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REFLECTION ON PATIENT REPORTED OUTCOME MEASURES FOLLOWING LATERAL OSTEOTOMIES DURING RHINOPLASTY; A COMPARISON BETWEEN PIEZOELECTRIC INSTRUMENTATION AND CONVENTIONAL OSTEOTOMES

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ABSTRACT

INTRODUCTION: Nasal osteotomies are commonly performed in rhinoplasty. Two of the most frequently used instruments are the guarded lateral osteotomes and piezoelectric instrumentation (PEI). One method of assessing rhinoplasty results is to measure outcomes using validated questionnaires, or patient-reported outcome measures (PROMs).

OBJECTIVES: To assess the effect of conventional osteotomes and PEI on patient-reported outcome measures.

METHODS: A retrospective cohort study performed on primary open rhinoplasty. Patients were divided into two groups according to technique used for nasal osteotomies. Fifteen cases were performed with conventional guarded osteotomes, and 15 were performed with PEI. Their preoperative and postoperative Standardized Cosmesis Health Nasal Outcomes survey (SCHNOS) scores, visual analog scale, functional (VAS-F) and cosmetic (VAS-C), were analyzed and compared.

RESULTS : Thirty patients with an average age (SD) of 27.1 (8.99) years. Six men (20%) and 24 women (80%). The PEI group's mean follow-up period (PO) was 50.33 (12.13) days as opposed to conventional group's 32.77 (14.74) days. For patients managed with conventional osteotomes, all PROMs were statistically significant with the exception to SCHNOS-O. For those performed with PEI, only the cosmetic outcomes demonstrated a statistically significant change (SCHNOS-C & VAS-C). SCHNOS-C exhibited a statistically significant difference between groups when postoperative PROMs were compared. VAS-C displayed a significant change in mean between preoperative and postoperative total PROMs values in both groups.

CONCLUSION: The use of PROMs is useful to assess different techniques in rhinoplasty, reflect on patient satisfaction and assist surgeons in evaluating their operative techniques. On a short term follow up, no significant change is evident in regard to functional outcomes between both groups. While the SCHNOS-C scores has better results in those treated with PEI.

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INTRODUCTION

Nasal osteotomies evolved throughout history. The first induced nasal bony fracture was reported in 1892 by Robert Weir (1) when he corrected nasal problems in two patients by using a chisel and nasal forceps. Although Jacques Joseph did not report the first reduction rhinoplasty operation, he is known to set the basic techniques that dominated rhinoplasty surgery for decades. His mastery in nasal osteotomies was quickly established by his development of the Joseph saw that became standard in the approach to the nasal skeleton (2). Students of Josephs continued the use of saws until the popularity of chisels that was adopted in the late 1920s (3). To avoid airway obstruction that resulted from the aggressive mobility of nasal bones as well as the low level of osteotomy of the Joseph's technique, Maurice Cottle invented

his push-down technique which involved lateral osteotomies, nasal septum reduction and the posterior repositioning of the intact bony cartilaginous nasal dorsum (4). A safer way to avoid mucosal injury, decrease bleeding and be as minimally traumatic as possible is with the use of a medially rotated guarded osteotome. This was used to decrease facial edema and discoloration (5). Their use varied among surgeons, either externally or endonasally, perforating or continuous (3). The popularity of osteotomes continued to increase and are the most widely used among rhinoplasty surgeons moving in to the 21st century. In 2007, the piezoelectric ultrasonic device was used for the first time to perform lateral osteotomies and nasal hump removal (6).

