

Group	Median	Mean	P value
Rotary (10)	15.00	14.13	0.09218[a]
Piezosurgery (10)	7.00	10.54	

[a] Wilcoxon signed rank test with continuity correction.

4. Discussion

Any surgical insult to the oral tissues produces inflammation in the post-surgery period which manifests as pain, swelling and a reduction in mouth opening (trismus) the degree of which depends on the duration of surgery, site involved, surgeon's experience, degree of tissue injury, the technique used, patient's systemic health status and associated medical therapy.[10] These three variables (pain, swelling and trismus) were assessed in transalveolar removal of lower third molars and a comparison of these variables was done with rotary technique versus piezosurgery technique.

Transalveolar extraction using piezosurgery took a longer time as compared to the rotary method in our study which was equivalent to the results of studies conducted by Sivolella at al,[11] Basheer et al.,[12] Mozatti et al.,[13] Bartuli et al.[14] and Mantovani et al.[15] Studies conducted by Basheer et al.,[12] Goyal et al.[16] and Mantovani et al.[15] concluded that piezosurgery technique resulted in less postoperative pain as compared to rotary technique, hence favouring our study results. However, study done by Chang et al.,[7] Piersanti et al.[17] and Bartuli et al.[14] found no statistically significant differences between the pain in rotary group and piezosurgery group. Postoperative pain is predominantly a consequence of inflammation caused by tissue injury.[18] In piezosurgery, bone at microscopic level has a much favourable osseous response due to reduced marginal osteonecrosis, therefore it resulted in less pain.[3]

Results for swelling were similar to that obtained by Piersanti et al.,[17] Mantovani et al.[15] and Chang et al.[7] which can be attributed to

the reduced trauma to the bone and surrounding soft tissues as well as the hemostatic effect on the capillaries in a traumatized bone when piezosurgery is used.[3] Study done by Basheer et al.[12] had results of trismus similar to that in our study. However, studies conducted by Chang et al.[7] and Sivolella et al.[11] showed no statistically significant differences between the 2 groups. Inspite of different results obtained in previous studies, a recent metanalysis has found reduced postoperative sequelae in piezosurgery technique.[19]

Even though a longer surgery time was required for piezosurgery technique, it resulted in better postoperative outcomes in our study. This can be attributed to the specific characteristics of piezosurgery cutting mechanism. The microsurgical precision in the cutting due to micro vibrations with linear oscillation of 20–80 μm, as well as the selective action on hard mineralized tissues resulted in a much favourable outcome.[5] In piezosurgery, the need for pressure application is reduced as compared to conventional technique, hence increasing surgical control for the operator. The ultrasonic vibrating insert on contact with the saline solution produces microscopic vapor bubbles which leads to *cavitation phenomenon*, improving the visibility of operative field by limiting the extravasation of blood. Scanning electron microscope studies have demonstrated irregular surface in surgical field while using bur in rotary handpiece, whereas a perfectly clean surface immediately covered with fibrin is observed after bone cutting using piezosurgical technique.[5]

Piezosurgery can be considered as a better alternative to conventional rotary technique especially in mandibular third molars with a less surgical difficulty.[3] Our study, with only one patient having a severe Pederson difficulty index score, also demonstrated better postoperative results using piezosurgery technique similar to the results obtained in previous studies.

Salivary cortisol represents that portion of serum cortisol which is biologically active.[20] Advantages of salivary cortisol measurements include ease of sample collection and lack of the psychologic stress of puncturing the vein.[21] Salivary cortisol levels have been known to elevate after tooth extraction as per literature with the highest levels of salivary cortisol found after 15 min of tooth extraction with a significant variation in the sample values (p value = 0.002).[22] Even though the salivary cortisol levels were elevated in our study, the pattern of elevation was quite different from the previous studies. The mean values in both the groups were recorded lowest in the third sample (i.e twenty minutes post extraction). Also, both the groups demonstrated an unexpected increase in mean salivary cortisol levels in the 4th sample (i.e one week post extraction). This can be attributed to the stress resulting from psychological fear of the recent surgical process or the fear of possibility of pain experienced in the subsequent visit after one week.

This is the first study which has compared the postoperative salivary cortisol response in rotary and piezosurgery techniques. Our limitation was a small sample size used in our study. Randomized controlled studies with a large sample size are needed in the near future.

5. Conclusions

The piezosurgery technique was a better alternative to rotary technique in terms of postoperative outcomes of pain, edema and trismus inspite of the increased surgery duration in piezosurgery technique. Salivary cortisol level seems to be a valid indicator of intraoperative stress, therefore it is suggested that further scientific work is needed to study the nature of salivary cortisol response in transalveolar extraction of lower third molars.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Declaration of competing interest

There is no conflict of interest to declare by the authors.

