

Minimally traumatic extraction techniques in nonrestorable endodontically treated teeth: A comparative study

ABSTRACT

Aim: The goal of this study was to assess the effectiveness of piezotome as compared to periotome extractions of nonrestorable endodontic treatment of teeth in terms of operational time, pain control, and postoperative bone loss considering the prosthetic rehabilitation in future.

Materials and Methods: A double-blind, randomized controlled trial was conducted with 100 patients who wanted single-rooted teeth to be extracted (which failed endodontically). The participants have been randomized into two equal groups named as - (i) a periotome group (ii) and a piezotome group. Duration of the surgery, postoperative pain within 7 days, complications (if any) associated with the extraction process were performed as a part of clinical assessment. Bone loss has been analyzed 6 months after the surgery radiographically. The data have been recorded and analyzed using the version 22.0 of the SPSS software package.

Results: All parameters in the periotome category ($P < 0.05$) were statistically significant except for bone loss and gingival laceration in comparison to piezotome group. In the piezotome group, a longer time was observed for surgery and delayed pain control was achieved. In our study, we found statistically significant more marginal bone loss in piezotome group in comparison with periotome group.

Conclusion: The findings of this study indicate that for intraoperative and postoperative comfort periotome could be used as a safer and cheaper option for atraumatic extractions but piezosurgery may prove as a better choice soon for surgeries in the maxillofacial region to maintain soft-tissue integrity.

Keywords: Atraumatic extraction technique, periotome, piezotome

INTRODUCTION

Over the past few decades, the scientific literature of maxillofacial surgery has enhanced its wings in a wide variety of areas including neurovascular reconstruction, craniofacial surgery, and distraction osteogenesis. However, in many countries, the bread and butter of most maxillofacial surgeons appear to be exodontia including routine extractions as well as impacted tooth removal.

A complex cascade of biochemical and histologic events ensues during postextraction wound healing that leads to physiologic changes in the alveolar bone as well as soft-tissue architecture.^[1] The least traumatic the extraction procedure, the lesser are the alterations in soft and hard tissue. This led to the introduction of atraumatic techniques of tooth extraction aimed at extracting the tooth or tooth's root while

preserving gingivae, bone, and other soft and hard tissue underlying structures for easier prosthetic rehabilitation

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in future. There are many methods for minimally invasive dental extraction techniques available including piezosurgery, physics forceps, periotome, benex vertical extractor, and many more which aids in maintaining adequate bulk of bone that is a prerequisite in intraosseous implant placement. Periotome has been used in extracting the tooth without causing damage to the osseous structure of endodontically treated teeth as well as fractured crown cases maintaining the hard- and soft-tissue architecture.^[2]

Moreover, when mentioning extraction with minimal damage to surrounding soft tissue, piezosurgery stands for an innovative technique for osteotomy which uses the micro-vibrations of scalpels at an ultrasonic frequency to enable surgeons to work on the bone with more efficiency without injuring the surrounding soft tissue integrity.^[3]

The proponents of both periotome and piezotome have claimed to reduce soft-tissue injury and minimizing bone loss in the future too. Although many case reports and studies have advocated the use of periotome or piezosurgery individually, not many have studied the use of both periotome and piezotome in endodontically treated teeth which are more prone to fracture during extraction.

We therefore performed a prospective, double-blind, and randomized controlled study to test the effectiveness of piezotome as well as periotome in the extraction of endodontically treated teeth that failed to restore.

MATERIALS AND METHODS

A prospective, double blind, randomized controlled study was conducted with 100 patients (58 women and 42 men) reported to the “Department of Oral and Maxillofacial Surgery,” who wanted single-rooted teeth to be extracted (which failed endodontically) [Figures 1, 2 and Diagram 1]. The analysis was approved by the “Research and Ethics Committee of the institution.” Each patient received informed permission and clarification of the goals, effects, and potential risks of