Understanding how the piezoelectric device works starts from understanding the origin of piezo electricity and piezoelectric material properties. The word "Piezo" comes from the greek word piezein which means squeeze or press tightly and the word "electric" comes from the greek word elektron which means amber (7). The definition of a piezoelectric material is a solid object that produces an electric charge when exposed to pressure. This phenomenon is called the "piezoelectric effect". Some of these materials when exposed to an electric current can produce slight movement, vibrations or an ultrasonic pulse which is called the "reverse Piezoelectric effect". Examples of natural piezoelectric material include Quartz crystals, Topaz, Rochelle salt, Schorl Tourmaline, Sugar cane, DNA, Dentine, Enamel, bone and tendons (8). Piezoelectricity was discovered in the year 1880 by the French brothers Jacques and Pierre Curie (9). After a year, Lippman (10) mathematically proved the reverse effect. The use of piezoelectric surgery device expanded and has been used intraoperatively to cut bone precisely while minimizing injury to the nearby vital tissues. It is utilized in performing craniotomies and cranial osteoplasty without injuring the underlying dura (11), performing precise hand bone osteotomies avoiding nearby nerve harm (12), facial nerve decompression (13), endoscopic dacryocystorhinostomy (14) and many otologic procedures (15–17). The use of piezoelectric device in oral and maxillofacial surgery became popularized and was performed for different indications including bone graft harvesting, biopsy and precise bony osteotomies (18). In rhinoplasty, under wide exposure and direct vision, precise bony cuts were made leading to a stable, symmetric and narrower bony dorsum (6).

The patient's subjective analysis and the surgeon's intraoperative assessment are typically used to evaluate rhinoplasty procedures. Therefore, it is important for patient reported outcome measures (PROMs) to evaluate results of everyday clinical practice and assess patient level of satisfaction. The indication of cosmetic procedures is to improve patients' satisfaction and in turn improve their quality of life (19). Many PROMs have been utilized for that purpose, most commonly, the rhinoplasty outcomes evaluation (ROE) (20). and the nasal obstruction symptom evaluation (NOSE) scale (21). The Standardized Cosmesis and Health Nasal Outcomes Survey (SCHNOS) is a relatively newly validated 10-item questionnaire that reflect both functional and cosmetic nasal status and has been validated in multiple languages (22). The visual analogue scale (VAS) is a psychometric measuring instrument utilized to detect symptom severity in individual patients. It is also used to monitor symptom response and assess effectiveness of certain treatment protocols (23).

Methods

This study complied with the international guidelines for research ethics and was conducted after receiving the ethical clearance from the research ethics committee at the Faculty of Dentistry, Alexandria University. All participants signed informed consent before undergoing the operation to confirm their understanding of surgery outcome and risks they might encounter during the procedure.

A retrospective cohort study performed on a primary open rhinoplasty population of 30 patients at the department of maxillofacial and plastic surgery, Alexandria University, Alexandria, Egypt and the Division of Facial Plastic and reconstructive surgery, Stanford School of Medicine, Stanford, CA, USA after approval of the institutional review board. They were divided in to 2 groups according to the method used in performing lateral nasal bony osteotomy. 15 cases were performed with conventional guarded lateral osteotomes, and 15 were performed with PEI.

Preoperative and earliest post operative visit (PO) SCHNOS scores were collected and evaluated. The scores have 10 questions, each scaled from 0 to 5. Zero meaning having "no problem" while 5 meaning "severe problem". The first 4 questions are related to nasal airway patency and function determining the degree of nasal obstruction, they are referred to as SCHNOS-O. the following 6 questions are concerned with nasal cosmesis and referred to them as SCHNOS-C. The total scores for both nasal obstruction and cosmetic domains were calculated. Total SCHNOS-O was determined by adding the result of the first 4 questions, divide them by 20 and then multiply by 100 to get a total percentage. While SCHNOS-C was calculated by adding the outcome of the 6 questions, dividing them by 30 and multiplying the total with 100. Post operative total SCHNOS-O and total SCHNOS-C were compared to their corresponding Preoperative results. **(Figure 1)** (22)

In order to express a general assessment of the patient's nasal function and aesthetic issues, a visual analogue scale (VAS) was also used. From 0 to 10, patients were asked to rate two VAS scales related to their nasal obstruction symptoms (VAS-F) and the satisfaction with nasal appearance (VAS-C). "0" indicated no nasal blockage whereas "10" indicated severe nasal obstruction for VAS-F. On VAS-C a score of "0" indicated complete dissatisfaction with one's nasal appearance, while a score of "10" indicated high levels of aesthetic satisfaction. **(Figure 2)** (23) The studied population included patients that had history of trauma and cleft lip nose deformity. Patients with previous nasal surgery or younger than 16 years of age were excluded.

