

Comparison of two approaches to lateral nasal osteotomy in Saudi patients

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BACKGROUND: Nasal deformity is an abnormality in the appearance of the nose due to either congenital defect or trauma. In traumatic cases, patients often present with combined functional and cosmetic complaints. Therefore, otolaryngologists take into account both breathing and aesthetic nasal issues.

OBJECTIVES: To evaluate the changes in the nasal dorsum and base; compare breathing and aesthetic satisfaction scores between two approaches to lateral nasal osteotomy: low-to-low and low-to-high.

DESIGN: Comparative observational; data gathered retrospectively and prospectively.

SETTING: Head and Neck and Skull Base Center, King Abdullah Medical City, Makkah, Saudi Arabia.

PATIENTS AND METHODS: Patients who received hump reduction rhinoplasty from 2013 to 2016 met the inclusion criteria.

MAIN OUTCOME MEASURE(S): The differences in dorsal (DW) and ventral (VW) widths with a fixed inter-pupillary distance (IPD). Satisfaction scores for both cosmetic perspective and breathing functionality.

RESULTS: We included 46 patients; 28 patients underwent low-to-low osteotomy and 18 patients underwent low-to-high osteotomy. With both approaches, there were statistically decreases from preoperative to postoperative ratios of VW/IPD and DW/IPD. However, differences in DW/IPD ratio and VW/IPD ratio (pre- versus post-op) were significantly higher in the low-to-low group ($P < .0001$). All showed breathing satisfaction postoperatively regardless of the operative approach. Only patients who underwent the low-to-high osteotomy were neutral or dissatisfied with aesthetic sensibility.

CONCLUSION: Both types of osteotomy showed a satisfactory outcome in both objective and subjective measures. However, low-to-low osteotomy was superior in pre- to post-operative differences in DW/IPD and VW/IPD ratios.

LIMITATIONS: Sampling was by convenience. The study was conducted in a single tertiary center and was a small sample.

Rhinoplasty refers to various types of plastic surgeries performed to reconstruct or correct the nasal anatomy to achieve optimal functioning or enhance the aesthetics of the nose.¹ Most common indications for rhinoplasty are respiratory impediment, congenital defects, or a failed primary rhinoplasty. Additionally, rhinoplasty is one of the most desired and commonly performed facial aesthetic surgeries.²

Depending upon the type of nasal deformity, techniques can include transverse, medial or lateral osteo-

mies; however, the latter remains the key techniques.^{3,4} Numerous lateral osteotomy protocols are employed based on the requirements of the individual case. Two of the most commonly used approaches to lateral osteotomy are low-to-high and low-to-low osteotomy. Both these approaches differ in degree of movement of the bone, the extent of the bony fracture, and the direction of the procedure. The low-to-high osteotomy begins at the piriform aperture and traverses towards the intercanthal line, ending high on the nasal dorsum. This protocol

is performed less often and is preferred for correction of a minor roof opening or mobilization of a moderately wide nasal base.⁵ Low-to-low osteotomy is more powerful as it results in more medial movement of the nasal bone.⁵ Therefore, the low-to-low osteotomy is more widely used to correct a large open roof and excessively wide nasal base.⁵ Like the low-to-high approach, this procedure also begins low along the piriform aperture and remains low all the way up to the inner canthus. Both approaches differ in their ability to move the nasal wall. A low-to-low approach often leads to a complete transversal osteotomy that allows total movement of the lateral nasal wall, while the low-to-high approach leads to limited movement as it preserves the bony contact at the greenstick fracture.⁵

Lateral osteotomy can lead to complications like ecchymosis, prolonged edema, functional nasal obstruction, aesthetic deformities, and excessive haemorrhage.⁶ Selection of the suitable surgical technique, surgeon's expertise, use of appropriate equipment and to an extent the variations associated with individual patients are important factors that determine the type and degree of complications.

These approaches (low-to-high and low-to-low osteotomies) have been well documented for their technical differences and outcomes in clinical studies in some western countries.^{1,2} However, data on the differences in two approaches in the finer aspects of outcomes and in the subjective scales of patient satisfactions are not reported for a Middle East population including Saudi Arabians. Hence, this study was conducted to compare the results of reduction (narrowing) of the nasal dorsum and nasal base by low-to-low and low-to-high osteotomy. Additionally, the secondary objective was to determine patient satisfaction in terms of breathing and aesthetics of the nose.

