Comparison of Piezosurgery and Conventional Rotative Instruments in Direct Sinus Lifting

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Objectives: *The purpose of this study was to compare the intraoperative and postoperative effects of Piezosurgery and conventional rotative instruments in direct sinus lifting procedure.*

Patients and Methods: *Twenty-three patients requiring direct sinus lifting were enrolled. The osteotomy and sinus membrane elevation were performed either with Piezosurgery tips or rotative diamond burs and manual membrane elevators. Time elapsed between bony window opening and completion of membrane elevation (duration), incidence of membrane perforation, visibility of the operation site, postoperative pain, swelling, sleeping, eating, phonetics, daily routine, and missed work as well as patient's expectation before and experience after the operation were evaluated.*

Results: *There was no significant difference between Piezosurgery and conventional groups regarding incidence of membrane perforation, duration, and operation site visibility as well as patient's expectation before and experience after the operation (*$P > 0.05$*). However, there were significantly more pain and swelling in the conventional group compared with the Piezosurgery group (*$P \leq 0.05$*).*

Conclusion: *Sinus lifting procedure performed with Piezosurgery causes less pain and swelling postoperatively compared with conventional technique. Patients' daily life activities and experience about the operation are not affected from the surgical technique. (Implant Dent 2013;22:662–665)*

Key Words: Piezosurgery, sinus lift, rotative instruments, swelling, pain

Piezosurgery is based on ultrasonic principle with modulated frequency and controlled tip vibration range.[1–4] Selective cutting is possible with different frequencies acting only on hard tissues. It is particularly important when working in close proximity to vital anatomical structures such as nerve, vessel, dura matter, or maxillary sinus membrane (Schneiderian membrane).[1,5] Piezosurgery has a wide field of application in dental implantology including sinus lifting, autogenous bone harvesting, bone crest splitting, and removing of failed implants. It provides precise bone cut without much pressure, which helps to prevent excessive heat that would result in bone damage.[2,3,5]

Sinus lifting is a commonly performed procedure in implant therapy when there is bone deficiency in the maxillary posterior region. It allows placement of implants with sufficient length and enables prosthetic rehabilitation of the edentulous posterior maxilla.[6–8] Direct sinus lifting is indicated when the residual alveolar bone height is less than 5 mm.[6,7] For this purpose, the lateral window approach is preferred in our clinic using rotatory handpieces, osteotomes, and mallets.[6,9] Piezosurgery has been introduced for sinus membrane elevation for both direct and indirect sinus lifting procedures lately. The lower risk for membrane perforation and enhanced patient comfort enables Piezosurgery to be the preferred device to conventional techniques.[6,7,9] The aim of this study was to compare the intraoperative and postoperative effects of Piezosurgery and conventional rotative instruments in the direct sinus lifting procedure.

PATIENTS AND METHODS

Twenty-three patients requiring dental implant therapy in the posterior maxillary region with severe bone deficiency were included in the study. Inclusion criteria were the need for unilateral or bilateral direct sinus lifting (residual alveolar bone height <5 mm), not having any systemic disease, no history or present maxillary sinus infection or pathology, smokers less than 10 cigarettes per day, and not using any antibiotics or steroids on the day or at least 30 days before surgery.

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Radiographic examination was carried out with panoramic and dental volumetric tomography to evaluate the anatomical structure of the maxillary sinus and to measure the distance between alveolar crest and sinus floor. Only 1 side was included in the study, even if the patient needed bilateral sinus lifting. The osteotomy site included 1 premolar and 1 molar tooth width to standardize the size of bony window opened for each group.