RESULTS

Thirty patients comprised the study cohort, their average age (SD) was 27.1. (8.99). 24 women (80%) and 6 men (20%). 14 (46.7%) and 16 (53.3%) patients were operated in Alexandria University and Stanford school of medicine respectively. In 2 (6.7%) patients, rhinoplasty was done solely for functional purposes; in 15 (50%) cases, it was performed for aesthetic reasons; and in 13 (43.3%) patients, it was done for combined functional and cosmetic reasons. **(Table 1)** Six (20%) of the patients had a history of trauma, and thirteen (43.3%) of them were patients with cleft lip and nose deformities. The mean follow-up period (PO) for the piezo group was 50.33 (12.13) days, compared to 32.77 (14.74) days for the conventional group.

For the group of patients treated by the conventional method, SCHNOS scores as well as VAS improved from preoperative to postoperative visit in term of total outcomes. Slight decrease in mean total scores was seen from 55 (28.28) to 40.38 (20.66) in regard to SCHNOS-O. While significant change was evident in SCHNOS-C, decreasing from 70.89 (15.51) to 14 (12.03). VAS-F decreased from 5.13 (2.62) to 2.54 (2.18) and VAS-C increased from 0.87 (1.3) to 8.69 (1.38). **Table 2** presents the statistically significant difference between preoperative and postoperative PROMs except for the SCHNOS-O, which was insignificant with a P value of 0.114. For patients managed with PEI, comparing between preoperative and post operative PROMs showed improvement on both functional and cosmetic aspects. Mean of SCHNOS-O decreased from 36.3 (36.27) to 26 (21.89), SCHNOS-C showed a definite improvement of 7.55 (11.78) on postoperative visit compared to 54.2 (26.76) preoperatively. VAS-F decreased from 3.53 (2.66) to 2.47 (2.58) and VAS-C increased from 3.67 (1.63) to 9.13 (1.3). Statistically significant difference was only shown for the cosmetic outcomes (SCHNOS-C & VAS-C). P values were 0.001. **(Table 3)**

Comparing postoperative SCHNOS and VAS between the two groups shows only statistically significant difference in SCHNOS-C with p= 0.023. **(Figure 3)** while SCHNOS-O, VAS-F and VAS-C had a nonsignificant p value of >0.05. **(Table 4)** Mean change between preoperative and postoperative total PROMs scores in the two groups is compared and presented in **Table 5**. Significant change is seen only in VAS-C total score between conventional and piezo groups with a p value of 0.024 (mean change was 7.69 (2.29) and 5.47 (2.23), respectively). This change is illustrated in **Figure 4**. While the statistical values for SCHNOS-O, SCHNOS-C, and VAS-F were non-significant (p=0.853, p=0.432, and p=0.266, respectively).

STANDARDIZED COSMESIS AND HEALTH NASAL OUTCOME SURVEY (SCHNOS)

Over the past **month**, how much of a **problem** was the following:

	No problem					Extreme problem
1. Having a blocked or obstructed nose	0	1	2	3	4	5
2. Getting air through my nose during exercise	0	1	2	3	4	5
3. Having a congested nose	0	1	2	3	4	5
4. Breathing through my nose during sleep	0	1	2	3	4	5
5. Decreased mood and self-esteem due to my nose	0	1	2	3	4	5
6. The shape of my nasal tip	0	1	2	3	4	5
7. The straightness of my nose	0	1	2	3	4	5
8. The shape of my nose from the side	0	1	2	3	4	5
9. How well my nose suits my face	0	1	2	3	4	5
10. The overall symmetry of my nose	0	1	2	3	4	5

Figure 1: The Standardized Cosmesis and Health Nasal Outcomes Survey (SCHNOS).