METHODS

This comparative observational study involved retrospective and prospective data collection. It was conducted between January 2013 and January 2016. The study was approved by the Institutional Review Board (IRB) of King Abdullah Medical City (KAMC) under IRB No. 14-118. All Saudi patients aged ≥ 18 years who underwent or who were candidates for low-to-low or low-to-high lateral osteotomies after nasal hump removal as a part of reduction rhinoplasty were recruited. Patients who had been considered for revision rhinoplasty, had other dorsal abnormalities, or did not receive hump reduction were excluded from the present study. Initially, low-to-high osteotomy was undertaken for all patients in our center. Starting from January 2014, empirical obser-

vations suggested that Saudi candidates for rhinoplasty had a preference for relatively more width reduction in their noses (as suggested by satisfaction scores recorded in patient chart). Subsequently, another approach (low-to-low osteotomy) was undertaken and retrospective and prospective data collection for the study was initiated.

Based on the surgical approach, eligible patients were categorized into patients who underwent lateral low-to-low osteotomy and patients who underwent lateral low-to-high osteotomy. A written consent was obtained from all the participants who were enrolled after January 2014, start date of the data collection. For patients who were operated on prior to this date, data was collected by retrospective chart review.

Preoperative evaluation

As a part of a standard protocol, patients were evaluated preoperatively for the indicated reduction rhinoplasty. Frontal photographs were captured for each patient by a Nikon digital camera with an 18-55 mm lens (model D3200) in a standardized setting by a single photographer. The dorsal width (DW) and the ventral widths (VW) were measured on the frontal view using Adobe Photoshop software measuring tool (version 7.0; Adobe Systems Inc., San Jose, California). By convention, interpupillary distance (IPD) was fixed at 30 mm on all frontal views to make the measuring comparisons standardized at a fixed frontal distance. Therefore, DW/IPD and VW/IPD were calculated⁷ to reflect the objective differences between the two surgical approaches (low-to-low osteotomy and low-to-high osteotomy). After surgery, breathing and aesthetic satisfaction scores were obtained from each patient based on a five-point Likert-type scale, from extremely dissatisfied (score=1) to extremely satisfied (score=5).

Surgical procedure

All surgical procedures were performed by the senior author. All patients received general anaesthesia. The hump removal (hump reduction) was performed in both groups, resulting in an open roof deformity. Subsequently, osteotomy was performed to close the defect and to achieve symmetry of the asymmetrical nasal bone deformity. In both groups, 20 mL of 1% lidocaine with 1:100000 epinephrine was injected (intranasal) along the lateral nasal sidewall bilaterally, allowing seven minutes for the haemostatic effect of epinephrine to occur. The surgeon used a flat 2-mm microosteotome, which was sharpened by a surgical stone then rinsed with saline solution, wiped with a clean towel, and rinsed again to remove all the dust particles. The sharpened osteotome was in-

roduced at the mid-portion of the bony nasal pyramid and multiple interrupted osteotomies were performed 2 mm apart as they followed the predefined pattern. For the low-to-low group, the procedure began low along the piriform aperture and followed the base of the nasal pyramid as it approached the medial canthus (**Figure 1**). For the low-to-high group, the procedure started at the piriform aperture and then reached the nasal dorsum after which it was anteriorly redirected, away from the medial canthus (**Figure 2**). After bilateral osteotomies were completed in each patient in both groups, a greenstick fracture was made to medialize the nasal bones in both groups by gentle pressure between thumb and forefinger. Finally, a gentle sustained pressure was applied to prevent bleeding and ecchymosis. Further, the skin was cleaned with alcohol and adhesive strips were applied. Finally, an external nasal splint was fixed for three weeks and prophylactic antibiotics were prescribed to all patients postoperatively.

Postoperative evaluation

A lag period of 12 months was respected for all the patients to allow surgical edema to be resolved. All surgical sutures were removed on day 7, postoperatively. A few minor postoperative complications were reported including dorsal irregularity and nasal valve narrowing. Other complications such as bleeding or infection were not reported in our study. A postoperative photograph was taken to measure the nasal widths by the same photographer using the same digital camera as in the preoperative assessment. In addition, postoperative satisfaction for breathing and aesthetic aspects was assessed in all patients from both the groups.

Statistical analysis

The data was analysed by using SPSS version 16 (SPSS Inc., Chicago, IL, USA). Descriptive analysis was carried out and categorical data was presented as a frequency and percentage; while numerical data was subjected to Shapiro-Wilk test to determine the normality of the distribution. Normally distributed data was expressed as a median (ranges) and was analysed using nonparametric tests. Pre- and post-operative VW/IPD and DW/IPD ratios for both approaches were considered normally distributed data and were compared using paired sample t test. Pre- to postoperative changes in VW/IPD and DW/IPD ratios were compared between the two operative approaches using the Mann-Whitney U test. A proportional odds ordinal logistic regression model was used to compare the two groups, in terms of patient's satisfaction level with aesthetic sensibility. The proportional odds assumption was met for this regression model. An

alpha level of <0.05 was considered significant for each analysis.

