Efficacy of V–Y Closure of Upper Lip After Le Fort I Osteotomy Advancement and Superior Repositioning on Facial Esthetics in Comparison to Simple Continuous Closure: A Statistical Analysis

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Abstract This study aims to evaluate efficacy of V–Y closure of upper lip incision on facial esthetics in comparison to simple continuous closure after Le Fort I advancement and superior repositioning of maxilla. Thirty-four patients were divided in two groups i.e. V–Y closure group (group I = 17 patients) and simple continuous closure group (group II = 17 patients). The preoperative and 1 year post-operative linear and angular changes of hard and soft tissue points of groups I and II were statistically compared. Labial changes were more favourable in V–Y closure group in comparison to simple continuous closure group in both the Le Fort I maxillary movements. The upturning and forward movement of the nose were seen in both the maxillary movements but these nasal changes did not differ significantly between the groups. It was observed that the technique of V–Y closure of upper lip delivers adequate results contributing to better facial esthetics when compared to simple continuous closure.

Keywords Le Fort I osteotomy · V–Y closure · Nasolabial esthetics · Upper lip lengthening

Introduction

Surgical movement of the maxilla via Le Fort I osteotomy for correction of dentofacial deformity usually results in variable soft tissue changes. Such changes are influenced by the magnitude and direction of the maxillary shift during the surgical procedure and these may be difficult to control because of considerable variation in soft tissue adaptation [1]. The various adverse changes which occur after Le Fort I osteotomy of maxilla such as alar flaring, upturning of the nasal tip, thinning of the upper lip, reduced vermilion exposure, accentuation of nasolabial groove, compromise in the desired facial esthetics. Several methods have been used to correct these adverse changes like alar base cinching, partial or total removal of the anterior nasal spine, vertical incision with tunneling on the buccal side and V–Y closure (VYC) of the wound to improve nasolabial esthetics after Le Fort I osteotomy [2]. In order to assess the efficacy of V–Y closure technique in improving the facial esthetics after Le Fort I osteotomy, number of studies had been carried out. However, there is still no conclusive evidence to suggest that the technique of VYC vis-à-vis simple continuous closure (SCC) delivers the appropriate result [3]. The results delivered after VYC of upper lip were statistically compared with the results of SCC in the patients who were selected and managed for vertical and horizontal midface deformity by Le Fort I advancement and superior repositioning procedure. It was observed that the technique of VYC of upper lip delivers adequate results contributing to better facial esthetics when compared to results of SCC.

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Materials and Methods

Thirty-four patients who had anteroposterior deficiency and vertical excess of maxilla were included in the study and those with prior or concomitant additional midfacial surgery or craniofacial syndrome, were excluded. Patients were divided in two groups i.e. V–Y closure group (group I) and SCC group (group II). Group I comprised of 17 patients who were managed with VYC after Le Fort I advancement and superior repositioning while group II which was the control group comprised of 17 patients who were managed by SCC after Le Fort I advancement and superior repositioning. After mobilization and fixation of the mobilized segment, either VYC or SCC procedure was performed in midline on upper lip. The nasolabial linear and angular measurements were done on patients preoperatively and 1 year post-operatively. Also, preoperative and post-operative changes of hard and soft tissue points after 1 year were measured using lateral cephalogram tracings (Fig. 1). The hard and soft tissue points, taken into consideration for statistical analysis, were point A (deepest point in midline between anterior nasal spine and alveolar crest of maxilla), point I (tip of maxillary central incisor), posterior nasal spine (PNS), pronasale (Pn), subnasale (Sn), labrale superior (Ls) and stomian superior (Sts). The labial and nasal parameters consisted of upper lip length (Sn–Sts), superior thickness of upper lip (A–Sn), inferior thickness of upper lip/upper vermilion exposure (Sts–Ls), nasolabial angle (Pn–Sn–Ls), nasal tip projection (S–N–Pn) and maximum alar width (MAW). All the hard and soft tissue points were measured using X and Y axes centered at sella. The X axis runs from sella through nasion plus 7° and the Y axis runs vertically downwards from sella

Fig. 1 Cephalometric tracing for hard and soft tissue landmarks

Fig. 2 Hard and soft tissue landmarks

(Fig. 2). Negative values were taken in a cranial and backward direction while positive values taken in a caudal and forward direction. For all the hard and soft tissue measurements on X and Y axes, letter x and y was added to them respectively.

