Evaluation of Periotome versus Piezotome in non-restorable teeth extraction with immediate implant placement (A Clinical Study)

Original Article

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ABSTRACT

Aim: This study was performed to compare the clinical and radiographic outcomes of Periotome versus Piezotome in non-restorable teeth extraction with immediate implant placement

Materials and Methods: Twenty patients (12 males and 8 females with a mean age of 40.8 ± 11.9 years) with non-restorable maxillary single rooted teeth indicated for extraction and requesting implant placement were selected in this study. The patients were divided equally into 2 groups. In the first group (Group I) the non-restorable teeth were extracted using periotome and in the second group (Group II), teeth were extracted using piezotome followed by simultaneous implant placement in both groups. Clinical and radiographic assessment was carried out in terms of post-operative pain, duration of extraction, horizontal bone width and vertical bone changes.

Results: Periotome group showed a statistically significant lower pain scores and shorter duration of extraction when compared to piezotome group. Considering the horizontal and vertical bone changes, a non-statistically significant difference appeared between the two groups.

Conclusion: Atraumatic extraction using periotome or piezotome with simultaneous implant placement showed excellent results regarding ridge preservation with insignificant changes in bone width or height after two months postoperatively. Concerning the clinical outcomes, our findings were in favor of periotome over piezotome in terms of less post-operative pain and shorter duration of the extraction procedure.

Key Words: Periotome, Piezotome, Immediate implant placement

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INTRODUCTION:

Dental extraction is considered one of the most common procedures conducted in the dental practice. Conventional extraction technique utilizing forceps and/or elevators is considered a painful procedure with delivery of high forces leading to alteration of the bundle bone, disruption of the blood vessels and increased bone resorption. [1- 3]

Following conventional dental extraction, 0.4- 3.9 mm of vertical bone loss and 2.6- 4.5 mm of horizontal bone loss was reported, where two-thirds of the bone resorption occur within the first three months following extraction.[4] It was also reported that following dental extractions, the level of osteoclasts decrease over a period of 4 weeks and the osteoblastic levels peaks at 6- 8 weeks and remains stable thereafter. [5]

With the increased demand on implantology, different procedures gained popularity for preserving the bone of the alveolar ridge such as atraumatic extractions and immediate implant placement.[6, 7] Immediate implant placement minimizes the bone resorption and the crestal bone loss of the alveolar ridge which ensures a pleasant esthetic outcome. [8- 10]

Different techniques for atraumatic extraction have been introduced in literature including periotome, piezotome, proximators and Benex vertical extractor.[11]

Periotomes are hand instruments made of a very thin metallic blade that are wedged between the roots and the bone severing the periodontal ligaments sharpey's fibers in a repetitive circumferential fashion allowing for easy extraction of the tooth with minimal pressure, thus preserving the bone integrity of the socket [3, 12- 14]

Piezotome extraction involves the use of ultrasonic vibrating scalpel tips brought into the space between the root and bone to cut the periodontal ligament fibers allowing for simple atraumatic extractions with minor forces. [15, 16] In this study, dental extraction using periotome versus piezotome with simultaneous implant placement was carried out and assessed in terms of post-operative pain, duration of extraction, horizontal bone width and vertical bone changes.

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MATERIALS AND METHODS:

Twenty six patients (16 males and 10 females with a mean age of 40.8 ± 11.9 years) with non-restorable maxillary single rooted teeth indicated for extraction and requesting implant placement were selected from the outpatient clinic of Oral and Maxillofacial Surgery Department, Faculty of Dentistry, Cairo University. Any patient with psychological disorders, tooth mobility, periapical infection, bleeding tendency, diabetes or any systemic disease that contraindicates dental extraction and/or implant placement was excluded from the study. This study was approved by the Research Ethics Committee of Faculty of Dentistry, Cairo University.

Sample size calculation : This power analysis used duration of extraction as the primary outcome. Based upon the results of Sharma et al [16] , the mean and standard deviation (SD) values for time were 12.816 (7.3938) and 5.7801 (4.0437) minutes, respectively. Using alpha (α) level of (5%), β level of 0.8 (Power = 80%); the effect size (d) for Mann-Whitney U test was 1.181 and the minimum estimated sample size was 13 cases per group. Sample size calculation was performed using G*Power Version 3.1.9.2.II.

Cone beam CT was performed preoperatively to evaluate the width and height of bone and for adequate selection of the implant size (Fig.1).