RESULTS

In a consecutive series of 46 patients who underwent reduction rhinoplasty, 28 patients underwent low-to-low osteotomy and 18 patients underwent the low-to-high osteotomy. With both approaches, there was a significant decrease from preoperative to postoperative ratios for the VW/IPD, as this difference was remarkably noticeable with the low-to-low approach (0.1, 95% CI 0.07-0.12) (**Table 1**). Similarly, both approaches showed a significant decrease in DW/IPD when preoperative and postoperative ratios were compared statistically for both low-to-low and low-to-high approaches independently (0.08, 95% CI 0.06-0.09; 0.01, 95% CI 0.01-0.02, respectively) (**Table 2**). A comparison of these two measurable lines is illustrated for the low-to-high and low-to-low approaches (**Figures 3-6**). The difference in the VW/IPD ratio (pre versus post-op) was significantly higher with the low-to-low approach compared with that of low-to-high approach ($P<.0001$) (**Table 3**). Similarly, the difference in DW/IPD ratio (pre-versus post-op) using the low-to-low approach was significantly higher compared with the low-to-high approach ($P<.0001$).

All patients showed breathing satisfaction postoperatively, regardless of the approach used. Moreover, all patients who were neutral or dissatisfied underwent the low-to-high approach (**Table 4**). The odds of having greater satisfaction with aesthetic sensibility was greater in patients treated with the low-to-low approach when compared with the low-to-high approach, (OR=3.8, 95% CI 1.1-12.6, $P=.03$).

DISCUSSION

The ideal type of lateral nasal osteotomy should be able to maintain the harmony of the periosteal bony layer wall attachments, the nasal mucosa, and should also provide the desired outcome along with improved patient satisfaction (measured by enhanced aesthetics and improved breathing). Furthermore, such a technique is expected have high or absolute success rates owing to its safety, precision, reproducibility and minimal undesired consequence.^{6,8} These factors are governed by numerous variables, one of these being ethnic variations.

This study was the first to compare outcomes of low-to-low osteotomy and low-to-high osteotomy in patients of Saudi ethnicity. Along with clarifying the clinical suitability of these approaches, this study also aimed to understand the two approaches and analyze which is more likely to achieve better satisfaction among the Saudi population. The low-to-low approach was more suitable

Table 1. Analysis of the pre- and post-operative VW/IPD ratios of patients who underwent low-to-low and low-to-high osteotomies.

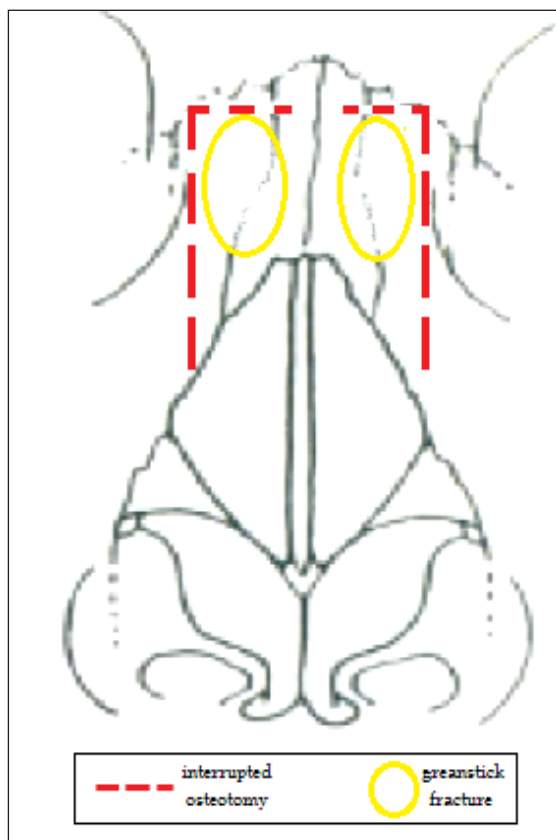
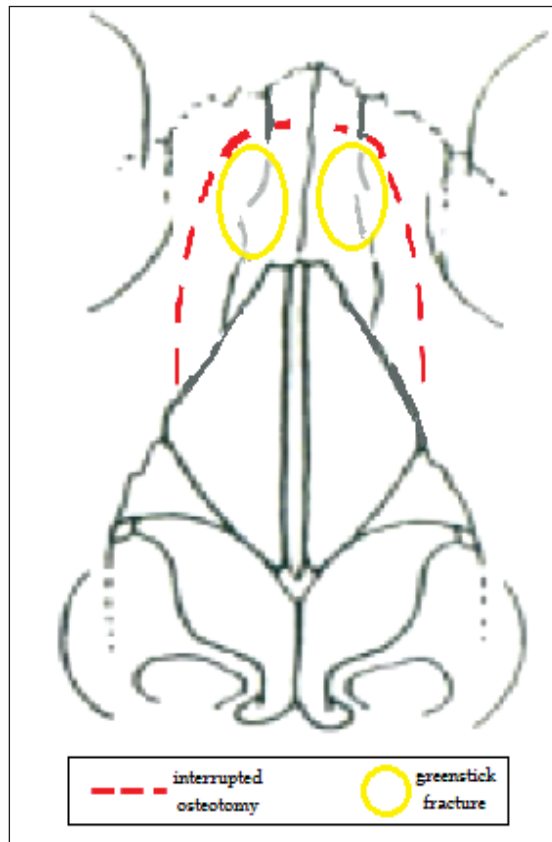
Technique	N	Preoperative ratio	Postoperative ratio	Difference	t statistic	Degrees of freedom	P value (2-tailed)
Low-to-low	28	0.48 (0.07)	0.38 (0.06)	0.10 (0.07-0.12)	7.9	27	<.0001
Low-to-high	18	0.49 (0.05)	0.47 (0.06)	0.02 (0.008-0.04)	3.2	17	.005