Patients were randomly allocated to the Piezosurgery group and the conventional rotative instruments group. All the operations were done by the 2 similar experienced oral and maxillofacial surgeons under local anesthesia using Ultracaine D-S fort (articaine HCL: 40 mg/mL; epinephrine HCL: 0.012 mg/mL). After raising a mucoperiosteal flap, osteotomy was performed with either Piezosurgery device (EMS Piezon Master Surgery, EMS Electro Medical Systems SA; Nyon, Switzerland) or rotative diamond burs (with copious sterile saline), osteotomes, and mallets. Sinus membrane dissection and elevation were also performed with either Piezosurgery tips or direct sinus lift elevators. The bony wall was gently pushed inside the sinus cavity to form the roof of the graft site. The occurrence of membrane perforation was noted.

After obtaining sufficient space by elevating the sinus membrane, allegenous freeze-dried corticocancellous bone chips (Maxxeus, Community Tissue Services; Dayton, OH) were used for grafting. Bony sinus windows were covered with a resorbable collagen membrane (Collagene AT, Sistema AT; Padova, Italy). Mucoperiosteal flaps were primarily closed with 3/0 silk suture. All the patients were prescribed 1000 mg amoxicillin + clavulanic acid combination twice daily for 5 days and 500 mg paracetamol twice daily, chlorhexidine mouth rinse starting from the next day of the surgery twice daily for 15 days. Sutures were removed on the 7th postoperative day. Dentures were not permitted for use until they had been adjusted and refitted no sooner than 2 weeks after surgery.

Following parameters were assessed to compare the effects of the 2 techniques.

- Time from the beginning of osteotomy to the completion of sinus membrane elevation
- Incidence of membrane perforation during the operation
- Operation site visibility was assessed by the surgeon with a 4-point scale: 0, very poor visibility; 1, moderate visibility; 2, good visibility; and 3, excellent visibility.
- Patients were given a questionnaire for self-assessment of these parameters. Postoperative pain, swelling, sleeping, eating, phonetics, daily routine, and missed work were self-assessed by the patient on a 4-point scale ranging from 0 to 3: 0, little/none; 1, some; 2, quite a bit; and 3, very much. Patients were asked to fill out the form on 8th, 24th, 48th, and 72nd postoperative hours and on the 7th day.
- On the 7th postoperative recall, the patients were also asked to compare their expectation before the procedure and experience after the procedure. 0, My expectation and experience was same/similar; 1, My experience was better than my expectation; 2, My experience was worse than my expectation; 3, No idea.

This study was approved by the local Ethical Committee of the Istanbul Medipol University and informed consent was obtained from each participant.

Statistical Analysis

Unpaired Student t test was used to compare time from the beginning of osteotomy to the completion of sinus membrane elevation between the groups. Mann-Whitney U test was used to compare the other parameters between the groups, and Fisher exact test was used to compare incidence of membrane perforation. $P \leq 0.05$ was considered significant. All the analyses were performed using NCSS (Number Cruncher Statistical System) 2007 and PASS 2008 statistical software.

RESULTS

The results of 21 out of 23 patients were evaluated. Two patients were excluded (1 patient from each group) due to postoperative wound infection. The Piezosurgery group consisted of 6 men and 5 women with age range of 31 to 66 years and a mean of 48.8 years. The conventional group consisted of 7 men and 3 women with age range of 38 to 51 years and a mean of 46.2 years. Only 1 membrane perforation occurred in each group during the operation (9% in Piezosurgery group versus 10% in conventional group) ($P = 0.100$). The perforation was closed with resorbable collagen membrane, and the operation was carried on. There was not a significant difference in time elapsed between bony window opening and completion of membrane elevation between the Piezosurgery and conventional groups ($P = 0.566$). There were also no statistical significant differences in operation site visibility ($P = 0.144$) and patients' expectations and experiences before and after the operation between both groups ($P = 0.859$) (Table 1). Pain intensities on 8th and 24th postoperative hours were significantly higher in the conventional group than the Piezosurgery group ($P = 0.003$ and 0.014, respectively). There were no significant differences in pain intensity between the groups on 36th and 72nd postoperative hours and on the 7th day ($P = 0.100$, 0.126, and 0.485, respectively).