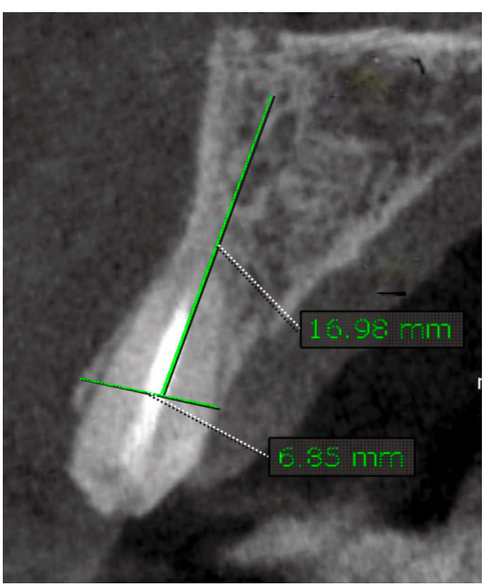


Figure.1: Showing a preoperative cone beam CT with a horizontal bone width of 6.85 mm and a vertical bone height of 16.98 mm

The patients were divided equally into 2 groups. In the first group (Group I) the non-restorable teeth were extracted using periotome and in the second group (Group II), teeth were extracted using piezotome. Immediate implant placement following the extraction was carried out in both groups.

Surgical procedure

The surgical procedure in both groups was performed under local anesthesia (ARTINIBSA 40 mg/0.01 mg/ml, Inibsa Dental S.L.U, Barcelona, Spain) using local infiltration technique. A gingival incision was performed and a mucoperiosteal flap was elevated.

In group I, a periotome was inserted between the root and the bone and moved all around the tooth in a walking motion technique. When the tooth was dislodged, tweezers were used to remove the tooth from the socket leaving an intact crestal bone. In group II, the piezotome tip was placed between the root and the bone and extended apically parallel to the long axis of the root in an in-and-out movement to avoid heat generation. This was performed all around the tooth circumference until the root is dislodged and the tooth was finally removed from the socket using tweezers (Fig. 2, 3, 4).

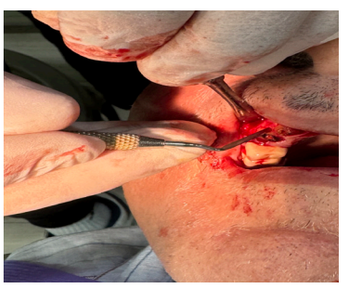


Figure.2: Showing extraction of a non-restorable maxillary right canine through placement of a periotome between the bone and the root

Figure3: Showing extraction of a non-restorable maxillary left canine using piezotome

Figure4: Showing an intact labial plate of bone following tooth removal

In both groups, Implant site preparation was started initially using a pilot drill of 2.0 mm diameter. The drilling was performed in the apical third of the palatal wall of the socket and extended 3-4 mm apical to the base of the socket. Bone osteotomes was used sequentially from small to larger diameters until reaching the desired implant width and height. Adequate implant size (TRI Dental Implants Int, Switzerland) was selected while taking into consideration that any gap between the implant and the bone doesn't exceed 2mm. Implants were placed into the prepared site with a torque range of 15-25 N-cm. Flap was sutured back in place using 4-0 vicryl sutures (Assut Assucryl PGA, Switzerland) and the implants were left to heal for 2 months (Fig.5).

Figure5: Showing the surgical site after 2 months postoperatively

The patients were instructed to:

• Bite on a gauze for one hour.
• Apply ice packs 10 mins/hour for 5 hours on the day of surgery.
• Eat soft cold diet on the day of surgery.
• Use chlorohexidine mouth wash for 15 days starting next day of surgery.
• Start prophylactic antibiotic 500 mg of amoxicillin (Amoxil 500 mg, GlaxoSmithKline. Cairo, Egypt) 3 times a day.
• Take analgesics (Paracetamol 500mg tab, Medical Union Pharmaceuticals, Egypt) for pain alleviation whenever needed.

Evaluation methods:

1-Clinical evaluation:

• Duration of extraction: The duration of extraction was measured using a stop watch starting from the application of the periotome or piezotome until the tooth was finally removed from the socket.
• Pain: Pain was assessed using the visual analogue scale of pain (VAS) from 0-10 on the day of surgery and through counting the total number of analgesic tabs consumed during one week postoperatively.

2-Radiographic evaluation:

Cone beam CT (CBCT) was performed preoperatively and after 2 months postoperatively.
Evaluation of the horizontal bone width was performed through measuring the crestal bone width preoperatively and after 2 months postoperatively (Fig.6).
Evaluation of the vertical bone height was performed through "Ondemand3d" software. The preoperative and post-operative data were scanned and exactly overlapped, merged and fused by the software algorithm with a different color for each image (Fig.7).