Values are mean and standard deviation (paired t test) and mean (95% confidence interval) for the difference.

Table 2. Analysis of the pre and post-operative DW/IPD ratios of patients who underwent low-to-low and low-to-high osteotomies.

Technique	N	Preoperative ratio	Postoperative ratio	Difference	t statistic	Degrees of freedom	P value (2-tailed)
Low-to-low	28	0.31 (0.06)	0.23 (0.04)	0.08 (0.06-0.09)	9.5	27	<.0001
Low-to-high	18	0.32 (0.06)	0.30 (0.06)	0.0144 (0.01-0.02)	3.8	17	.001

Values are mean and standard deviation (paired t test) and mean (95% confidence interval) for the difference.

**Figure 1.** Low-to-low pathway.**Figure 2.** Low-to-high pathway.

for closure of a wider open roof, whereas the low-to-high approach was performed less often to achieve minor changes. However, it is important to test the suitability, outcomes and patient satisfaction for a population to aid

in achieving better clinical outcomes.

Both approaches were able to achieve a significant reduction in VW/IPD and DW/IPD ratios postoperatively. However, the low-to-low approach achieved a higher

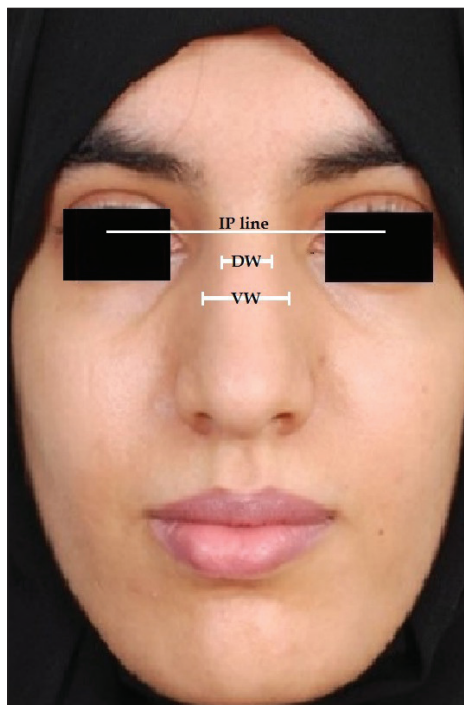


Figure 3. Preoperative photo of low-to-high approach. IP (Inter-pupillary); DW (dorsal width); VW (ventral width).