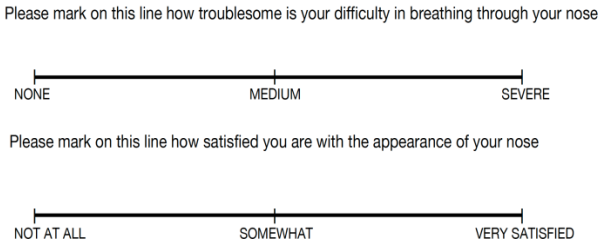

Figure 2: Visual Analogue Scales.

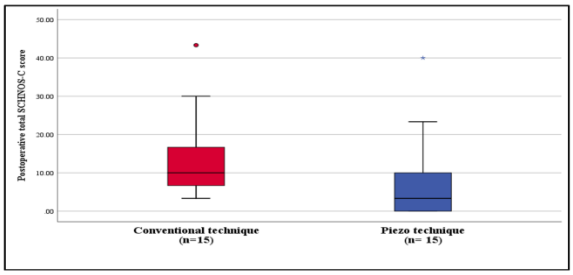

Figure 3: Total SCHNOS-C total score between Conventional and Piezo techniques.

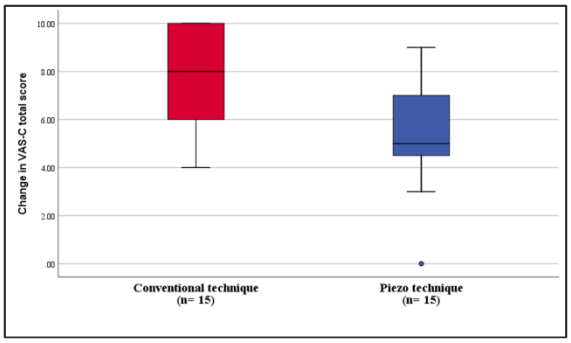

Figure 4: Change in total VAS-C total score between Conventional and Piezo techniques.

Table 1: Sociodemographic characteristics of the studied patients

Sociodemographic data	Frequency (n=30)	%
Gender:		
Male	6	20.0
Female	24	80.0
Age (years):		
Mean (SD)	27.1 (8.99)	
Median (Min. – Max.)	26.0 (16.0 – 47.0)	
Etiology:		
Functional	2	6.7
Cosmetic	15	50.0
Both Functional & Cosmetic	13	43.3

Table 2: Comparison between pre- and post-operative total SCHNOS and VAS scores in the conventional group.

	Preoperative (n= 15)	Postoperative (n= 15)	Test of significance (p)
SCHNOS-O:			
Mean (SD)	55.0 (28.28)	40.38 (20.66)	Z= -1.579 p= 0.114
Median (Min – Max)	55.0 (0.0 – 95.0)	40.0 (10.0 – 70.0)	
SCHNOS-C:			
Mean (SD)	70.89 (15.51)	14.0 (12.03)	Z= -3.062 p= 0.002*
Median (Min – Max)	73.33 (43.33 – 90.0)	10.0 (3.33 – 43.33)	
VAS-F:			
Mean (SD)	5.13 (2.62)	2.54 (2.18)	Z= -2.526 p= 0.012*
Median (Min – Max)	5.0 (0.0 – 9.0)	2.0 (0.0 – 6.0)	
VAS-C:			
Mean (SD)	0.87 (1.3)	8.69 (1.38)	Z= -3.201, p= 0.001*
Median Min – Max)	0.0 (0.0 – 4.0)	9.0 (6.0 – 10.0)	

Z; Wilcoxon test
SD; Standard deviation, *; Significant (p< 0.05)

Table 3: Comparison between pre- and post-operative total SCHNOS and VAS scores in the Piezo group.

