Comparative evaluation of piezotome versus periotome extractions of non-restorable endodontically treated teeth: A randomized clinical trial

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Comparative evaluation of piezotome versus periotome extractions of non-restorable endodontically treated teeth: A randomized clinical trial

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ABSTRACT

Aim: The study was intended to evaluate the efficacy of piezotome versus periotome extractions of non-restorable endodontically treated teeth in relation to prevention of marginal bone loss, operating time of the procedure, and postoperative sequale.

Methods: Forty-two patients with age range of 30–55 years requiring extraction of maxillary single rooted teeth that failed endodontically were randomly divided into two equal groups, a piezotome group and a periotome group. Clinical assessment was performed through measuring the marginal bone loss, time taken for extraction, postoperative pain and any complications related to the extraction procedure. The data was recorded then analyzed using IBM SPSS software package version 22.0.

Results: The difference between the times required for extraction in both groups was not statistically significant, although slightly longer time was recorded in the piezotome group. The piezotome group showed a statistically significant lower value regarding the marginal bone loss when compared to the periotome group. On the other hand, concerning the severity of postoperative pain, both groups did not show a statistically significant difference.

Conclusions: The results of the present study support that the piezotome was a more efficient choice for preservation of marginal bone in endodontically failed teeth indicated for extractions compared to the periotome.

1. Introduction

Dental extraction is among the most frequently carried out procedures in dentistry. It was the first dental practice performed centuries ago. Since then different forms and designs of instruments have been popular for this procedure [1]. However, dental extraction is a traumatic method causing alveolar bone damage and soft tissue injury [2].

This unfortunate situation was the trigger for the development of atraumatic tooth extraction techniques, which aim for the removal of tooth or tooth root, while maintaining the gingiva, bone and the surrounding hard and soft tissue structures in a harmonious relation. Instruments such as periotome, piezosurgery, Benex vertical extractor and physics forceps and many other have been specially designed to extract teeth atraumatically with minimum discomfort to patient [3].

Given the increased demand on implantology, atraumatic extraction has come to be an essential step and the use of periotome has proved that it reduces soft tissue injury in addition to saving the bony integrity of the socket [4].

Moreover, when talking about atraumatic tooth extraction with preserving the surrounding integrity of soft tissue, the “Piezosurgery” comes to mind. It effectively enables the surgeon to work on bone and dentin [5].

To investigate atraumatic extraction, the study was intended to evaluate the efficacy of piezotome versus periotome extractions of non-restorable endodontically treated teeth in relation to prevention of marginal bone loss, operating time of the procedure, and postoperative sequale.

2. Materials and methods

Forty-two patients (30 females and 12 males) with age range of 30–55 years were included in this prospective study who reported to Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Alexandria University, requiring extraction of maxillary single rooted teeth that failed endodontically and consenting for the study. Ethical approval was obtained from the research ethics committee, Faculty of Dentistry, Alexandria University. Total 42 extractions (twelve centrals, six laterals, six canines, 18 s premolars) were done. The patients were
randomly divided into two equal groups, a piezotome group and peri-
otope group. The choice of performing the 1st procedure (piezotome or peri-
tome) was determined by tossing a coin. Subsequently, alternation
between the use of the two techniques was followed. Thus, with each
method, 21 extractions were done.

Pre-surgical preparation was done for each patient including case
history, and radiographic examination (Periapical or panoramic
radiograph or CBCT) (Figs. 3A and 4A).

Guided by the standard aseptic surgical protocols, extractions were
performed under local anaesthesia, using Mepivacaine-I. (Mepivacaine
31.36mg/1.8 ml + Levonordefrine 0.09mg/1.8 ml, Alexandria Co. for
pharmaceuticals and chemical industries, Alexandria, Egypt). Local
infiltrations were given at the labial/buccal and palatal mucosa in every
extraction.

Pre extraction bone level (Peb) was measured using Hu- Friedy
periodontal probe. Three points were selected for measurements (me-
sial third, middle third and distal third) on the labial/buccal side of
tooth to be extracted. The distance between the gingival margin and the
marginal bone was measured by inserting the probe to the depth of the
gingival sulcus and the Peb value at each point was recorded.

For the periotope group, PEREUR6 periotope (Hu- Friedy Mfg.
Co.,LLC) (Fig. 1) was inserted beneath the gingival margin between the
bone and the root surface. Parallellity of the periotope blade to the
long axis of the tooth was maintained, and then the periotope was
moved horizontally right and left to cut the periodontal ligaments.
(Fig. 3B).

