Comparison of Outcome of Modified Millard's Incision and Delaire's Functional Method in Primary Repair of Unilateral Cleft Lip: A Prospective Study

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Abstract

Background Certain preoperative anatomical features may lead the surgeon to choose one particular incision pattern in preference to another. No one technique of cleft lip repair consistently produces ideal aesthetic and functional results.

Objectives This study was conducted to compare the outcomes attained using two different designs of skin incision used for surgical correction of unilateral cleft lip. **Materials and Methods** Modified Millard's incision and Delaire's functional method techniques were performed and evaluated on 18 patients who received primary unilateral cleft lip repair. Soft-tissue measurements of the lip and nose were recorded preoperatively. Analysis was based on postoperative assessment of the white roll, vermilion border, scar, Cupid's bow, lip length, and nostril symmetry and appearance of the alar dome and base. Chi-square and Fisher exact test, Student *t* test (two tailed, independent) and Student *t* test (two tailed, dependent) were used for statistical analysis of study parameters at 5 % level of significance.

Results Preconceptions that one particular technique was better suited to certain preoperative cleft anatomical forms

were not proven statistically. The outcome of our surgical methods was good and suggested quantitative changes with progressive diminution of asymmetry of the cleft and non cleft sides.

Conclusion Lip length improvement was better in case of modified Millard's incision. The Delaire's functional method of cleft lip repair results in improved nasal symmetry due to correction of the abnormal insertions of the underlying musculature.

Keywords Cupid's bow · Lip length · Delaire's functional lip repair · Millard's incision · Nostril symmetry

Introduction

Our society sets considerable importance for esthetics and is undoubtedly a potent factor in the initial formation of relationships. The impact of disfigurement on the face has a traumatic effect on the mind of the beholder. Cleft lip and palate is one of most common congenital craniofacial deformities [1] and continues to be a significant public health problem. The reported worldwide incidence of cleft lip and palate is 1 in 800 live births [2]. The condition has racial variation. It is most common in Asians (1 in 500 births) followed by Caucasians (1 in 750 births) and least common in African Americans (1 in 2000 births) [3, 4]. In terms of gender, cleft lip and palate is more common in males and isolated cleft palate is more common in females. The most common presentation is cleft lip and palate (approximately 45 %) followed by cleft palate alone (app 35 %) and cleft lip alone (app 20 %). The unilateral cleft lip is nine times more common than the bilateral cleft and occurs twice as frequently on the left side than on the right [3, 5].

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Surgeons have repaired the deformity of cleft lip for past 2000 years, since the first attempt was performed during chin dynasty by a physician in China [6, 7]. Many ingenious procedures have been applied and many modifications added to produce the best possible esthetic cleft lip repair like LeMesurier 1949; Tennison 1952; Randall 1959; Pfeifer 1970; Millard 1976 [6–8]. Mirault was amongst the first to describe the technique of increasing lip length by using a small flap taken from the cleft side. However this technique did not reconstruct the cupid's bow. LeMesurier later described the inset of rectangular flap from the cleft side into a releasing incision on to the no cleft side to create an artificial cupid's bow. Tennison described a triangular flap to preserve the Cupid's bow. Randall later worked out the geometry of this flap, adding precision and reproducibility to the triangular flap technique. The technique creates an unnatural scar across the philtral column and flattens the philtral dimple. In addition, the triangular flap does not address the nasal deformity.

Millard introduced the rotation advancement technique in 1955, which over comes many of the pitfalls of earlier techniques. The rotation-advancement technique is the most commonly used method today for the repair of unilateral clefts. The technique preserves the cupid bow and the philtral dimple and improves the nasal tip symmetry. The rotation-advancement lengthens the lip by rotation incision that releases the medial lip element allowing the cupid bow to rotate downwards into normal position. A small back cut is used to further increase the length, if needed. The lateral lip element is advanced into the gap created by the rotation of the medial element thus completing the reconstruction of the upper lip [9, 10].