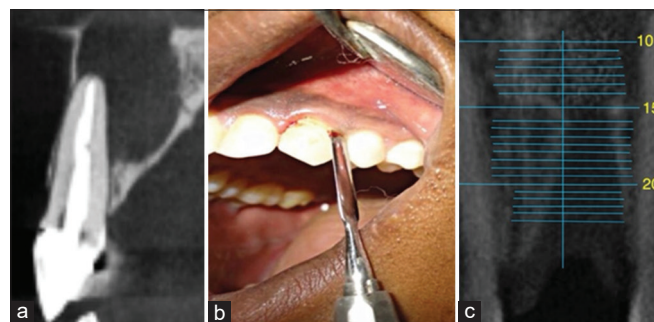


Figure 1: (a) Cone-beam computed tomography of RC treated tooth (b) using periotome (c) extraction done

this clinical trial before enrollment. The computer-generated randomization method has been used for the random assignment of groups (A piezotome group or B periotome group). Therefore, 50 extractions have been made for each process. Presurgical planning including radiographic evaluation as well as case history was performed for each patient. Aseptic tooth extraction was performed under local anesthesia (LA) (2% lignocaine with 1:200,000 adrenaline) and every patient received postextraction antibiotics and instructions. For Ethical Clearance was obtained from Institutional Ethical Committee- SRCD SR Ethical Committee with Ref no SRCD SR/ACAD/2020/8496 dated 20.08.2020).

The Hu-Friedy periodontal probe was used to measure preextraction bone level (Peb). For the measurements on the labial side of the tooth to be removed, three points were chosen (middle third, distal third, and mesial third). The marginal height of the bone has been determined by inserting the probe into the gingival sulcus depth, and Peb was measured at every point.

In the periotome group, Hu-Friedy’s periotome was kept in a modified pen grasp and positioned at 20° on the long tooth axis into gingival sulcus after the clinical examination of the tooth to be removed. It was used to first detach the cervical gingival fibers, then proceeded to periodontal ligament space several millimeters tangentially to the root surface to break down the periodontal ligament fibers and the same movement was repeated until 2/3rd distance toward the root apex was reached and the access was achieved.

In piezotome group, SATLEC ACTEON piezotome was used. LC 2 tips were secured to the handpiece and used for all four surfaces. The vibrating osteotomy blade tip was inserted in

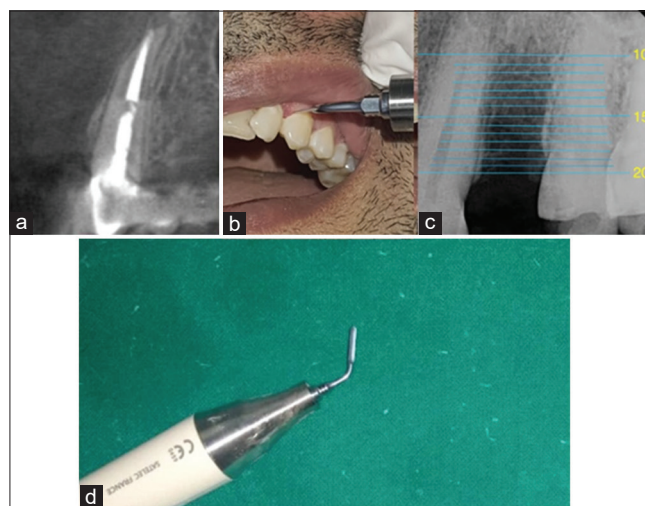


Figure 2: (a) Preop cone-beam computed tomography (b) Using piezotome (c) 6 months postop extraction with piezotome (d) piezotome instrument

between the bone and the root underlying gingivae. The blade was advanced in a sweeping movement maintaining the parallelism along the tooth axis and moved toward the apex in small increments of 2–4 mm.

Periodontal ligament cutting was replicated on all four surfaces for both groups until the root was mobilized entirely. After that, the extraction of a tooth was aided with tooth particular forceps.

Pain was evaluated with “Visual Analog Scale” before LA administration, preoperatively, and postoperatively throughout the 7 days. The procedure duration was estimated from administering LA onwards to completion of the tooth extraction during the intraoperative process. Complications, if any (bone plate fracture, excessive bleeding, delayed wound healing, pain beyond 7 days, and dry socket) and gingival laceration were assessed immediately postoperatively as well as during the 7 days postoperative phase.