Figure 6: showing cone beam CT after 2 months postoperatively with a crestal bone width of 6.82 mm

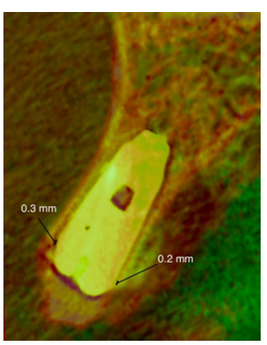


Figure 7: Showing the merged preoperative (red) and postoperative (green) cone beam CT with a decrease of labial bone height by 0.3mm and lingual bone height by 0.2mm

Statistical Analysis

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). All data showed normal (parametric) distribution except for number of analgesic tablets and pain scores which showed non-parametric distribution. Data were presented as mean, standard deviation (SD), median and Inter-Quartile Range (IQR) values. For parametric data, Student's t-test was used compare between the two groups. Repeated measures ANOVA test was used to compare between ridge widths in the two groups as well as to study the changes in ridge width after two months. Bonferroni's post-hoc test was used for pair-wise comparisons when ANOVA test is significant. For non-parametric data, Mann-Whitney U test was used to compare between the two groups. The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.

Results

A statistically significant shorter duration of extraction was associated with group I when compared to Group II (P-value <0.001, Effect size = 4.974) (Table 1) (Fig.8).

Table (1). Descriptive statistics and results of Student's t-test for comparison between duration of extraction (minutes) in the two groups

Group II (n = 13)		*Group II (n = 13)*		*P-value*	*Effect size (d)*
Mean	*SD*	*Mean*	*SD*		
4.81	*0.58*	*7.66*	*0.57*	*<0.001**	*4.974*

*: Significant at $P \leq 0.05$

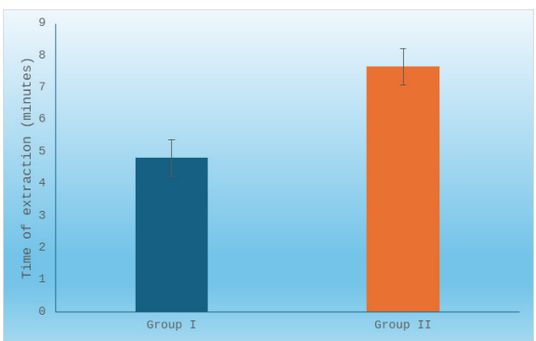


Figure 8: Bar chart representing mean and standard deviation values for duration of extraction in the two groups

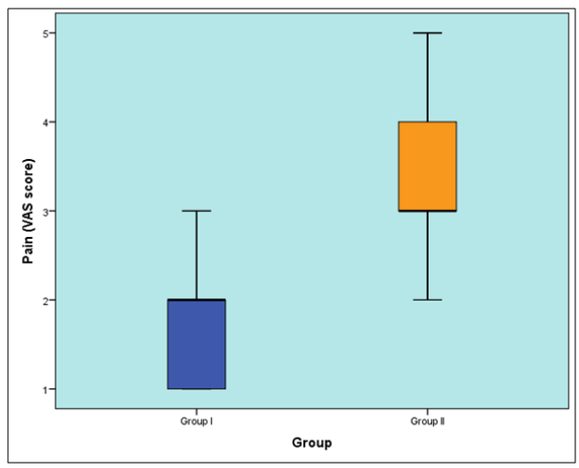
VAS of pain score

Group I showed statistically significantly lower pain score than Group II (P-value <0.001, Effect size = 1.955) (Table 2) (Fig.9).

Table (2). Descriptive statistics and results of Mann-Whitney U test for comparison between pain scores in the two groups

Group II (n = 13)		*Group II (n = 13)*		*P-value*	*Effect size (d)*
Median (IQR)	*Mean (SD)*	*Median (IQR)*	*Mean (SD)*		
2 (1, 2)	*1.77 (0.73)*	*3 (3, 4)*	*3.46 (0.97)*	*<0.001**	*1.955*

*: Significant at $P \leq 0.05$



Fiure.9: Box plot representing median and Inter-Quartile Range (IQR) of pain scores in the two groups

Number of analgesic tablets consumed

Group I showed statistically significantly lower number of analgesic tablets consumed than Group II (P-value = 0.002, Effect size = 1.474) (Table 3) (Fig.10).