Statistical Analysis

The hard and soft tissue changes of two groups were compared using unpaired *t* test which was used to define significant differences between the two groups where $p < 0.05$. Relationship between various hard and soft tissue parameters was assessed using correlation and regression analysis. The equation used for correlation and regression analysis was: $A = bC + I$ wherein, A represents the soft tissue changes which is a dependent variable, b is the coefficient indicating the percentage of change of the soft tissues after 1 mm of bony movement, C denotes the movement of the bony point which is an independent variable and I (intercept) demonstrates the change of the soft tissue after no movement of the bone [2]. Regression analysis was performed with hard tissue points as independent variables and soft tissue points as dependent variables. The relationships between the vector of skeletal movements and changes at soft tissue points in X and Y directions were described with correlation and regression analysis using calculated Pearson correlation coefficient (r) where an r^2 value of 1 indicates 100 % correlation, whereas an r^2 value of 0 indicates no correlation. The equation with the bony point having highest r^2 value was considered the most important independent variable for particular soft tissue point and was therefore selected for soft tissue analysis.

Results

The osseous movements measured, showed no significant differences between the two groups (Table 1). Inter-group analysis (unpaired *t* test) revealed significant differences for all soft tissue landmarks between the SCC and VYC groups (Table 2). The correlation and regression analysis of hard and soft tissue landmarks for superior repositioning are shown in Table 3 and for advancement in Table 4. The labial and nasal changes for VYC and SCC groups can be appreciated in Figs. 3–8.

Labial Changes

The Sn followed the osseous movement at point A which maintained the superior thickness of upper lip in advancement

Table 1 Hard tissue changes in mm for V–Y closure group and simple continuous closure group

Hard tissue parameters	VYC	SCC	VYC vs SCC
Ax	4.8 ± 23	3.8 ± 2.5	NS
y	−4.2 ± 2.6	−3.6 ± 2.2	NS
Ix	3.1 ± 1.8	3.3 ± 2.4	NS
y	−3.3 ± 23	−4.1 ± 2.6	NS
PNSx	2.6 ± 1.2	2.3 ± 1.8	NS
y	−2.8 ± 1.7	−2.6 ± 1.4	NS

NS Not significant

Table 2 Soft tissue changes in mm and angular changes for V–Y closure group and simple continuous closure group

Soft tissue parameters	VYC	SCC	VYC vs SCC
Lsx	2.8 ± 1.2	0.7 ± 1.8	0.005
y	−2.6 ± 2.3	−0.4 ± 2.4	0.02
Snx	2.7 ± 1.1	0.8 ± 1.6	0.004
y	−2.1 ± 1.2	−0.5 ± 1.8	0.02
Stsx	2.1 ± 2.7	0.5 ± 2.5	0.06
y	−1.3 ± 2.8	−0.3 ± 2.3	0.05
Pnx	1.6 ± 0.8	0.8 ± 1.5	0.06
y	−2.2 ± 1.6	1.6 ± 2.8	0.05
MAW			
Pre	23.4 ± 2.8	22.9 ± 2.4	NS
Post	24.2 ± 1.8	25.8 ± 1.9	0.06
Angles			
S–N–Pn			
Pre	123.4° ± 5.1°	122.4° ± 3.8°	NS
Post	125.8° ± 4.8°	126.6° ± 4.1°	0.05
Pn–Sn–Ls			
Pre	110.4° ± 4.2°	109.2° ± 3.2°	NS
Pea	115.6° ± 5.2°	110.3° ± 4.0°	0.02

NS Not significant

Table 3 Significant regression equations for Le Fort I superior repositioning with V–Y closure and simple continuous closure