	Preoperative (n= 15)	Postoperative (n= 15)	Test of significance (p)
SCHNOS-O:			
Mean (SD)	36.3 (36.27)	26.0 (21.89)	Z= -69.0 p= 0.49
Median (Min – Max)	30.0 (0.0 – 90.0)	20.0 (0.0 – 80.0)	
SCHNOS-C:			
Mean (SD)	54.2 (26.76)	7.55 (11.78)	Z= -3.237 p= 0.001*
Median (Min – Max)	50 (0.0 – 100.0)	3.33 (0.0 – 40.0)	
VAS-F:			
Mean (SD)	3.53 (2.66)	2.47 (2.58)	Z= -.851 p= 0.395
Median (Min – Max)	4.0 (0.0 – 8.0)	1.0 (0.0 – 8.0)	
VAS-C:			
Mean (SD)	3.67 (1.63)	9.13 (1.3)	Z= -3.313, p= 0.001*
Median (Min – Max)	4.0 (1.0 – 7.0)	9.0 (5.0 – 10.0)	

Z; Wilcoxon test
SD; Standard deviation, *; Significant (p< 0.05)

Table 4: Comparison between conventional and piezo techniques as regard post-operative total SCHNOS and VAS scores.

	Conventional (n= 15)	Piezo (n= 15)	Test of significance (p)
SCHNOS-O			
Mean (SD)	40.38 (20.66)	26.0 (21.89)	U= 58.0, p= 0.068
Median (Min – Max)	40.0 (10.0 – 70.0)	20.0 (0.0 – 80.0)	
SCHNOS-C			
Mean (SD)	14.0 (12.03)	7.55 (11.78)	U= 49.0, p= 0.023*
Median (Min – Max)	10.0 (3.33 – 43.33)	3.33 (0 – 40)	
VAS-F			
Mean (SD)	2.54 (2.18)	2.47 (2.58)	U= 86.5, p= 0.605
Median (Min – Max)	2.0 (0.0 – 6.0)	1.0 (0.0 – 8.0)	
VAS-C			
Mean (SD)	8.69 (1.38)	9.13 (1.3)	U= 116.5, p= 0.353
Median (Min – Max)	9.0 (6.0 – 10.0)	9.0 (5.0 – 10.0)	

U; Mann-Whitney test
SD; Standard deviation, *; Significant (p<0.05)

Table 5: Comparison between conventional and piezo techniques as regard change in total SCHNOS and VAS scores.

	Conventional (n= 15)	Piezo (n= 15)	Test of significance (p)
SCHNOS-O change:			
Mean (SD)	-11.92 (24.03)	-10.33 (45.45)	U= 93.5, p= 0.853
Median (Min – Max)	-15.0 (-60.0 – 25.0)	0.0 (-85.0 – 75.0)	
SCHNOS-C change:			
Mean (SD)	-56.15 (21.25)	-40.67 (29.06)	U= 80.5, p= 0.432
Median (Min – Max)	-56.67 (-83.33 – 0.0)	-46.67 (-80.0 – 6.67)	
VAS-F change:			
Mean (SD)	-2.46 (2.82)	-1.07 (3.75)	U= 73.5, p= 0.266
Median (Min – Max)	-3.0 (-7.0 – 2.0)	0.0 (-7.0 – 5.0)	
VAS-C change:			
Mean (SD)	7.69 (2.29)	5.47 (2.23)	U= 49.0, p= 0.024*
Median (Min – Max)	8.0 (4.0 – 10.0)	5.0 (0.0 – 9.0)	

U; Mann-Whitney test
SD; Standard deviation, *; Significant ($p<0.05$)

DISCUSSION

Since the beginning of nose reshaping surgeries, there has been controversy over the ideal methods to perform nasal bone osteotomies. Surgeons evaluated osteotomy instruments based on instrument availability, cost, handling, safety, severity of postoperative complications, and long-term outcomes. The course of lateral nasal osteotomy also varied from one surgeon to the other (3). PROMs are essential for determining patient acceptance of their rhinoplasty procedure and the surgeon's personal assessment. Evaluating various techniques and their effects on patient outcomes is also helpful.

