ORIGINAL ARTICLE

Reducing the Vermilion Notch in Primary Lip Repairs: Z-Plasty Versus the Noordhoff Triangular Flap

Saadia Nosheen Jan, Farid Ahmad Khan, Hamid Hussain Ansari, Asif Hanif and Afzaal Bajwa

ABSTRACT

Objective: To compare Z-plasty and the Noordhoff flap for reducing notching in the vermilion during primary repair.
Study Design: Comparative study.
Place and Duration of Study: Plastic Surgery Department, Mayo Hospital, Lahore, from March 2008 to August 2010.
Methodology: Patients presenting for primary unilateral cleft lip repair were included. The modified Millard's technique was used for lip repair. The percentage of the total vermilion thickness notched was recorded at 6 months follow-up. The repair was graded as: < 0.5 mm good, > 0.5 mm but < 1 mm satisfactory and > 1 mm poor. Patient satisfaction was rated on a scale of 1 to 10, with 10 being the happiest patient.
Results: In Group 1 (Z-plasty) 25 patients, and in Group 2 (Noordhoff flap), 20 patients achieved a good result. Five patients in Group 1 and 7 patients in Group 2 achieved a satisfactory result. Three patients in Group 2 had a poor result. Patient satisfaction and vermilion repair were comparable when comparison was made between the two groups ($p > 0.05$).
Conclusion: The Noordhoff flap needs more expertise and finesse. All 3 poor results were achieved early in the study. Z-plasty was easier to execute and gave a good result in almost all hands.

Key words: *Primary unilateral cleft lip. Modified Millard's repair. Vermilion notch. Noordhof's lateral triangular flap. Z-plasty.*

INTRODUCTION

The quest for a perfectly repaired cleft lip with minimal scarring has baffled plastic surgeons for centuries. In 1955, Millard proposed the idea of advancing a lateral flap into the upper part of the lip in combination with a downward rotation of the medial segment,[1] meaning a rotation advancement repair. The technique with various modifications is still used by most surgeons worldwide to repair the unilateral cleft lip. One of the known setbacks of this procedure is a notch in the vermilion. The term notch in this study will be used to describe a depression of the vermilion on both sides of the repaired cleft as well as a break in the free border of the lip.[2] Both are caused by a straight line closure of the vermilion (employed by Millard) in an otherwise well done lip repair. This results in a linear scar, which when contracts produces a notch at the cleft borders of the vermilion and lower down in the free border of the upper lip. The vermilion in the medial segment (non-cleft segment containing the Cupid's bow) is often deficient as compared to the vermilion in the lateral (cleft) segment. Failure to augment the vermilion width further aggravates the appearance of the notch. To counteract these pitfalls, straight line vermilion closure was shunned and surgeons started performing a Z-plasty on the vermilion. Z-plasty balanced the tissue elements in both the segments and also solved the problem of straight line vermilion closure. Noordhoff presented a triangular flap from the lateral segment to be interposed into an incision made in the medial segment where the vermilion is deficient.[3,4] Both techniques have proved to be efficient in reducing the vermilion notch by evading straight line closure of the vermilion. However, there is scant literature on the comparison between the two techniques.

This study was done to compare the two well-known methods of reducing vermilion notching during primary lip repairs, Z-plasty and the Noordhoff flap.

METHODOLOGY

This study was conducted at the Plastic Surgery Department, Mayo Hospital, Lahore, from March 2008 to August 2010. In the study, patients with primary unilateral cleft lips were included. Primary bilateral cleft lips were excluded as some degree of notching is inevitable in the repair no matter what technique is used. Thirty patients chosen at random underwent vermilion repair with a Z-plasty and 30 with the Noordhoff's triangular flap. The idea was to solely compare the results of the interrupted closure in preventing notch formation, using a standard method of cleft repair. An asymmetric Z-plasty was executed on the vermilion below the white roll to prevent straight line closure so that the larger limb of the Z is designed on the lateral segment where the vermilion is more abundant and is interposed into the medial lip segment. The other limb of the Z was made smaller and interposed into the lateral lip segment to balance the two sides (Figure 1). The Noordhoff's flap is a triangular flap consisting of

Department of Plastic and Reconstructive Surgery, Mayo Hospital, Lahore.

Correspondence: *Dr. Saadia Nosheen Jan, 94-J, DHA Phase 1, Lahore.*
E-mail: saadia_jan@yahoo.com

Received December 24, 2010; accepted February 15, 2012.

