Piezosurgery versus Conventional Osteotomies and Rasping in Open Rhinoplasty

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Abstract

Background: Piezosurgery is appropriate for all bony surgeries, but it is predominantly helpful when access is limited and/or the bones are close subtle soft tissue, **Aim and objectives;** this work aimed for comparing conservative osteotomies and rasping with the Piezosurgery medical device, as regard operative time, post-operative edema, ecchymosis, and pains in open rhinoplasty patients. **Subjects and methods:** It is a prospective study done at our university hospital from June 2019 to December 2020. This study included 40 patients, 20 done with Piezosurgery technique in osteotomy and rasping, other 20 with conventional technique in osteotomy and rasping. This study involves both males and females their age range from 18-50 years, informed consent taken. **Results:** Postoperative ecchymosis was statistically significant in 2nd and 4th day's postoperative, Piezosurgery better than conventional osteotomy and rasping ($p < 0.05$), but in 7th day no significant difference between both techniques ($p = 1.00$), **Conclusion:** Piezosurgery is a safe, feasible, and helpful technique for accomplishment of lateral osteotomy and rasping in rhinoplasty. The Piezo electrical medical device concentrates the action completely on mineralized tissue therefore protecting the nasal mucosa. Piezosurgery is accompanying with reduced severity of edema and ecchymosis, and pain in comparison to conservative osteotomy.

Keywords: Piezosurgery, Rhinoplasty, Osteotomy, Conventional Technique, Soft Tissues

Introduction

In rhinoplasty operation, managing the bony vault and side walls is commonly accomplished with mechanical tools: chisels, saws, osteotomes, and rasps [1]. For decades, these devices were advanced to minimalize damages to the adjacent soft tissue and to increase accuracy [2].

But the sustained absence of accuracy and the accompanying non-controllable fractures lines encouraged the exploration for more accurate operative devices tools. So, electronic devices with responding heads have been established to surmount the restrictions of manual tools [2]. Power-derived burrs, rasps, and saws were made explicitly for the usage in rhinoplasty operation with respectable outcomes [3].

While restrictions existing like the cost, elevated surgical period, and risk of soft tissues injuries, more exposures, and trouble doing side osteotomies [4]. Lately, surgeons have started to use Piezo-electric-derived ultrasonic devices for the managing bony vault and side osteotomies [5].

Experimental and clinical research in several topics of oral and maxillofacial operation proposes the usage of Piezotome to decrease post operative morbidities and improve healing. This work aimed to study if rhinoplasty operation with Piezotome may reduce post-operative morbidities and rise general cases satisfactions in comparison to rhinoplasty with old-style devices and protocol [5].

Piezo-electric operation is built on Piezo-electric vibration made by an electric piezoceramic transducers, which could then be employed for cutting bone via different tips [6]. Fundamentally, electric current goes

across the ceramic, causing oscillations of ultrasonic frequencies that is then amplified and transported to a vibrant insert [7]. Bony tissues are blended and detached by suctions irrigations with no thermally or mechanically injuries to the adjacent tissues [6].

Piezosurgery is appropriate for all bony operation, but it is predominantly valued when accessing restricted and/or the bones are adjacent to delicate soft tissue (nerves, vessels, skin, dura, mucosa, and pleura). It permits the surgeons to accomplish ostectomy, osteotomy, and osteoplasty. PE is well-known clinically, with review studies describing its development over the past two decades [8].

In 2010, Pribitkin et al. described on their practice utilizing PEI (Piezo-electric instruments) for dorsal hump elimination in 60 cases. As well as managing the bony vaults, deepening of the radix-glabellar zone was accomplished as shown. Significantly, they can smooth the mobilized nasal bone next osteotomies with no danger of disrupting serious soft tissues attachments. They as well described the usage of PEI for turbinectomy, septoplasty, and frontal nasal spine resections [9].

In 2011, Greywoode and Pribitkin extended their retrospective clinical analysis to dorsal reductions in 103 cases with more focus on frontal nasal spine resections (100 cases) and glabellar deepening (3 cases), in addition to routine usage in smoothing mobilized nasal bone and carving convexness of the nasal bone [10].

This work aimed for comparing conservative osteotomies and rasping with the piezo surgery medical instrument, as regard operative time, post-operative edema, ecchymosis, and pains in open rhinoplasty patients.