After extraction, the distance between the marginal bone and the gingival has been calculated and known as “postextraction bone level” (Pob). It has been determined by positioning the Hu-Friedy probe at previously selected points at the edges of the socket. The difference between Pob and Peb has been recorded, the marginal bone loss’s amount has been revealed by the difference in the evaluation of the bone loss during the procedure between these two mean values. Furthermore, bone loss was assessed by comparing the cone-beam computed tomography obtained preoperatively and 6 months postoperatively (considering the nearest anatomic landmark). The following parameters have also been collected sex, age, tooth, Periodontal Disease Index (PDI), the operator, and mobility grade. The investigators and the patients were blinded to avoid bias.

Statistical significance was $P < 0.05$, and data on 100 participants were collected from radiographic and clinical results and assessed with SPSS Version 22.0 (“Statistical Package for Social Sciences”).

RESULTS

There were 100 people (58 women and 42 men) registered, 4 people (2 in piezotome and 2 in periotome group) lost since they have not come for follow-ups. The finding was based on the analysis of 96 patients and in both groups, there were 48 patients. They were between 20 and 55 years with a mean age of 32.47 years.

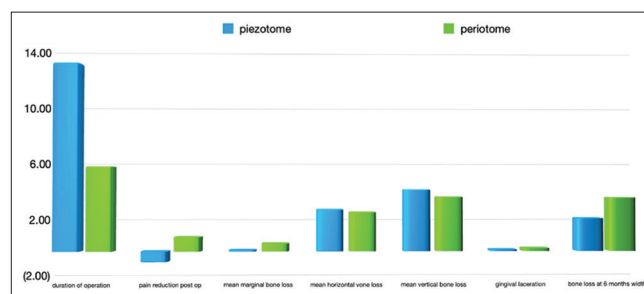
In this analysis, all teeth removed were single-rooted teeth that had failed root canal therapy. Clinical parameters such

as loss of marginal bone, extraction time, postoperative pain reduction and bone loss at 6 months were recorded. Graph 1 and Table 1 reveal that the procedure duration in piezotome group was substantially longer than that of the periotome group ($P < 0.01$). Periotome group pain relief was substantially higher than piezotome group when an intergroup comparison was made. In three patients, gingival lacerations have been noticed – 2 in periotome and 1 in piezotome group but not of statistical significance as per the grading score. Mean marginal bone loss immediate postoperative was assessed with independent samples *t*-test which was 0.0832 mm (± 0.56 mm) in piezotome group and 0.5433 (± 0.24 mm) in periotome group. The difference between two groups ($P < 0.05$) was statistically important. Bone loss 6 months postoperative was also assessed using independent samples *t*-test. It was assessed in horizontal and vertical parameters with a mean height loss of 4.21 mm (± 0.26 mm) and mean buccolingual width loss of 2.85 mm (± 1.28) in piezotome group. Mean height loss was 3.71 (± 1.24) mm and mean buccolingual width loss was 2.67 (± 2.24) mm in periotome group. On analysis, it was not statistically relevant ($P > 0.05$), even in the piezotome group the bone loss was more.

Complications such as a dry socket and buccal plate fracture were rarely observed and were of no statistical significance among both the groups, although on the 7th day, moderate pain was more experienced in piezotome patients. To avoid bias, all the extractions were performed by operators with similar experience and single observer was appointed to assess the clinical and radiographic parameters (keeping the procedure performed blind). On multiple comparisons, no correlation between various variables (surgery length, pain reduction, complications, bone loss) and the grade of tooth mobility and PDI has been noticed.