Groups	Regression equation	<i>r</i>	<i>p</i>
VYC	Lsx = 0.6Iy + 0.9	0.7	0.001
	Lsy = 0.56Iy + 0.1	0.5	0.001
	Snx = 0.56Ay − 1.24	0.8	0.002
	Stsy = 0.4Ay + 1.2	0.5	0.003
	Stsy = 0.7Iy − 1.2	0.72	0.001
	Pny = 0.89Ay − 0.63	0.7	0.01
	Pnx = 0.61Ay + 0.5	0.7	0.01
	Sny–Stsy = 0.7Ay + 1.9	0.8	0.03
	Sny–Lsy = 0.39Iy − 0.8	0.6	0.002
	NTP = 0.72Ay − 0.49	0.7	0.003
SCC	Lsy = 0.18Ay + 1.3	0.6	0.03
	Sny = 0.6Ay + 0.72	0.5	0.02
	Stsy = 0.34Iy + 1.1	0.5	0.02
	Pny = 0.42Ay − 0.62	0.4	0.04
	Pnx = 0.4Iy + 0.36	0.4	0.44
	Sny–Stsy = 0.6Ay − 0.9	0.7	0.05
	Stsy–Lsy = 0.48Iy + 0.7	0.6	0.06

Table 4 Significant regression equations for Le Fort I advancement with V–Y closure and simple continuous closure

Groups	Regression equation	<i>r</i>	<i>p</i>
VYC	Lsx = 0.5Ix + 2.3	0.6	0.06
	Lsx = 0.6A + 1.2	0.7	0.001
	Snx = 0.8Ax + 0.94	0.8	0.002
	Sny = 0.6Ax + 0.4	0.5	0.06
	Stsx = 0.8Ix + 0.8	0.4	0.002
	Pnx = 1.3Ax + 0.6	0.9	0.001
	Pny = 0.61Ix − 0.68	0.7	0.01
	Sny–Stsy = 0.5Ax + 0.7	0.6	0.03
	Stsy–Lsy = 0.39Iy + 0.8	0.6	0.04
	NTP = −0.5Ax − 0.4	0.7	0.03
SCC	Lsx = 0.5Ix − 0.5	0.8	0.01
	Lsx = 0.6Ax − 0.7	0.7	0.04
	Snx = 0.62Ax − 0.9	0.6	0.06
	Stsx = 0.76Ix − 0.9	0.8	0.01
	Stsx = 0.9Ax − 1.2	0.7	0.002
	Pnx = 0.4Ax + 0.5	0.6	0.02
	Pny = −0.3Ix + 4	0.6	0.05

r Pearson correlation coefficient, *p* significance

cases with VYC while there was reduction in superior thickness of upper lip in advancement cases with SCC. In superior repositioning cases, there was reduction in superior thickness of upper lip with VYC as shown by negative value of intercept of Sn whereas with SCC there was increase in superior thickness of upper lip. In advancement cases with VYC, there

Fig. 3 Le Fort I advancement with V-Y closure of upper lip (pre-operative)

Fig. 5 Le Fort I superior repositioning with V-Y closure of upper lip (pre-operative)

Fig. 4 Le Fort I advancement with V-Y closure of upper lip (post-operative)

was more of forward movement of Ls (upper vermillion border) independent of the osseous movement maintaining the horizontal lip projection (lip pout) whereas for SCC there was loss of horizontal projection of upper lip indicated by negative value of intercept. Inferior thickness of upper lip/upper

Fig. 6 Le Fort I superior repositioning with V-Y closure of upper lip (post-operative)

vermillion exposure was significantly different between VYC and SCC groups after maxillary movements. In superior repositioning cases, there was decreased vermillion exposure as derived from intercept of Stsy–Lsy for VYC but at the same time, there was increase in distance between Sn and Sts in a vertical direction leading to upper lip lengthening. In cases of superior repositioning with SCC there was increased

Fig. 7 Le Fort I superior repositioning with simple continuous closure of upper lip (pre-operative)

Fig. 8 Le Fort I superior repositioning with simple continuous closure of upper lip (post-operative)

vermillion exposure as well as shortening of upper lip. Forward movement of stomion superior was found in maxillary advancement cases with VYC which maintained the upper vermillion exposure while upward and backward movement of stomion superior in advancement cases with SCC lead to thinning of upper lip.