Patients and Methods:

It is prospective study done at our university hospital from June 2019 to December 2020. This study included 40 patients, 20 done with Piezosurgery technique in osteotomy and rasping, other 20 with conventional technique in osteotomy and rasping. This study involves both males and females their age range from 18-50 years, informed consent taken.

For all patient's operative duration has been documented, and photos were taken and scored for ecchymosis and edema on post-operative days 2, 4, 7 days. Furthermore, pain levels were assessed on the 2nd day postoperatively.

Study Methods:

Inclusion criteria: Patients with nasal deformity with age range from 18-50 years old either males or females, informed consent were given to all patients.

Exclusion criteria: Pediatric patients, revision cases, recent nasal infection and recent nasal trauma and bone fracture (3months -trauma)

Surgical Technique:

The interferences have been accomplished under general anaesthesia by the same surgeon; An "open" approach has been utilized for all patients. Anesthetic infiltration was attained with 1: 100,000 epinephrine solution at the level of the side nasal pyramid walls and intranasally.

In our study we used Piezo medical device from Mectron Carrasco, Italy.

All surgeries were initiated with a mid-columellar V incision, and the nasal skeleton was exposed in the subperichondrial and subperiosteal operative anatomic plane. The comprehensive subperiosteal degloving of the whole nasal bones had been performed up to the nasal maxillary sulcus, medial canthus, and nasion in all cases, non-dependent of the kind of osteotomy device utilized. Vessels, counting the angular vein and arteries, have been sealed if visible throughout the expositions of nasal bones to minimalize soft-tissue injuries. Thereafter the explanation of nasal skeleton, septal mucoperichondrial has been raised bilaterally and cartilage grafts have been gathered from cartilaginous septum to utilize in re-shaping and re-construction of the nose in all cases.

For patients suffering from dorsal hump, thereafter dorsum exposures, hump elimination was done with a Piezoelectric medical device **Figure (1)** (PMD; Piezo-surgery, Mectron Carrasco, Italy) with an OP-1insert tip **Figure (2).**

A gentle rasping movement has been accomplished to eliminate the additional dorsal bony mass. Through a columellar access, medial nasal osteotomies similarly may be accomplished by means of the Piezo-electric device with an MT-1 insert tip **Figure (3)**. Ultrasonic resonance frequency (ranged between 24.7 to 29.5 kHz) in low-frequency amplitudes are selected by the user. A foot pedal permits the surgeons for controlling all the restrictions (power, mode, and irrigation).

For lateral osteotomies, a 2 mm incision of the skin, underlying apparent muscular aponeurotic system, and periosteum has been accomplished 8 to 10 mm medially and descending from the medial canthus. A bent, narrow, and unguarded tip of the PMD scalpel was introduced via the incision to the bony surface **Figure (4)**. The scalpel was manually pushed cranially and caudally into the incision to produce minimal periosteal detachment and was restricted to the ideal line of the lateral osteotomy. No actual subperiosteal tunnel was created. Then, the PMD was activated. The vibrating scalpel was moved continuously along the ideal line of the osteotomy while gently pressuring the bony surface. The obtained osteotomy was not strictly perforating but almost continuous and was entirely completed from the access position. After the procedure was performed on the contralateral site, a greenstick fracture was obtained with minimal manual pressure at the canthal level. Adequate irrigation was maintained during the osteotomy procedure to avoid heating and consequent skin burn. In conventional osteotomy group, an osteotomy 2-mm width was used.

All cases have been released from hospital care the same day, or at next day afterward rhinoplasty with antibiotic coverage (amoxicillin-clavulanic acid tab 1gm two times daily), ibuprofen 400 mg when needed to permit following-up of post-operative pains, prednisolone 20mg once daily for 10 days.

Post-surgical managing was as well uniform. All cases were informed to keep the semi-seated location; cold compresses have been used to the eyes and nonstop changed during the first 24 hours, the septal splint together with the dressing cast on the post-surgery 7th day, we did not use nasal packs for all patients.

We gathered data concerning the operative period form, the postoperative course and the following-up retro. Throughout the hospital stay and after patient discharge, we everyday checked the next criteria concerning the postoperative course: pains, edema and peri-orbital ecchymosis.

Duration of the operation evaluated by the time taken during osteotomy and hump removal not all the time of the operation since first incision, this due to variability in every case (bleeding, fibrosis).