Table (3). Descriptive statistics and results of Mann-Whitney U test for comparison between number of analgesic tablets in the two groups

Group II (n = 13)		*Group II (n = 13)*		*P-value*	*Effect size (d)*
Median (IQR)	*Mean (SD)*	*Median (IQR)*	*Mean (SD)*		
4 (3, 4.5)	*3.85 (1.07)*	*6 (5, 6.5)*	*5.62 (1.33)*	*0.002**	*1.474*

*: Significant at $P \leq 0.05$

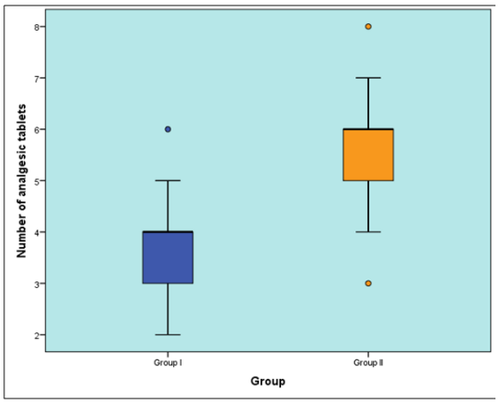


Figure10: Box plot representing median and Inter-Quartile Range (IQR) of number of analgesic tablets in the two groups (Circles represent outliers)

Ridge width (mm)
a. Comparison between the two groups

Pre-operatively as well as two months, there was no statistically significant difference between the two groups (P-value = 0.907, Effect size = 0.001) and (P-value = 0.672, Effect size = 0.008), respectively (Table 4) (Fig.11).

Table (4): Descriptive statistics and results of repeated measures ANOVA test for comparison between ridge width measurements (mm) in the two groups

Time	Group I (n = 13)		Group I (n = 13)		P-value	Effect size (Partial Eta squared)
	Mean	SD	Mean	SD		
Pre-operative	7.31	0.6	7.28	0.73	0.907	0.001
2 months	7.11	0.56	7	0.71	0.672	0.008

*: Significant at P ≤ 0.05

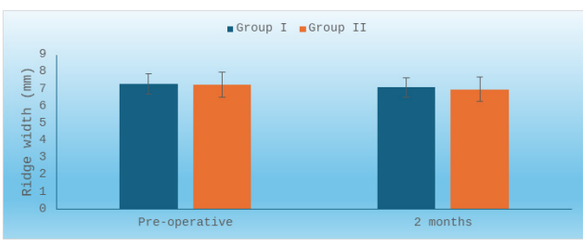


Figure 11: Bar chart representing mean and standard deviation values for ridge width measurements in the two groups

b.Comparison between amounts of decrease in ridge width in the two groups
Decrease in ridge width = Width (2 months) – Width (Pre-operative)
A non-statistically significant difference between the amounts of decrease in ridge width appeared in the two groups (P-value = 0.060, Effect size = 0.896) (Table 5) (Fig.12).

Table (5): Descriptive statistics and results of Student's t-test for comparison between amounts of decrease in ridge width measurements (mm) in the two groups

Group II (n = 13)		*Group II (n = 13)*		*P-value*	*Effect size (d)*
Mean	*SD*	*Mean*	*SD*		
0.2	*0.08*	*0.28*	*0.06*	*0.060*	*0.896*

*: Significant at P ≤ 0.05

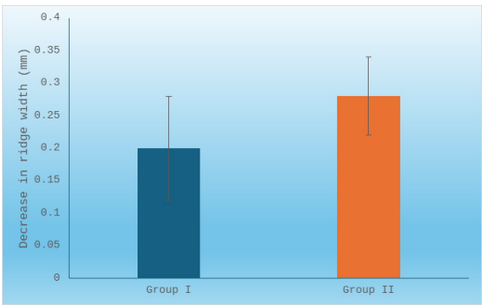


Figure 12: Bar chart representing mean and standard deviation values for amounts of decrease in ridge widths in the two groups

Vertical bone changes (mm)
Whether at the buccal or lingual sides, there was no statistically significant difference between amounts of vertical bone changes in the two groups (P-value = 0.153, Effect size = 0.579) and (P-value = 0.080, Effect size = 0.716), respectively(Table 6) (Fig.13).