For the piezotome group, SATLEC ACTEON piezotome (A company
of ACTEON Group, France) was used. LC1 and LC2 tips were used and
secured to the hand piece. The LC1 tip was used for the labial/buccal
and palatal surfaces of the root while the LC2 tip was used for the
mesial and distal surfaces (Fig. 2). The vibrating osteotomy blade tips
were inserted beneath the gingival margin between the bone and
the root surface. Also, maintaining the parallellity to the long axis of
the tooth, the blade was moved in a sweeping fashion; proceeding in small
increments of 2–4 mm towards the apex. (Fig. 4B).

For both groups, cutting of the periodontal ligament was repeated
on all of the four surfaces of the root (labial/buccal, palatal, mesial and
distal). This action was performed till the root was completely
mobilized then the final removal of the tooth was aided with the tooth
specific forces.

A stop watch was used to measure the time taken for extraction in
minutes and seconds (mins, secs). Recording time started from
the application of the tip of the periotope or piezotome on the tooth till
removal of tooth out of the socket. After that, clinical examination of
the extracted tooth to inspect the root for fracture was performed.

The distance from the gingival margin to the marginal bone was
measured and referred to as Post Extraction Bone level (Pob). It was
measured by placing the probe at the edges of the socket at the pre-
viously chosen points.

Peb and Pob mean values of the three points were obtained and the
amount of marginal bone loss was indicated by the difference between
these two mean values.

All post extraction sites were covered by gauze pressure packs and
the patients were given post-operative instructions. All the patients
were prescribed Diclofenac Sodium Tab. 50 mg for 2 days.

Through follow up, postoperative pain was evaluated using the VAS
scale on 1st and 3rd postoperative days and any other complications
were also recorded.

Statistical significance was set at p ≤ 0.05 and the data obtained
from clinical findings was analyzed using Statistical Package for Social
Sciences SPSS version 22.0.

3. Results

The present study was conducted on forty-two (30 female and 12
male) patients requiring extraction of single rooted teeth that failed
endodontically, selected from the outpatient clinic of the Oral and
Maxillofacial Surgery Department, Faculty of Dentistry, Alexandria
University. Their ages ranged between 30 and 55 years with mean age
of 37.67 years.

All the teeth extracted in this study were single rooted maxillary
teeth with failed root canal treatment. The patients were randomly
divided into two equal groups; a piezotome group and a periotope
group each consisting of 21 patients. All patients were followed up
Fig. 4. (A) periapical radiograph showing endodontically treated tooth indicated for extraction (B) Extraction using piezotome.

Table 1
Group Statistics for marginal bone loss.

<table>
<thead>
<tr>
<th>technique</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
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<td>Marginal bone</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>loss</td>
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<td></td>
</tr>
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Table 2
Independent Samples Test for comparing the 2 groups regarding marginal bone loss.

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<th>Mean Difference</th>
<th>Std. Error Difference</th>
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<td>.07103</td>
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<td>Equal variances assumed</td>
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<td>Equal variances not assumed</td>
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</table>

Table 3
Group Statistics for time taken during extraction.

<table>
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<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
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<td>Time taken for</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>extraction</td>
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<td></td>
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</tbody>
</table>

Fig. 5. Mean marginal bone loss in both groups.

The clinical evaluation showed that the mean marginal bone loss in the periotome group was 0.83 mm (±0.24 mm), while the mean marginal bone loss in the piezotome group was 0.54 mm (±0.22 mm). The difference was statistically significant between the two groups (p < 0.05) [Table 1 and 2, Fig. 5].

3.2. Time taken for extraction

Statistical analysis was performed using the independent samples t-test. The mean time taken for extraction in the periotome group was 7 min and 44 s and the standard deviation was 1 min and 58 s, while the mean time taken for extraction in the piezotome group was 8 min and 45 s and the standard deviation was 1 min and 59 s. The difference was statistically insignificant between the two groups (p = 0.108) [Table 3 and 4, Fig. 6].

4. Discussion

Atraumatic dental extractions induces minimal trauma during teeth removal preserving the architecture of adjacent bone and gingiva. On the other hand, conventional dental extractions can involve reflection of a mucoperiosteal flap in combination with leverage elevation of the tooth against adjacent bone to assist removal with forceps. This often
leads to fracture or deformity of the dentoalveolar area in addition to traumatizing delicate gingival papillae, consequently, impeding successful implant placement. Various forms of atraumatic techniques have gained popularity to become a standard procedure for tooth extraction [6].