Post-operative Pain was assessed using the visual analog scale (VAS). A VAS scored of 3 or more needed the usage of analgesic treatment **Figure (5).**

Eyelid edema has been assessed by a 4-grade visual scale at 2nd, 4^{th,} and 7th day postoperatively. **Figure (6)**

Statistical analysis: collected data analyzed via IBM-SPSS-26 (USA). Data was presented as mean±SD, median (range). Comparisons between quantitative variables were done by means of the nonparametric Mann-Whitney test. For comparing of serial measurements within every case the nonparametric Friedman test and Wilcoxon signed rank testing have been utilized **[13]**. At P-values <0.05 result has statistical significance.

Results

In our study we have 40 patients, 20 done with traditional osteotomy and rasping (16 females and 4 males), and 20 with Piezosurgery method (14 females and 6 males), their age ranges from 18-50 years, mean age was 33.34 years (standard deviation 10.23 years). **Figure (7, 8, 9, 10)**

Pain evaluation on the 2nd post-operative day, eighty percent of cases done with Piezosurgery showed minimal discomfort (vas <3), so no need for analgesics. While patients with traditional method it was necessary in seventy percent of patients and this change was significant (p value< 0.05).

According to duration of surgery conventional osteotomy allowed shorter operative time compared to Piezosurgery, this mostly happened at the beginning of our usage of piezo machine but with more training and experience the duration of surgery decreased, the difference was nonsignificant (p>0.05).

Table (1): Comparison between 2 techniques in pain score and duration of surgery

	Conventional Osteotomies and Rasping		**Piezosurgery**		**P value**
	Mean	**SD**	**Mean**	**SD**	
VAS	3.10	0.79	1.85	0.75	<0.001
Duration	13.8	1.7	12.8	1.9	0.088

Postoperative edema was statistically significant in day 2 and 4 postoperative ($p < 0.05$), Piezosurgery better than conventional osteotomy and rasping, but in 7th day postoperative no statistically difference between both techniques ($p = 0.108$) **(figure. 11)**.

Table (2): Comparison of oedema scores between 2 techniques

	Conventional Osteotomies and Rasping					Piezosurgery					P value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Edema day 2	2.65	0.75	2.50	2.00	4.00	1.60	0.94	1.00	1.00	3.00	0.001
Edema day 4	2.15	0.67	2.00	1.00	3.00	1.30	0.47	1.00	1.00	2.00	< 0.001
Edema day 7	1.30	0.47	1.00	1.00	2.00	1.00	0.00	1.00	1.00	1.00	0.108

Postoperative ecchymosis was statistically significant in 2nd and 4th days postoperative, Piezosurgery better than conventional osteotomy and rasping ($p < 0.05$), but in 7th day no significant difference between both techniques ($p = 1.00$) **(figure. 12)**.

Table (3): Comparison of Ecchymosis scores between 2 techniques

	Conventional Osteotomies and Rasping					Piezosurgery					P value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Ecchymosis day 2	2.35	0.49	2.00	2.00	3.00	1.75	0.44	2.00	1.00	2.00	0.005
Ecchymosis day 4	1.55	0.51	2.00	1.00	2.00	1.00	0.00	1.00	1.00	1.00	0.002
Ecchymosis day 7	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.000

Discussion

Successful rhinoplasty is the consequence of controlled variations in the nasal framework and its soft tissues covering. Changes and formative of the nasal bony structures give a continuing challenging in esthetic and re-constructive operation [14]. Side osteotomies accompanying with a rise in haemorrhage, edema, and ecchymosis. This was validated by other reports and may be contributed significantly to rhinoplasty post-operative morbidities [15].

The present work was executed to assess and for comparison of the clinical outcome between Piezo-surgery technique against a conservative osteotomy technique for side osteotomy and rasping in open-method rhinoplasty. Our study included 40 patients (20 done with piezo, 20 traditional osteotomy). Our results demonstrated that Piezosurgery decreases edema, pains, and ecchymosis post operatively.

There is significant less pain in second day postoperative with Piezosurgery compared with conventional osteotomy in our study which similar to **Koc et al.** [16] that showed less pain on first and seventh day postoperative with Piezosurgery which was significant.

Fallahi et al. [17] showed also significant less pain postoperatively with Piezosurgery compared with conventional osteotomy days 1, 2, and 3postoperative. **Troedhan** [18] showed less pain which is significant at seventh day postoperatively with Piezosurgery. **Tirelli et al.** [19] also showed less pain which is significant postoperatively in Piezosurgery compared with conventional osteotomy.