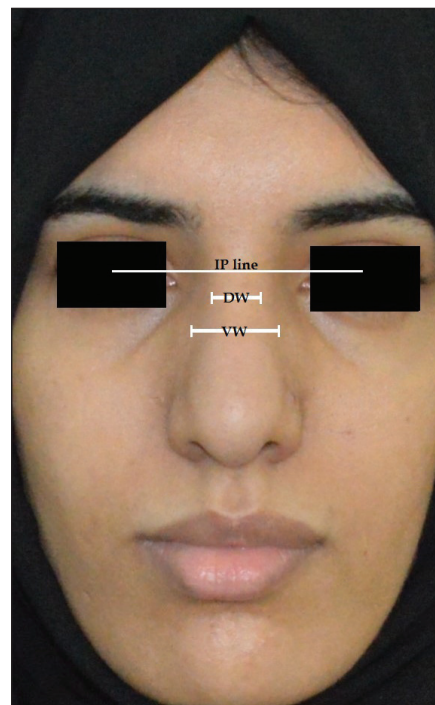


Figure 4. Postoperative photo of low-to-high approach. IP (Inter-pupillary); DW (dorsal width); VW (ventral width).

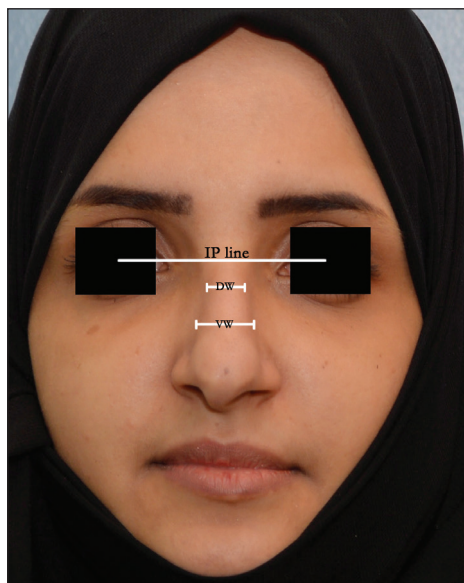


Figure 5. Preoperative photo of low-to-low approach. IP (Inter-pupillary); DW (dorsal width); VW (ventral width).



Figure 6. Postoperative photo of low-to-low approach. IP (Inter-pupillary); DW (dorsal width); VW (ventral width).

Table 3. Comparison of the pre- to postoperative difference in VW/IPD and DW/IPD ratios between low-to-low and low-to-high osteotomies.

Parameter	Low-to-low	Low-to-high	Mann Whitney-U test statistic	P value (2-tailed)
VW/IPD ratio	0.1 (0.0 – 0.33)	0.01 (0.0-0.1)	55.5	<.0001
DW/IPD ratio	0.07 (0.03 – 0.17)	0.02 (0.0 – 0.07)	23.5	<.0001

Values are median (range) difference (Mann Whitney-U test).

Table 4. Comparisons of post-operative breathing and aesthetic sensibility satisfactions between the two groups.

Outcome	Technique	Very dissatisfied	Dissatisfied	Neutral	Satisfied	Very satisfied
Breathing	LTL (n=28)	0	0	0	7	21
	LTH (n=18)	0	0	0	2	16
Aesthetic	LTL (n=28)	0	0	0	12	16
	LTH (n=18)	0	1	3	8	6

LTL: low-to-low; LTH: low-to-high.

value of significance (21% reduction in men and 26% reduction in women) as compared with the low-to-high approach (4% reduction in men and 6% reduction in women). The median and range values for the change in VW/IPD and DW/IPD ratios were much higher for low-to-low osteotomy.

In 1987, Romeo and Rollin were one of the first to conclusively establish that a wide variation in outcomes exists between different types of lateral osteotomies. The authors employed computerized tomography scanning at two days and six months postoperatively, to compare outcomes.⁹ The variation in the extent of difference in outcomes for low-to-low and low-to-high approaches was expected to reflect the difference in postoperative breathing and aesthetic satisfaction. Both approaches achieved superior breathing and aesthetics, but the low-to-low osteotomy seems to be a better option as there were no ratings of dissatisfaction. These results are actually more indicative of the success of the surgery as rhinoplasty is an aesthetic procedure. Therefore, our results help us conclude that Saudi individuals are more likely to be satisfied as nasal widths are reduced, which enables otolaryngologists to visualize the ideal nose from their perspective. Though clinical outcomes are important, aesthetic outcomes determine the lifelong benefits of the procedure.¹⁰ Furthermore, the feedback also reflects on the quality of healthcare, which ultimately assists in overall medical care improvements.

Limitations were that the study was based on convenience sampling. Also, the study was conducted in a single tertiary center on a small sample (46 patients). To conclude, low-to-low lateral osteotomy achieved superi-

or results as compared with low-to-high osteotomy, both in terms of aesthetic lines and patient satisfaction.

Conflict of interest

None.

Funding source

None.

Financial disclosure

None.

Consent

Informed consent was obtained from all subjects after approval of the protocol by an institutional review board (IRB) of King Abdullah Medical City (KAMC), Makkah, Saudi Arabia.

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