References

1. Santosh P. Impacted mandibular third molars: review of literature and a proposal of a combined clinical and radiological classification. *Ann Med Health Sci Res.* 2015;5(4):229–234.
2. Syed KB, Alqahtani FHK, Mohammad AHA, Abdullah IM, Qahtani HSH, Hameed MS. Assessment of pain, swelling and trismus following impacted third molar surgery using injection dexamethasone submucosally: a prospective, randomized, crossover clinical study. *J Int Oral Health.* 2017;9(3):116–121.
3. Rullo R, Addabbo F, Papaccio G, Aquino RD, Maria V. Piezoelectric device vs conventional rotative instruments in impacted third molar surgery : relationships between surgical difficulty and postoperative pain with histological evaluations. *J Cranio-Maxillofacial Surg.* 2018;41(2):e33–e38.
4. Rahnama M, Czupkałło Ł, Czajkowski L, Grasza J, Wallner J. The use of piezosurgery as an alternative method of minimally invasive surgery in the authors' experience. *Wideochirurgia I Inne Tech Maloinwazyjne.* 2013;8(4):321–326.
5. Vercellotti T, Nevins ML, Kim DM, et al. Osseous response following resective therapy with piezosurgery. *Int J Periodontics Restor Dent.* 2005;25(6):543–549.
6. Patil A, Tamagond S, Patil S, Shah P, Patil J, Shigli A. Assessment of the changes in the stress-related salivary cortisol levels to the various dental procedures in children. *J Indian Soc Pedod Prev Dent.* 2015;33(2):94–99.
7. Chang HH, Lee MS, Hsu YC, Tsai SJ, Lin CP. Comparison of clinical parameters and environmental noise levels between regular surgery and piezosurgery for extraction of impacted third molars. *J Formos Med Assoc.* 2015;114(10):929–935.
8. Pederson GW. Surgical removal of tooth. *Pederson Oral Surgery.* Philadelphia WB Saunders; 1988.
9. Schultze-Mosgau S, Schmelzeisen R, Frölich JC, Schmele H. Use of ibuprofen and methylprednisolone for the prevention of pain and swelling after removal of impacted third molars. *J Oral Maxillofac Surg.* 1995;53(1):2–7.
10. Paruk F, Chausse JM. Monitoring the post surgery inflammatory host response. *J Emerg Crit Care Med.* 2019;3:47–60.
11. Sivolella S, Berengo M, Bressan E, Fiore A Di, Stellini E. Osteotomy for lower third molar germectomy: randomized prospective crossover clinical study comparing piezosurgery and conventional rotatory osteotomy. *J Oral Maxillofac Surg.* 2011;69(6):e15–23.
12. Basheer SA, Jay Govind R, Daniel A, Sam G, Adarsh VJ, Rao A. Comparative study of piezoelectric and rotary osteotomy technique for third molar impaction. *J Contemp Dent Pract.* 2017;18(1):60–64.
13. Mozzati M, Gallesio G, Russo A, Staiti G, Mortellaro C. Third-molar extraction with ultrasound bone surgery: a case-control study. *J Craniofac Surg.* 2014;25(3):856–859.
14. Bartuli FN, Luciani F, Caddeo F, et al. Piezosurgery vs high speed rotary handpiece: a comparison between the two techniques in the impacted third molar surgery. *Orale Implantol.* 2013;6(1):5–10.
15. Mantovani E, Arduino PG, Schierano G, et al. A split-mouth randomized clinical trial to evaluate the performance of Piezosurgery compared with traditional technique in lower wisdom tooth removal. *J Oral Maxillofac Surg.* 2014;72(10):1890–1897.
16. Goyal M, Marya K, Jhamb A, et al. Comparative evaluation of surgical outcome after removal of impacted mandibular third molars using a Piezotome or a conventional handpiece: a prospective study. *Br J Oral Maxillofac Surg.* 2012;50(6):556–561.
17. Piersanti L, Dilorenzo M, Monaco G, Marchetti C. Piezosurgery or conventional rotatory instruments for inferior third molar extractions? *J Oral Maxillofac Surg.* 2014;72(9):1647–1652.
18. Ramsay MA. Acute postoperative pain management. *Baylor Univ Med Cent Proc.* 2000;13(3):244–247.
19. Al-Moraissi EA, Elmansi YA, Al-Sharaee YA. Does the piezoelectric surgical technique produce fewer postoperative sequelae after lower third molar surgery than conventional rotary instruments? A systematic review and meta-analysis. *Int J Oral Maxillofac Surg.* 2016;45(3):383–391.
20. Greabu M, Purice M, Totan A, Spînu T, Totan C. Salivary cortisol-marker of stress response to different dental treatment. *Rom J Intern Med.* 2006;44(1):49–59.
21. Miller CS, Dembo JB, Falace DA, Kaplan AL. Salivary cortisol response to dental treatment of varying stress. *Oral Surg Oral Med Oral Pathol Oral Radiol.* 1995;79(4):436–441.
22. Kareem JJ, Radhi H, Hassan AF. Influence of dental extraction on patient's stress and anxiety levels by assessing the salivary cortisol concentration at different time points during the extraction procedure. *Mustansiria Dent Journal.* 2012;9(2):208–217.