However the functional reconstruction of the cleft lip was passed over lightly, given token acknowledgement or completely ignored [8]. These techniques paid little attention to the anatomical correction of the cleft lip defect. The well designed incision with simple repair of the orbicularis oris muscle seems to cause changes in the shape of the upper lip during motion and with age [11]. It was realized that muscle repair must be accurate and precise for optimal results. Victor Veau a pediatric surgeon from Paris is regarded as the father of 20th century's cleft surgery. In his textbook "Bec de lievre" of 1938 which is still considered as standard, he clearly outlined the functional concept of surgical treatment of patients with clefts of the lip, alveolus and palate [7].

The functional repair of cleft lip as described by Delaire adheres to the principle of "Embryological surgery" as conceived by Veau in which the situation that existed at birth is recreated. There is no true hypoplasia of tissues in cleft lip, and normal tissues exist on either side of the cleft. Taking this into account Delaire described a technique which places importance on lifting the entire functional

matrix by sub periosteal dissection up to the nasal septum. Also the skin which appears to be short is only because it is retracted due to lack of activity of the underlying muscle. Once correct apposition of muscle is performed and activity is resumed the skin distends and lengthens [12], thus avoiding the need for skin lengthening incisions which have the disadvantage of creating a longer lip on the cleft side [12, 13].

No one technique of lip repair consistently produces ideal aesthetic and functional results [6]. Hence, the present study was conducted to prospectively evaluate the post-surgical results of upper lip and nose in unilateral cleft lip patients by using Modified Millard's incision and Delaire's functional method.

Materials and Method

Source of the Data

Patients seeking treatment for cleft lip at Department of Oral and Maxillofacial Surgery, Krishnadevaraya College of Dental Sciences and Hospital, Bangalore, India, were included in our study. All patients in the age group of 10 weeks to 20 years reporting with unilateral cleft lip only were included in the study.

Method of Collection

This prospective study includes 18 unilateral cleft lip patients, among which 9 patients each were operated with Modified Millard's incision [9, 10] and Delaire's functional method [12, 13] respectively. Patients were evaluated for White roll match, Vermillion match, Scar appearance, Cupid bow, Lip length, Nostril symmetry, Alar dome and Alar base according to Steffensen's criteria [6, 14, 15]. All cleft lip surgeries were done by a single surgeon under general anesthesia.

Statistical Analysis

The recorded data was compiled and entered in a spreadsheet computer program (Microsoft Excel 2007) and then exported to data editor of SPSS version 15.0 (SPSS Inc., Chicago, Illinois, USA). Descriptive statistics included computation of percentages, means and standard deviations. The variables were assessed for normality using Kolmogorov–Smirnov test and were found to be normally distributed. Chi-square and Fisher exact test were used to find the significance of study parameters on categorical scale between two or more groups. Student *t* test (two tailed, independent) has been used to find the significance of study parameters on continuous scale between two

groups (inter group analysis) and Student *t* test (two tailed, dependent) has been used to find the significance of study parameters on continuous scale within each group. Significance was assessed at 5 % level of significance.

Results

Out of 18 unilateral cleft lip patients, 9 patients each were operated with Modified Millard's incision and Delaire's functional method respectively and the comparison of mean lip length, nasal height and nasal width is as shown in Table 1. The pre-operative non-cleft values 10.22 ± 2.39 and 8.28 ± 0.67 were considered as controls in both Modified Millard's and Delaire's functional method respectively. Comparison of pre-operative and post-operative cleft values showed a definite change in the values from 6.83 ± 1.90 to 10.17 ± 2.42 in Modified Millard's and 5.78 ± 0.62 to 8.33 ± 0.94 in Delaire's functional method. This difference was statistically significant ($P < 0.05$). The percentage change of lip length in post-operative cleft side from pre-operative cleft side showed 48.9 % change in Modified Millard's incision and 44.1 % change in Delaire's functional method. The *P* values obtained for both the incisions were <0.001 , which signifies statistically significant change in lip length of cleft side in both the incisions. But clinically lip lengthening on cleft side was best achieved by Modified Millard's incision than Delaire's functional method.