Table 1. Comparison of the Parameters Self Assessed by the Patients Postoperatively.

	Operation Duration	Expectation-Experience	Operation Site Visibility
Group 1	18.00 ± 8.23	0.70 ± 1.25	1.70 ± 0.48
Group 2	20.20 ± 8.58	0.60 ± 0.84	2.10 ± 0.99
P	0.566	0.859	0.144

There is not a significant difference between the Piezosurgery and conventional groups regarding operation duration, expectation-experience, and operation site visibility. Values are given as mean ± SD. Group 1: conventional group and group 2: Piezosurgery group.

Table 2.

	8th h		24th h		36th h		72nd h		7th d	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Pain	**2.60 ± 0.51**	**1.70 ± 0.67**	**1.70 ± 0.67**	**0.80 ± 0.63**	1.20 ± 0.63	0.70 ± 1.06	0.70 ± 0.48	0.60 ± 1.26	0.20 ± 0.42	0.50 ± 0.84
Swelling	**2.40 ± 0.96**	**1.10 ± 0.73**	**2.60 ± 0.70**	**1.40 ± 0.70**	**2.10 ± 0.74**	**0.90 ± 0.87**	1.00 ± 0.81	0.70 ± 0.95	0.20 ± 0.42	0.20 ± 0.42
Sleeping	2.00 ± 0.81	1.30 ± 0.67	1.00 ± 0.94	0.80 ± 0.63	0.50 ± 0.52	0.40 ± 0.96	0.20 ± 0.42	0.40 ± 0.96	0.20 ± 0.42	0.20 ± 0.42
Eating	1.90 ± 0.87	1.60 ± 0.84	1.70 ± 0.95	1.20 ± 0.79	1.40 ± 1.07	0.60 ± 1.07	0.70 ± 0.82	0.70 ± 1.25	0.40 ± 0.51	0.50 ± 1.08
Phonetics	1.60 ± 0.96	1.10 ± 0.87	1.10 ± 0.74	0.80 ± 0.79	0.30 ± 0.48	0.60 ± 0.84	0.10 ± 0.31	0.30 ± 0.67	0.00 ± 0.00	0.20 ± 0.42
Daily routine	1.80 ± 0.78	1.10 ± 0.87	1.60 ± 0.96	0.70 ± 0.82	0.90 ± 0.87	0.60 ± 0.96	0.40 ± 0.51	0.50 ± 0.97	0.10 ± 0.31	0.20 ± 0.42
Missed work	1.70 ± 1.16	1.10 ± 0.99	1.40 ± 1.17	0.60 ± 0.69	1.00 ± 1.15	0.60 ± 0.96	0.70 ± 0.82	0.60 ± 0.96	0.10 ± 0.31	0.40 ± 0.51

There is significant more postoperative swelling and pain in the conventional group compared to the Piezosurgery group. Other parameters regarding daily life activities have similar results. Values are given as mean ± SD (bold numbers show significance). Group 1: conventional group and group 2: Piezosurgery group.

There was significantly more swelling in the conventional group on the 8th, 24th, and 36th postoperative hours compared to Piezosurgery group ($P = 0.07$, $P = 0.02$, and $P = 0.08$, respectively). Swelling on the 72nd postoperative hours, and on the 7th day did not show significant difference between the groups ($P = 0394$ and 1.00, respectively). There were no significant differences between the groups regarding sleeping, eating, phonetics, daily routine, and missed work at the abovementioned time intervals (Table 2).