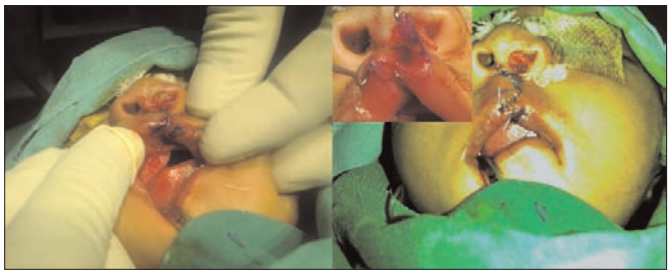

Figure 1: Z-plasty. Inset shows raised Z-plasty flaps.

Figure 2: The Noordhoff triangular flap.

vermilion and the marginal orbicularis oris muscle from the lateral lip element where the vermilion is thicker. The flap was designed from the excess vermilion that would otherwise be pared off in a straight line closure of the vermilion. It was interposed into a back cut made on the medial lip element at the level of muco-vermilion junction or red line to balance the two sides (Figure 2). To reduce the margin for error, all procedures were performed by either the senior surgeons of the department or year three residents. Utmost care was taken to fulfill all the other criteria of a good cleft lip repair, for example proper marking of point 4 (where the vermilion is thickest), adequate rotation of the medial lip element to correct vertical height discrepancy, proper muscle release and suturing, release of the lower lateral cartilages and their suspension. The results were followed-up at 6 months postoperatively. The repair was graded according to the total vermilion thickness notched in millimeters of notch depth. If the percentage of the total vermilion thickness notched was < 0.5 mm the repair was termed good and no revision procedures were required. If the percentage was > 0.5 mm but < 1 mm the repair was satisfactory. Revision procedures depended on the patient satisfaction scores. If the notch depth was greater than 1 mm of the total lip thickness, the repair was labelled poor and a revision procedure was definitely indicated.

Patient satisfaction was rated on a scale from 1 to 10, with 1 being the least satisfied and 10 being the happiest patient, similar to the visual analogue scale for pain. Patient satisfaction was highly subjective and some patients were dissatisfied with even minor discrepancies while others were happy with the same result.

Statistical analysis was done by Statistical Package for Social Sciences (SPSS) version 15. Nominal data like vermilion repair (good, satisfactory and poor) and patient's satisfaction (dissatisfied, satisfied and happy) were recorded as frequency. Comparison between the groups with respect to vermilion repair and patient's satisfaction were analyzed by chi-square test. A $p < 0.05$ was considered significant.

RESULTS

Sixty patients included 40 males and 20 females. The age ranged from 3 months to 20 years. The results are shown in Table I and II. Comparable results for Z-plasty and the Noordhoff triangular flap were obtained. The slight discrepancy favouring Z-plasty was attributed to the more difficult execution of the Noordhoff flap accurately.

In Z-plasty method, 25 vermilion repair were good (83.4%) and 5 were satisfactory (16.6%). In Noordhoff method, 20 repair were good (66.7%), 7 satisfactory (23.4%) and 3 repair were poor (10%). When data was analyzed to find out the association of vermilion repair (good, satisfactory and poor) by Z-plasty with Noordhoff, it was statistically not significant [$p > 0.05$] (Table I).

In Z-plasty method, patient's satisfaction was noted, 2 were dissatisfied (6.6%), 5 were satisfied (16.7%) and 23 were happy (76.7%). In Noordhoff method, 4 were dissatisfied (13.3%), 6 were satisfied (20%) and 20 were happy (66.7%). The data was analyzed to find out association between satisfaction score (dissatisfied, satisfied and happy). The comparison of Z-plasty with Noordhoff was statistically not significant [$p > 0.05$] (Table II).

Table I: Comparison of vermilion repair by Z-plasty and the Noordhoff's method.

Vermillion repair	Z-Plasty method (n=30)		Noordhoff method (n=30)		p-value
	No.	%	No.	%	
Good	25	83.4	20	66.7	0.128*
Satisfactory	05	16.6	07	23.4	0.509*
Poor	-	-	03	10.0	0.068*

**P value p > 0.05 (Not significant).*

Table II: Comparison of patient satisfaction after Z-plasty and Noordhoff's triangular flap.