Nasal Changes

The results of this study revealed that the upwards rotation of the nasal tip did not significantly differ when using VYC as compared to SCC in both the maxillary movements. Superior and forward movement of Pn was evident in both the groups with increase in nasal tip projection and nasolabial angle after maxillary movements. The linear and angular changes resulted in upturning and forward movement of the nose in both the groups after maxillary movements in both directions. Though alar base flaring was found in VYC cases but was not statistically significant while significant alar base flaring was evident in SCC cases.

Discussion

Management of nasolabial morphology during maxillary osteotomy is an important factor for final esthetic results. Performing extensive adjuvant soft tissue procedures are often complicated by edema after the osteotomy as it make the proper handling of soft tissue difficult in order to achieve a particular surgical goal. So only the appropriate procedures which will improve the nasolabial esthetics of a particular patient should be performed at the time of surgery. VYC of the incision of upper lip has been evaluated here with regards to its effect on the final outcome of facial esthetics as compared to SCC. Various soft tissue points of nasolabial region are directly affected by movement of points A and I when moved in different directions. However, PNS does not seem to play a significant role in soft tissue movement of nose and upper lip [2]. Ls moves in backward direction in maxillary advancement cases causing thinning of upper lip [4]. In advancement cases with VYC, more of forward movement of Ls was found independent of forward movement of point A thus maintaining the adequate lip pout and inferior thickness of upper lip whereas the advancement cases with SCC, a backward movement of Ls was found which resulted in loss of lip pout and thinning of upper lip. In superior repositioning cases with VYC, there was more of forward and less of upward movement of Ls, leading to lip lengthening while maintaining the lip pout whereas in superior repositioning cases with SCC, there is upward movement of Ls leading to lip shortening with increased lip pout. The upward and

backward movement of stomion superior lead to decreased vermilion exposure of upper lip [2, 5]. Forward movement of stomion was found in maxillary advancement cases with VYC, hence decrement of vermilion exposure was not observed while in advancement cases with SCC, upward and backward movement of stomion superior was found leading to thinning of upper lip. The upper lip shortening occurs following SCC procedure as a result of vertical reduction in distance between Sn and stomion superior following superior repositioning [2, 4]. V–Y closure technique is therefore advocated following superior repositioning of the maxilla which promotes lip lengthening [6]. Lip shortening has been reported even after using V–Y closure technique [7]. In our cases with VYC after superior repositioning of maxilla, an increase in vertical length of upper lip was observed which can be attributed to the V–Y closure technique carried out on the upper lip. It has been reported that the increase in nasal tip projection after advancement and superior repositioning cases lead to upward movement of nose [2, 8]. However in our cases, increase in nasal tip projection was observed after maxillary movements in both the VYC and SCC groups with forward and upward movement of Pn leading to upturning and forward movement of the nose. The changes in nasolabial angle following maxillary advancement or superior repositioning as observed by various authors have not been predictable [4, 8]. The nasolabial angle changes were not significant after maxillary movements in both VYC and SCC groups. Although alar base flaring was found after maxillary movements with VYC, but same was not statistically significant whereas significant alar base flaring was evident in SCC cases following maxillary movements.

Thus the statistical analysis of our study confirms that the V–Y closure technique improves the overall facial esthetics considerably when compared to SCC technique after Le Fort I advancement and superior repositioning.

Summary and Conclusion

The changes which occur after mobilization of inferior segment of maxilla through Le Fort I osteotomy procedure of advancement and superior repositioning are not influenced by changes induced in the hard tissues alone but also influenced by the method of closure of incision which has been utilized for Le Fort I osteotomy. In our cases managed by VYC of the incision, which was statistically compared with SCC, it was found that the facial profile showed definite improvement aesthetically with V–Y closure than SCC.

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