DISCUSSION

The traditional dental extractions involve reflection of a mucoperiosteal flap combined with tooth elevation against surrounding bone to aid extraction with forceps. Extraction



Graph 1: Different parameters assessed in periotome and piezotome group

Table 1: Different parameter values in both groups

	Group	N	Mean Std deviation	Std error mean	P value
Duration of Operation	Piezo	50	12.816±7.3938	1.0456	0.0002
	Perio	50	5.7801±4.0437	0.5718	
Pain reduction in post op	Piezo	48	-0.7080±2.3069	0.3216	0.002
	Perio	48	0.9854±2.754	0.3432	
Gingival Laceration Grade	Piezo	50	0.1012±0.9035	0.6778	0.08
	Perio	50	0.2000±0.64218	0.09035	
Marginal Bone loss at surgery	Piezo	50	0.08324±0.2432	0.0512	0.007
	Perio	50	0.5433±0.2482	0.0476	
Bone Loss at post op 6 months width	Piezo	Width	2.254±4.2133		0.9
		Height	2.9133±0.2633		
	Perio	Width	3.6733±2.2415		
		Height	4.12±2.2280		
Mean Horizontal bone Loss	Piezo	Width	4.2142±2.6711		
	Perio	Height	3.7122±1.2432		
Mean Vertical Bone loss	Piezo	Width	0.0832±0.56		
	Perio	Height	0.5433±0.24		

of endodontically treated tooth is primarily because of nonrestorable caries, vertical root fracture, iatrogenic perforation, endodontic failure, etc.^[4] The common complications which are observed with such extractions are alveolar osteitis, trismus, postoperative pain, hemorrhage and wound dehiscence, fracture of cortical plates, or trauma to the adjoining soft and hard tissue. Traumatic extraction not only causes postoperative complications but also leads to ridge narrowing and this may further impede successful prosthetic placement.^[5]

Various studies have been advocating different “atraumatic techniques” of tooth extraction, the most common being the periotome and piezotome techniques.

Periotome is a combination of a mini scalpel and a miniature elevator and comprises of a very thin metallic blade and a miniature elevator that repetitively oscillates through gentle wedging movements to the root apex.^[6] Piezotomes, developed by Vercellotti,^[7] claim to promote rapid postoperative wound healing. They use ultrasonic micro-vibrations to efficiently sever the bone with minor damage to soft tissue. As far as we know, this is the first analysis comparing the postoperative soft as well as the hard-tissue changes when extracting nonrestorable endodontic tooth using periotome and piezotome.

Concerning the postoperative discomfort, the correlation with duration of surgery has been directly proportional to postoperative pain. In addition, postoperative pain has been cited as the most common complication to exodontia by “Bortoluzzi *et al.*,”^[8] “Sjogren *et al.*,”^[9] and “Al-Khateeb”^[10] in their reports. In their report, Adeyemo *et al.*^[11] also

addressed many preoperative complications including accidental crown, root or alveolar bone fractures which often lead to healing complications and extraction time also increased because of these complications that leads to delayed healing. Specifically considering the exodontia of endodontically treated teeth, they tend to require transalveolar surgery which takes more time and cause more anxiety to the patients. Considering the patient’s comfort, postoperative pain, and duration of surgery were considered as important parameters to decide the efficacy of the atraumatic extraction technique.

The patient’s comfort is not only determined by postoperative discomfort but also the time is taken for the surgery. Piezosurgery required greater time and higher cost of armamentarium as compared to periotome but all the teeth extractions were successful with no major complications. Similar findings have been quoted by Melek and Nouredin^[12] in their study. This could be due to changing of tips for different tooth surfaces too and excess time required for adjacent bone removal. Also, Bortoluzzi *et al.*^[8] mentioned the association of a longer surgery length with elevated postoperative pain which could be a possible reason for increased postoperative pain reduction in periotome group as compared to piezotome group. These findings are also similar to our previous study in which the use of periotome reduced postextraction discomfort as compared to conventional method.^[13] However, on the contrary, piezotome proved to be a better option in maintaining soft tissue integrity as two cases with periotome had Grade 1 gingival laceration (though not of statistical significance), whereas during extraction slippage of extraction forceps caused Grade 1 laceration in piezotome group.