In our study Piezosurgery taking more time than conventional osteotomy but result is insignificant which similar to **Tirelli et al.** [19], but **Koc et al.** [16] showed that there is significant difference between both techniques (conventional osteotomy short duration of surgery than Piezosurgery). When piezo medical device will be more available for surgeons, and with its easy learning curve the duration of surgery will decrease as shown in our results duration decrease with every patient.

According to our study edema assessed at 2, 4, 7 days postoperatively, and showed significant difference between both techniques in second and forth days postoperative (less edema in piezo) but in seventh day no significant difference between both techniques.

Koc et al. [16] showed less edema which is significant in first and seventh day postoperatively. **Fallahi et al.** [17] showed less edema which is significant at second day postoperatively, but insignificant in seventh day postoperatively.

Troedhan [18] showed less edema which is significant in seventh day postoperatively, **Ilhan et al.** [20] showed less edema which is significant in third day postoperatively with Piezosurgery, but in seventh day postoperatively examiner 1 showed less edema which is significant with Piezosurgery, examiner 2 showed no significant difference in seventh day postoperatively. **Tirelli et al.** [19] showed less edema within first 4days postoperatively which is significant with Piezosurgery.

In our study we showed less ecchymosis postoperatively with Piezosurgery which is significant in second and fourth, and insignificant in seventh day postoperative when compared with conventional technique.

Koc et al. [16] showed less ecchymosis which is significant in first and seventh day postoperatively with Piezosurgery. **Fallahi et al.** [17] showed less ecchymosis which is significant at second and seventh days postoperatively with Piezosurgery.

Troedhan [18] showed less ecchymosis which is significant in seventh day postoperatively with Piezosurgery. **Ilhan et al.** [20] showed less ecchymosis which is significant in third and seventh days postoperatively with Piezosurgery. **Tirelli et al.** [19] showed less ecchymosis in first 4days postoperatively which is significant with Piezosurgery.

Conservative approaches of osteotomy might need mechanical power and extended post-operative ecchymosis and edema can happen because of traumas to the nasal mucosa [15].

Robiony et al. [4] showed that when unguarded chisels are dimly utilized, nasal soft tissue and vessels can be injured, and risk of haemorrhage and ecchymosis is elevated.

Koc et al. [16] showed that Piezosurgery may be a perfect device for doing side osteotomy, in addition to hump resections, may be performed safely and successfully with this method.

As with any other novel method, a learning curve is essential, but Piezosurgery is a safe and straight forward method [21].

Labanca et al. [7] showed that Piezosurgery needs minimal exterior pressure post side osteotomy. It turns in a gentle way with no need for hammer. Piezosurgery used for avoiding morbidities and progress cases satisfactions.

Koc et al. [16] showed that Piezosurgery helped in lessening post-operative pains, edema, and ecchymosis, thus improving cases comfort, and lessening the period for recovery, and the piezo scalpel is easy to use and doesn't result in any mucosa lacerations.

In our work we found that pain was less and significant with Piezosurgery at 2^{nd} day postoperative, edema was less and significant at 2^{nd} and 4^{th} day postoperative with Piezosurgery and insignificant at 7^{th} day postoperative between both groups, ecchymosis was less and significant at 2^{nd} and 4^{th} day postoperative with Piezosurgery and insignificant at 7^{th} day postoperative between both groups, duration of surgery was shorter in conventional technique than piezo but insignificant. So, we recommend Piezosurgery technique than conventional technique in lateral osteotomy and hump removal in open rhinoplasty.

Conclusion

Piezosurgery is a secure, reasonable, and efficient technique for execution of side osteotomy and rasping in rhinoplasty. The Piezo electrical medical device permits to spare all soft tissue and it emphases the action completely on mineralized tissue therefore protecting the nasal mucosa. Piezosurgery is accompanying with reduced severities of edema and ecchymosis, and pain in comparison with conservative osteotomy.