DISCUSSION

Sinus membrane elevation and subsequent bone grafting are widely accepted procedures to insert implants for restoring the edentulous posterior maxilla.[2,5,6] There are different techniques and armamentaria presented to perform this surgery.[6,9–15] Oscillation frequency used in Piezosurgery is designed for acting only on mineralized tissue; therefore, the cutting tip becomes inactive when it contacts to soft tissue.[1–3,16] Piezosurgery is safely used in dentistry and other fields of medicine where there is high risk of damaging vital soft tissue such as nerves, dura matter, vessels, and so on.[1,3,4] Perforation of the sinus membrane is one of the most encountered intraoperative complications in sinus lifting.[17,18] Repairing of the perforations can be challenging due to size of the perforation, and there is a risk of surgical failure. When perforation occurs, closure with a resorbable membrane is a commonly used technique.[19–21] The intact sinus membrane is essential for graft stability and prevention of sinus infection. It is reported that sinus membrane perforation risk is reduced by using Piezosurgery.[1,8] Wallace et al[22] reported 7 membrane perforations in a total of 100 sinus lifting. All the perforations occurred while using hand instruments for membrane elevation but not during the use of Piezosurgery itself. Vercellotti et al[5] reported a rate of 5% for sinus membrane perforation during Piezosurgery. Barone et al[2] conducted a study that compared conventional drills and Piezoelectric device in maxillary sinus floor elevation. They concluded that the time required for window osteotomy was higher with Piezosurgery, but membrane perforation rate was smaller compared with the conventional method (23% vs 30%). There is a general agreement in the literature regarding the longer time period required for operations with the Piezosurgery device.[1,3,8] However, in our study, although the time for osteotomy and membrane elevation was longer in the Piezosurgery group than the conventional group, the difference was not statistically significant. This may be due to the experience of the surgeons and their familiarity with the Piezosurgery device because it is commonly used in our clinic. Only 1 sinus membrane perforation occurred in the Piezosurgery and conventional groups (9% vs 10%) during membrane elevation, which was closed with a collagen membrane barrier. Postsurgical periods were uneventful, and implants could be placed 6 months postoperatively.

Piezosurgery produces less vibration and noise as it uses microvibrations, in contrast to macrovibrations and the noise produced by conventional surgical burs and saws.[1,5] This makes the Piezosystem more manageable and allows greater intraoperative control. The clinician needs to apply very low pressure that permits precise cutting.[2,9] Heinemann et al[1] and Torrella et al[9] stated that Piezosurgery provides more comfort to the patient and to the practitioner during the operation and causes less morbidity and complications compared with conventional methods. In our study, the patient's expectation before and experience after the operation were similar in both the groups. Furthermore, there were no significant differences in postoperative daily activities such as sleeping, eating, phonetics, daily routine, and missed work between the groups. Therefore, the findings of this study necessitate additional detailed evaluation of patient's intraoperative assessment and postsurgical morbidity when Piezosurgery is used.

It is claimed that clear operation site can be provided by using the Piezosurgery device.[2,4] It maintains a blood-free surgical field during bone cutting due to air-water cavitation effect of the ultrasonic device.[1,5,11] In this study, the

visibility of the operation site was better with the Piezosurgery device, although the difference was not significant. This may be due to the use of copious sterile saline irrigation with rotating burs during the operation in the conventional group. This finding may be interpreted as the visibility of the operation site with the conventional system can be as clear as that of Piezosurgery device.

In this study, postoperative pain and swelling were significantly less in Piezosurgery group than the conventional group. Pain and swelling are the most encountered complications due to the nature of bone surgery, and intraoperative trauma to bone tissue is the most prominent causative factor. The authors of this study suggest that ultrasonic nature as well as more precise cut and less pressure during bone manipulation with the Piezosurgery handpiece provided less pain and swelling postoperatively.

There are a number of studies on the effects of Piezosurgery during surgical procedures, but this study is one of the more comprehensive studies.[6,12–14] It is suggested to conduct studies comparing the effects of Piezosurgery and conventional systems on various surgical procedures in implant dentistry.

Conclusion

Sinus lifting procedure performed with Piezosurgery causes less pain and swelling postoperatively compared with the conventional technique. Patients' daily life activities and experience about the operation are not affected by the technique used (Piezosurgery) to perform this surgical procedure.

Disclosure

The authors claim to have no financial interest, either directly or indirectly, in the products or information listed in the article.

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