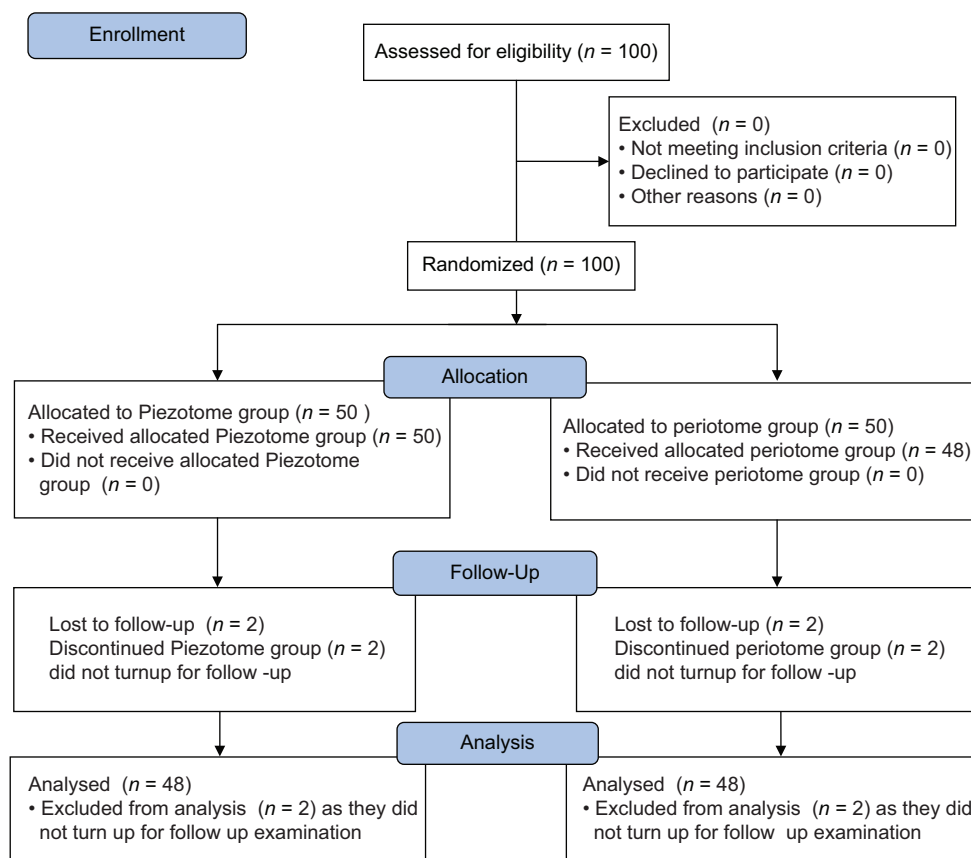


Diagram 1: CONSORT 2010 Flow Diagram

Comparing the extractions using piezoelectric instruments as compared to conventional instruments, Tsai *et al.*^[14] found attachment level more enhanced in piezotome group. On the contrary in our study, we found statistically significant more marginal bone loss in piezotome group in comparison with periotome group. This could be attributed to the fact periotome helps in extracting teeth without causing harm to osseous housing and maintaining the biological width of the adjoining gingiva.

Every extraction procedure is intended for rehabilitation procedure in the future and maintenance of height and width holds significance for prosthetic replacement.

Alveolar ridge resorption following tooth removal results from a basic bone physiological concept and maximum bone resorption takes place during the first 6 months postoperatively.^[15] In our study, at 6 months interval more bone resorption was observed in piezotome group than in periotome group but not of statistical significance. Means of extraction determines the amount of bone loss.

Furthermore, with some of the limitations of our analysis (we could not compare this with more than one or two studies as it is a new study) and the study was majorly concerned with

single-rooted teeth only, further studies with larger sample size including multirrooted teeth and bone loss assessment for longer period are recommended. Our study proposes, using periotome as atraumatic means of extraction for endodontically treated teeth considering it a more economical option with equally effective clinical outcomes and piezotome can be considered as a safe option for surgeries concerning the neurovascular bundle in the vicinity of the operating site.

CONCLUSION

The findings of this study propose that for intraoperative and postoperative comfort, periotome can be seen as safer and cheaper option for atraumatic extractions but piezosurgery may prove as a better choice soon for surgeries in the maxillofacial region to maintain soft-tissue integrity. The immediate bone loss when compared can be helpful for immediate prosthetic rehabilitation with the use of periotome but the results post 6 months present with same findings. Further more studies with larger sample size including multi-rooted teeth are suggested for definitive conclusion.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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