Vermilion repair	Z-Plasty method (n=30)		Noordhoff method (n=30)		p-value
	No.	%	No.	%	
1-5 (Dissatisfied)	02	6.6	04	13.3	0.38*
6-7 (Satisfied)	05	16.7	06	20.0	0.74*
8-10 (Happy)	23	76.7	20	66.7	0.38*

***P value p > 0.05 (Not significant).*

DISCUSSION

Unilateral cleft lip occurs with a frequency of 1.7 per 1000 in Pakistan.[5] This is slightly higher than in white newborns in whom it is 1 in 1000 while in American Indians, it is 3.1.[6] It has an unequal gender distribution favouring boys over girls.[7] In the current study, 40 males and 20 females were included giving a ratio of 2:1.

The most commonly used technique for unilateral cleft lip repair nowadays is the Modified Millard's repair. Notching is a known complication of this repair resulting from a straight line closure of the vermilion employed by Millard. The vermilion of the lip is a composite structure consisting of the Orbicularis oris muscle, fat, vermilion and specialized epithelium.[8] Bardach noted that vermilion notching was the most common complication after unilateral cleft lip repair.[9] However, the scarcity of literature pertaining to and comparing the techniques to avoid this notch is lamentable. Apart from avoiding a straight line closure of the vermilion, there are other parameters that must be achieved to attain a notch free repair of the vermilion. Utmost care was taken during this study to adhere to these parameters so that the ultimate result was not mitigated and a pure comparison of the two techniques for vermilion repair could be made. The primary cause of notching apart from a straight line approximation is reported to be the incision of the lateral lip element (point 4) too far medially along the cleft, beyond the tip of maximum vermilion thickness.[10] Here, vermilion, skin and muscle are underdeveloped. Lip closure then leaves a notch at the point of suture due to the thin lateral lip tissues being approximated to the fuller non-cleft side causing a notch.[8] An equally important parameter is proper approximation of the orbicularis muscle. If this is not sutured adequately a notch in the vermilion would inevitably result. Great care must be taken while paring the muscle on both the medial and lateral elements, so that there is a good bulk of muscle tissue that acts as a filler.[2] There is usually less vermilion on the medial portion of the lip than on the lateral lip segment. This builds an asymmetry that can be prevented or minimized by backcutting the mucosa in the gingivobuccal sulcus and by balancing the elements on either side by a Z-plasty or the Noordhoff's flap.[11] This should be done at the time of initial repair to lessen the social and economic repercussions that would otherwise arise. Secondary procedures like V-Y advancement, Kapetansky flaps, fat injections, dermal fat grafts, cartilage and even alloderm have been utilized to augment the vermilion.[12-16] Recently, scarred vermilion has been used as an inferiorly based,[15] or diamond shaped flap to redress the secondary notch.[17]

In the current study, the authors contrived to compare the two commonest methods of reducing the vermilion notch by avoiding straight line closure. In one study, with a straight line closure of the vermilion, a notch formed in 31% of cases.[4] Final adjustment of the vermilion is corrected by creating an assymetric Z-plasty,[18] with transposition of mucosal flaps to balance the lip at the time of primary lip repair. That the vermilion is thicker on the non-cleft or lateral lip segment was exploited by Noordhoff. He postulated that a triangular flap from the lateral lip segment where the vermilion is more abundant, inserted into an incision made on the medial cleft segment would expiate for the medial segment vermilion deficiency and prevent notch formation. Both techniques have proved worthy in not only avoiding a straight line closure of the vermilion, but also in augmenting the vermilion on the medial cleft segment. In the current study, it was noted that though the two methods were indeed helpful in reducing the notch, the proper execution of each technique was the mandatory pre-requisite for a good outcome. Although Z-plasty is simple and reproducible, correct placing of the Z is learnt with experience and must bring the Noordhoff's red line in alignment. Also, a Z-plasty strives to bring the two elements in balance after excess tissue has been excised, utilising the remaining available tissue. On the contrary, the Noordhoff triangular flap is designed from excess vermilion that would otherwise be pared off during making the incisions and augments the vermilion more effectively. However, the triangular flap is more difficult to master than Z-plasty and requires a learning curve. Despite its ingenuity in using excess tissue to augment the vermilion, the Noordhoff flap can produce an unsightly trapdoor effect that might have to be dealt with later.[19] Each technique has its protagonists. Z-plasty is one of the first procedures to be taught owing to its simplicity. The Charles-Pinto Centre for cleft lip and palate has always used a Z-plasty for the same reasons and consistently avoided a notch for over 15 years.[2]

Powar *et al.* noted that the ideal and parallel relationship between the white roll and the red line of Noordhoff was not maintained with either the Noordhoff's flap or the Z-plasty.[19] This may lead to discrepancies in the Cupid's bow symmetry. They designed a geometrically based triangular flap that is a modification of the Noordhoff's flap. The dimensions of the flap were calculated to exactly compensate for the deficiency on the medial lip segment. Their technique also differed from the original Noordhoff flap in that they used a straight line incision from the white roll to the base of the triangular flap on the lateral cleft segment. Revision procedures were planned in 4 of the 12 patients with satisfactory outcomes.