Table (6): Descriptive statistics and results of Student's t-test for comparison between crestal bone changes (mm) in the two groups

Side	Group I (n = 13)		Group I (n = 13)		P-value	Effect size (d)
	Mean	SD	Mean	SD		
Buccal	-0.3	0.11	-0.36	0.1	0.153	0.579
Palatal	-0.23	0.11	-0.31	0.08	0.080	0.716

*: Significant at P ≤ 0.05

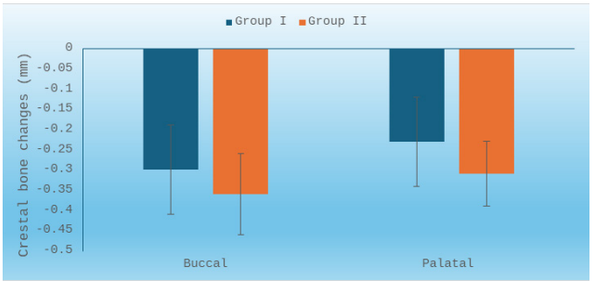


Figure 13: Bar chart representing mean and standard deviation values for crestal bone changes in the two groups

DISCUSSION

Preservation of the alveolar bone following tooth extraction is a main target to establish a successful implant placement. In an attempt to achieve this, atraumatic extractions with simultaneous implant placement was performed in this study.

In our study, atraumatic extraction techniques utilizing periotome and piezotome were selected to minimize the trauma and the forces delivered to the alveolar bone during extraction, hence; decreasing bone resorption. This agrees with Naenni et al [17] and Schneider et al [18] who reported that initiation of bone resorption begins immediately after tooth extraction and is strongly related to the amount of forces delivered to the bone during the extraction procedure. Other studies [19-21] also reported that conventional extraction techniques lead to a horizontal bone loss of 50-60% and vertical bone loss of 40% where two-thirds of this loss occur within the first three months following extraction.

In the current study, immediate implant placement was carried out for further preservation of the alveolar bone following the atraumatic extractions together with reducing the number of surgical interventions, decreasing the overall treatment time and increasing the patient acceptance. This coincides with the findings of other authors [8, 22-24] reporting that immediate implant placement is associated with a high percentage of clinical success and significant vertical and horizontal preservation of the alveolar ridge.

Primary implant stability is considered as the most important factor for success of a dental implant. [25] In this study, preparation of the implant site was extended 3-4 mm apical to the base of the socket in both groups. The osteotomy was started by a pilot drill followed by osteotomes to perform bone condensation and all the implants were inserted in place with a torque range of 15-25 N-cm indicating great stability. This agrees with Deval et al [26]who reported that drilling should extend at least 2 mm beyond the socket apex to achieve primary implant stability. Other studies [27-29] also reported that using osteotomes in preparation of the implant site increases the implant to bone contact and accelerates the trabecular bone formation, hence; increasing the implant success rate.

During our selection of the implant diameter, it was taken into consideration to minimize the gap between the bone and the implant to a 2mm or less where no bone grafts were used to fill the gap. Different studies [30-32] reported that bone to implant gap of less than 2mm is a narrow defect that doesn't necessitate placement of bone grafts without any effect on implant osseointegration or bone resorption. Paolantonio et al [32] also reported that implant placement on fresh extraction sockets with a gap of 2 mm or less maintains the original shape of the ridge.

In the present study, a significantly longer duration of extraction was associated with the piezotome group when compared to the periotome group. This agrees with other authors [33-35] reporting that using ultrasonic devices like piezotome increases the clinical time of the surgical procedures. In addition, Bortoluzzi et al [36] reported that longer surgeries are associated with increased post-operative pain. This can explain our outcomes where the piezotome group showed more post-operative pain when compared to the periotome group. Sharma et al [37] also reported lower pain scores when periotomes were used for atraumatic extractions. On the other hand, different studies [38-40] correlated the post-operative pain with the degree of trauma performed during extraction; this may suggests that extractions with piezotome cause a slightly more trauma than periotomes.

Our results showed non-significant changes in bone width and bone height between both groups after 2 months post-operatively. The mean values of the bony changes in both groups were minimal compared to other findings reported in the systematic review performed by Ten Heggeler et al [4] concerning the conventional extraction techniques. This can be attributed to the combination of atraumatic extractions together with immediate implant placement, where each procedure alone has been proved to decrease the bone resorption following tooth extraction. [8, 41-44]

CONCLUSION:

Atraumatic extraction using periotome or piezotome with simultaneous implant placement showed excellent results regarding ridge preservation with insignificant changes in bone width or height after two months postoperatively. Concerning the clinical outcomes, our findings were in favor of periotome over piezotome in terms of less post-operative pain and shorter duration of the extraction procedure.

CONFLICT OF INTEREST

This clinical study was self-funded by the authors, with no conflict of interest.

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