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Table (4): Comparison between 2 techniques in pain score and duration of surgery

	Conventional Osteotomies and Rasping		Piezosurgery		P value
	Mean	SD	Mean	SD	
VAS	3.10	0.79	1.85	0.75	<0.001
Duration	13.8	1.7	12.8	1.9	0.088

Table (5): Comparing edema scores amid 2 techniques

	Conventional Osteotomies and Rasping					Piezosurgery					P value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Edema day 2	2.65	0.75	2.50	2.00	4.00	1.60	0.94	1.00	1.00	3.00	0.001
Edema day 4	2.15	0.67	2.00	1.00	3.00	1.30	0.47	1.00	1.00	2.00	< 0.001
Edema day 7	1.30	0.47	1.00	1.00	2.00	1.00	0.00	1.00	1.00	1.00	0.108

Table (6): Comparison of Ecchymosis scores between 2 techniques

	Conventional Osteotomies and Rasping					Piezosurgery					P value
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum	
Ecchymosis day 2	2.35	0.49	2.00	2.00	3.00	1.75	0.44	2.00	1.00	2.00	0.005
Ecchymosis day 4	1.55	0.51	2.00	1.00	2.00	1.00	0.00	1.00	1.00	1.00	0.002
Ecchymosis day 7	1.00	0.00	1.00	1.00	1.00	1.00	0.00	1.00	1.00	1.00	1.000

Figure (1): Mectron Piezo Medical Device (PMD)

Figure (2): Hump removal tip

Figure (3): Medial osteotomy tip.

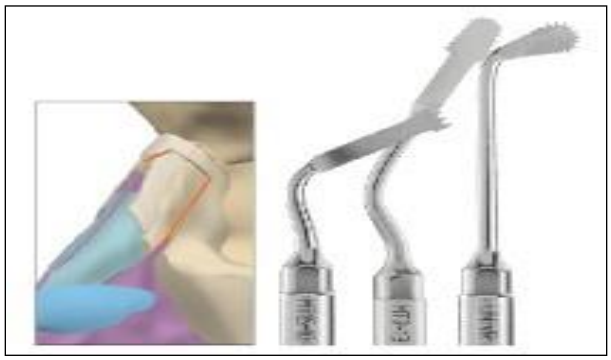

Figure (4): Lateral osteotomy tip.

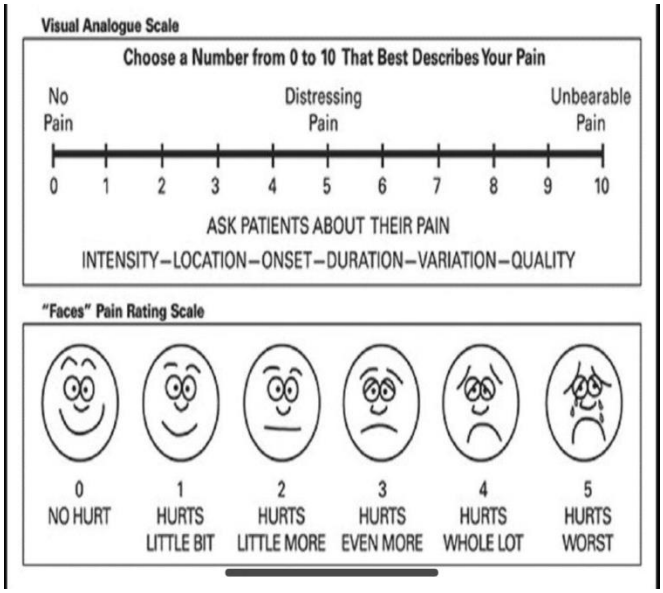

Figure (5): Visual analog scale (VAS) **[11]**

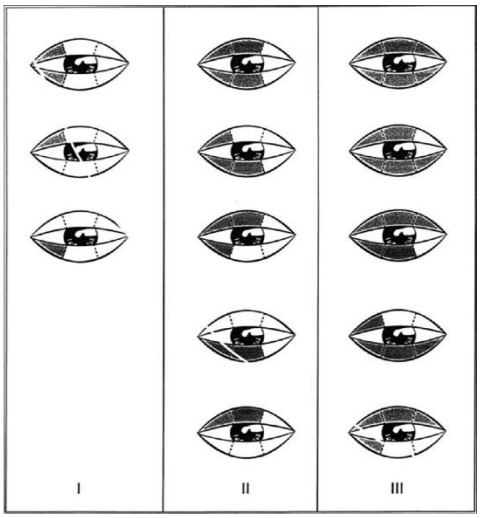

Figure (6): Method of evaluating periorbital ecchymosis. 1 ecchymosis to the medial one 3rd of the lower or up-per eyelid, 2 ecchymosis to the medial two thirds of the lower or upper eyelid, and grade 3 ecchymosis of the complete extent or up-per eyelid [12].