CONCLUSION

A notch in the vermilion after a Millard's repair often dissipates the efforts for a good cleft lip repair due to contraction of the straight line vermilion scar. Z-plasty and the Noordhoff's lateral segment triangular flap are both comparable in eluding straight line scarring and providing vermilion augmentation where needed. The method chosen is a matter of personal preference and expertise.

REFERENCES

1. Millard DR Jr. A primary camaflouge of the unilateral harlook. In: Skoog T, editor. Transactions of the first International Congress of Plastic Surgery. Stockholm; 1955. Baltimore: *Williams & Wilkins;* 1957. p. 160.

2. Narayanan PV, Adenwalla HS. Notch-free vermilion after unilateral cleft lip repair: the Charles-Pinto centre protocol. *Indian J Plast Surg* 2008; **41**:167-70.
3. Noordhoff MS. Reconstruction of the vermilion in unilateral and bilateral cleft lips. *Plast Reconstr Surg* 1984; **73**:52-61.
4. Noordhoff MS, Chen PK. Unilateral cheiloplasty. In: Mathes ST, editor. Plastic surgery. Philadelphia: *Saunders Elsevier;* 2006. p. 92.
5. Ajmal S, Khan MA, Khan TA, Yousaf K, Shadman M, Iqbal T. Evaluating anatomical subunit approximation technique for unilateral cleft lip repair. *JPMI* 2010; **24**:68-72.
6. Wyszynski DF, Beaty TH, Maestri NE. Genetics of non-syndromic oral clefts revisited. *Cleft Palate Craniofac J* 1996; **33**:406-17.
7. Derijcke A, Eerens A, Carels C. The incidence of oral clefts: a review. *Br J Oral Maxillofac Surg* 1996; **34**:488-94.
8. Patel IA, Hall PN. Freedermis-fatgraft to correct the whistle deformity in patients with cleft lip. *Br J Plast Surg* 2004; **57**:160-4.
9. Bardach J, Noordhoff MS. Correction of secondary unilateral cleft lip deformities. In: Bardach J, Salyer KE, editors. Surgical techniques in cleft lip and palate. St Louis: *Mosby;* 1991. p. 60.
10. Smith JD, Bumsted RM, editors. Paediatric facial plastic and reconstructive surgery. New York: *Raven Press;* 1993.
11. Stal S, Hollier LH. Secondary deformities of the cleft lip, nose, and palate. In: Mathes ST, editor. Plastic surgery. Philadelphia: *Saunders Elsevier;* 2006. p. 343.
12. Kapetansky DI. Double pendulum flaps for whistling deformities in bilateral cleft lips. *Plast Reconstr Surg* 1971; **47**:321-3.
13. Coleman SR. Facial recontouring with lipostructure. *Clin Plast Surg* 1997; **24**:347-67.
14. Papel ID, Frodel JL, Holt GR, editors. Facial, plastic and reconstructive surgery. 3rd ed. New York: *Thieme Medical Publications;* 2009.
15. Gryskiewicz JM. Dorsal augmentation with alloderm. *Semin Plast Surg* 2008; **22**:90-103.
16. Lee SW, Kim MH, Baek RM. Correction of secondary vermilion notching deformity in unilateral cleft lip patients: complete revision of two errors. *J Cranio Maxillo Fac Surg* 2011; **39**:326-9. Epub 2010 Sep 6.
17. Gur E, Zuker RM. The diamond vermilion flap: a new technique for vermilion augmentation in cleft lip repair. *Cleft Palate Craniofac J* 2000; **37**:123-4.
18. Bailey BJ, Johnson JT. Cleft lip and palate: evaluation and treatment of the primary deformity. In: Newlands SD, Calhoun KH, editors. Head and neck surgery-otolaryngology. Philadelphia: *Lippincott Williams & Willkin;* 2003. p. 1327.
19. Powar RS, Patil SM, Kleinman ME. A geometrically sound technique of vermilion repair in unilateral cleft lip. *Br J Plast Surg* 2007; **60**:422-5.