A method to decrease trauma to dentoalveolar housing during tooth extraction is through using the periosteum. Periotomes are instruments that utilize wedging and severing to facilitate tooth extraction [7]. A periosteum looks like a combination between a miniscalpel and a miniature elevator which comprise very thin metallic blade that is inserted in the periodontal ligament (PDL) space. The instrument utilizes gentle downward wedging towards the apex of the root in a repetitive oscillating manner [8].

When these fibers are severed, extraction of the tooth with minimal lateral pressure is permitted by simple rotational movements using the forceps [9]. Additionally, the enveloping soft tissue has not been affected by an incision or iatrogenic trauma. The drawbacks of this technique are the lengthy procedure of the extraction as well as the operator fatigue.

Similarly, White et al. [10] introduced automated periosteum as a useful device for atraumatic dental extractions. By avoiding reflection of a mucoperiosteal flap and injury to adjacent bone, gingival papillae were conserved giving prospect for future or immediate dental implant treatment.

Piezoelectric surgery has been used since 1988 with many improvements on the device. It provides ultrasonic frequency of 24–29 kHz, and a microvibration amplitude between 60 and 200 mm/s. It allows precise cutting of bone with a clean, minimal bloody field and without soft tissue damage [11,12]. A recent systematic review by Troedhan et al. [13] has revealed that piezotomes exerts minimal thermal damage on bone, enhanced bone healing, least destruction of bone due superior depth-control and accurate osteotomy cuts as well as protection to the soft tissue. However, they still have some disadvantages including longer surgical time and high cost of the armamentarium.

To our knowledge, the current study is the first clinical trial comparing the periosteum to the piezotome in atraumatic extraction of non-restorable endodontically treated teeth.

Endodontically treated teeth may be indicated for extraction due to non-restorable caries, vertical root fractures, failed root canal treatment or iatrogenic perforations [14]. Atraumatic dental extraction of such teeth is necessary to remove the whole tooth structure and preserve the surrounding alveolar bone for subsequent implant placement.

In this study all extractions were successful with no buccal plate fracture or root fracture in both groups. There was no need for mucoperiosteal flap and bone exposure. Similar findings were noticed by Sharama D et al. [15] who compared conventional methods of extraction to periosteum extraction. They noticed that buccal cortical plate fracture and apical third fracture was very minor in the periosteum extraction compared to the conventional extraction.

Our results show that healing was uneventful in all cases with no postoperative complications and only mild postoperative pain was experienced by patients of both groups which was completely resolved by the third postoperative day in all patients.

This was similar to the results with Sharama D et al. [15] who conducted that the use of periosteum reduced post extraction discomfort. Since the frequency and number of analgesics consumed were less than in the conventional extraction. Also, their study stated that the reduction in pain and gingival laceration favored the use of periosteum.

Concerning the piezotome, Tsai et al. [16] have investigated the outcome of piezoelectric instruments on healing of alveolar sockets after extraction of mandibular third molars. Comparing extractions using piezoelectric instruments to conventional instruments, it was found that the attachment level at the distal side of the mandibular second molar was more enhanced with piezoelectric instruments one month after extraction. This supports our results in which less marginal

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Table 4

<table>
<thead>
<tr>
<th>Time taken for extraction</th>
<th>Equal variances assumed</th>
<th>Mean Difference</th>
<th>Std. Error Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sig. (2-tailed)</td>
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<tr>
<td></td>
<td>.108</td>
<td>0.01:00</td>
<td>0:00:36</td>
</tr>
</tbody>
</table>

Fig. 6. Time taken for extraction in both groups.
bone loss was found in the piezotome group. Additionally, a meta-analysis by Al-Moraissi et al. showed that the occurrence of postoperative complications including pain, oedema, and trismus were greatly minimized with the piezoelectric surgery when compared to the conventional rotary instrument technique in lower third molar surgery. Moreover, the total number of analgesics consumed was lesser with piezosurgery. The only disadvantage faced was the extended time of the piezolectric surgery. This is consistent with our results in which piezosurgery was associated with better preservation of marginal bone but longer time was needed for extraction of endodontically treated teeth in comparison to the periotome [17]. The length of time in our study was (numerically but not statistically) slightly higher when comparing the piezotome to the periotome. This slight difference may be attributed to using different tips for the various tooth surfaces with subsequent repeated removal and insertion of tips when changing from one tooth surface to another.

In conclusion, the results of this clinical trial revealed that both the periotome and piezotome are good choices for atraumatic dental extraction of endodontically treated teeth, with the piezotome proving more efficient in reducing the marginal bone loss, thus providing better bone preservation for subsequent tooth replacement.

Conflicts of interest

The authors declare that they have no conflict of interest.

References