Figure (7): Assessment of female patient pre-operative and post rhinoplasty by piezosurgery at 2,4,7 days postoperative.

Preoperative

Postoperative

Figure (8): Assessment of female patient pre-operative and post rhinoplasty by conventional instruments at 2,4,7 days postoperative.

Figure (9): Assessment of female patient pre-operative and post rhinoplasty by piezosurgery at 2,4,7 days postoperative.

Figure (10): Assessment of female patient pre-operative and post rhinoplasty by conventional instruments at 2,4,7 days postoperative.

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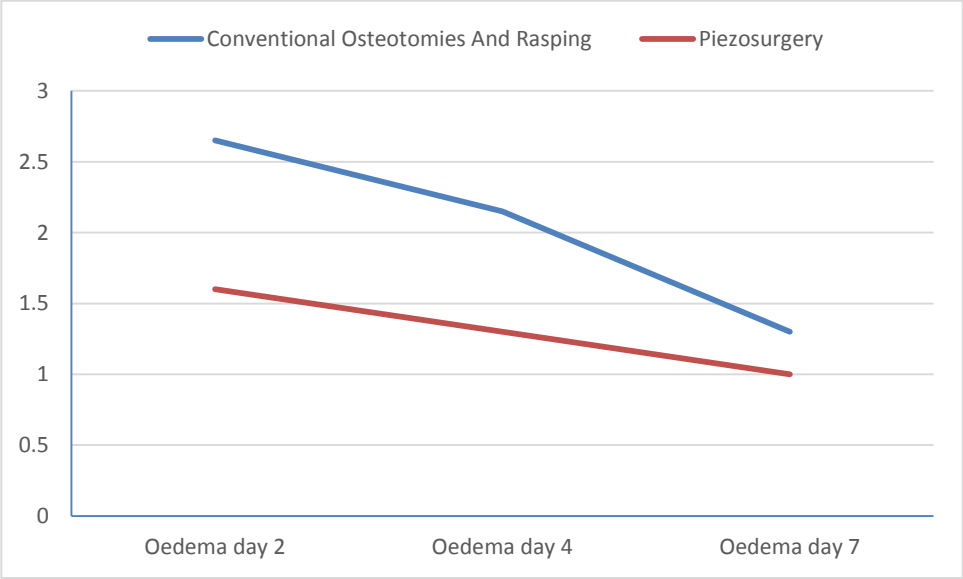

Figure (11): Comparison of postoperative scores in oedema between 2 techniques.

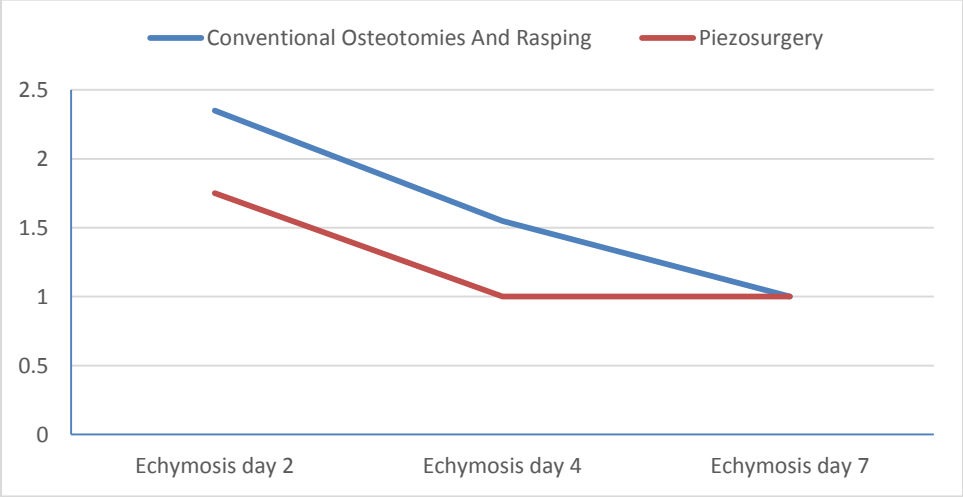

Figure (12): Comparison of postoperative scores in ecchymosis between 2 techniques.