Patient reported outcome measures not only were used to evaluate rhinoplasty outcome as a procedure (19), but have been utilized to assess the effectiveness of different intraoperative techniques. but have been utilized to assess the effectiveness of different intraoperative techniques (24). Troedhan used the ROE, preoperatively and at 6 months postoperatively, on patients who underwent rhinoplasty using either traditional instruments or the ultrasonic surgical device which showed improved results among those managed with PEI (25). ROE was also used to evaluate patient satisfaction after preservation rhinoplasty (26). Yet the use of PROMs has not been fully integrated in comparing different methods of nasal bone osteotomies. A 5-point VAS for nasal cosmesis and NOSE scales for nasal obstruction assessment were used by Nunes et al. to evaluate the application of a novel approach for intermediate osteotomies (27). Hernot et al. demonstrated better results on both ROE and NOSE scales when spreader grafts are used with osteotomies to correct crooked noses instead of osteotomies alone (28). NOSE scales were also employed by Simsek and Demirtas when performing osteotomies on wide nasal dorsum with large humps compared to no osteotomies in patients with narrow nasal dorsum and a minimal hump (29). No significant difference was seen when comparing the change between preoperative and postoperative outcome scores. Cakir et al. evaluated their new bone chisel scraping osteoectomy technique for lateral and medial osteotomies using NOSE scales (30).

The SCHNOS scores are very useful and widely used, not only where it was originated (22,24), but used by different rhinoplasty surgeons around the world (31–34). This short, validated questionnaire evaluates functional and cosmetic changes in all types of rhinoplasties reflecting patient's perspective as well as evaluating one's surgical results. Due to its recognized value, it has been translated to multiple languages to adapt to different populations around the world (35–38).

In our findings, all PROMs showed improvement in PO assessments compared to the preoperative results. We found significant improvement in the cosmetic outcomes (SCHNOS-C and VAS-C) in both groups with different methods used to perform lateral osteotomy on their postoperative visit. The VAS-F in the piezo group also failed to have a statistically significant difference. This could be contributed to the presence of cleft lip nose deformity patients within the conventional group with their associated variant anatomical abnormalities that causes nasal obstruction. Managing of such deformities yielded significant nasal airway flow improvement. Examples of such problems include the severity of septal deviation, associated turbinate hypertrophy, narrow pyriform aperture and narrower external valve due to weak hypoplastic ala.

The sole outcome measure with statistically significant improvement comparing PEI and guarded osteotome managed patients was the SCHNOS-C. Improved results were seen in the PEI group compared to the conventional group. The reason for such a difference may arise from the nature of the patient population between the two groups. Having more congenitally abnormal cleft nose deformities in the conventional group that are known to be not totally satisfied with their cosmetic outcome and the limitations that surgeons face to reach an excellent outcome. Conversely, the conventional group's VAS-C difference in change was higher than the piezo group. Meaning that the rhinoplasty procedure had a significant impact on this group of patient's aesthetic

appearance and improved it significantly from how it appeared prior to the surgery. Thus, while both groups showed improvement in self-reported cosmesis VAS or SCHNOS-C, the PEI and conventional groups each out-performed the other on different measures, perhaps due to the relatively small sample size.

The indecisiveness and uncertainty that accompanies the choice of osteotomy instruments, has always led to the debate on agreeing which is the best tool for nasal osteotomies. It is a fact that PEI produces precise and safe osteotomies but has the limitation of higher cost and more operative time. Although, guarded osteotomes are widely used, they carry the risk of increased intraoperative bleeding, injury to mucosa and unwanted fractures (39) This has also led to the development of more innovative techniques that can be particularly useful with closed rhinoplasty (30,40).

Our study's limitations include the presence of cleft lip and nose deformity population that have variant nasal and maxillary anatomy with nasal asymmetry which usually persists postoperatively and is very difficult to correct. This may be reflected on post operative outcome measures compared to the non-cleft population. Our postoperative PROMs results were recorded in less than a 3 month follow up. These results may change after resolution of nasal edema at a longer follow up period.

CONCLUSION

The use of PROMs is a useful tool to assess different techniques in rhinoplasty and to evaluate patient symptomatology before and after surgery. On a short term follow up, no significant change is evident in regard to functional outcomes between PEI and conventional osteotomes. While the cosmetic domain of SCHNOS scores has better results in those treated with PEI.

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Conflict of interests:

The authors declare that they have no conflict of interest.

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