The mean pre and post operative nasal height on cleft side in Modified Millard's incision was 2.67 ± 0.97 and 3.56 ± 1.51 mm whereas in Delaire's functional method it was 2.28 ± 0.36 and 2.89 ± 0.33 mm. The percentage change of nasal height, in post-operative cleft side from pre-operative cleft side showed 33.3 % change in Modified Millard's incision and 26.8 % change in Delaire's

functional method. The *P* value obtained for both the methods was observed to be statistically significant ($P < 0.05$).

The mean pre-operative nasal width on cleft side in Modified Millard's incision was 17.06 ± 5.72 mm which decreased to 8.56 ± 2.28 post operatively. Similarly, in Delaire's method the pre operative values were lowered from 15.11 ± 2.71 to 7.89 ± 1.69 . The percentage change of nasal width, in post-operative cleft side from pre-operative cleft side showed –49.8 % change in Modified Millard's incision and –47.8 % change in Delaire's functional method. The nasal width improvement is statistically significant ($P < 0.05$) in both of the incisions but when we observe in percentage symmetrical analysis, in the modified Millard's incision, the nostril width became smaller in size.

Qualitative analysis done based on the Steffensen criteria was rated as good, average and poor with a disparity of <2 mm (Table 2). Majority of the patients rated good (range from 45 to 78 %) for white roll match, vermilion match, scar appearance and alar base in both the groups. In relation to the cupid bow many rated as average (55.6 and 88.9 %) followed by good (33.3 and 11.1 %) in both the groups respectively. Lip length showed a difference of opinion with 66.7 % patients rating good in Millard's group and 66.7 % rating average in case of Delaire's group. With regard to the nostril symmetry very few (11.1 and 22.2 %) patients rated well in both the groups. In Millard's group an equal percentage (44.4 %) rated for average and poor, whereas in Delaire's group majority (66.7 %) rated as average. For alar dome most of the patients rated poor (77.8 %) in both the groups. Among the various parameters analyzed—white roll match, cupid bow, lip length and alar dome demonstrated favorable measurements in Millard's group and the vermilion match, scar appearance, nostril symmetry and alar base was better

Table 1 Grading criteria

	Good	Average	Poor
White roll match	Perfect	Diparity of <1 mm	Disparity of >1 mm
Vermilion match	Perfect	Diparity of <1 mm	Disparity of >1 mm
Scar appearance	No hypertrophy	Hypertrophy with no disturbance of cupid bow or columella	Hypertrophy with disturbance of cupid bow or columella
Cupid bow	Perfect	Distortion on cleft side is <2 mm	Distortion on cleft side is >2 mm
Lip length	Equal length on cleft and non cleft side	Shorter of cleft side >1 mm <2 mm	Shorter of cleft side >2 mm
Nostril symmetry	Equal height and width to normal side	>1 mm <2 mm in either height or width to normal side	>2 mm in either height or width to normal side
Alar dome	Equal curvature to normal side	–	Any depression compared to normal side
Alar base	At the same level of normal side	Difference of <1 mm compared to normal side	Difference of >1 mm compared to normal side

Table 2 Qualitative analysis according to Stefenson's criteria

Case	White roll match	Vermilion match	Scar appearance	Cupid bow	Lip length	Nostril symetry	Alar dome	Alar base
Millard's								
1	G	G	G	G	G	G	G	G
2	G	G	A	A	G	A	P	G
3	G	G	G	A	G	P	G	G
4	G	G	A	A	G	A	P	G
5	A	A	G	G	G	P	P	G
6	A	A	A	P	A	A	P	A
7	A	A	G	A	A	P	P	A
8	P	A	P	A	A	P	P	A
9	G	G	G	G	G	A	P	A
Delaire's								
10	G	G	G	A	G	A	P	G
11	P	A	G	A	A	A	P	G
12	A	G	G	A	A	G	P	G
13	A	A	G	A	A	P	P	P
14	G	G	G	A	G	A	G	G
15	A	G	G	A	A	A	P	G
16	G	G	A	A	A	A	P	G
17	G	G	A	G	G	G	G	G
18	A	A	A	A	A	A	P	A

in Delaire's method. All the differences in the above observations were not statistically significant ($P > 0.05$) (Tables 3, 4).

The results from among the many patients who received primary unilateral cleft lip repair by Modified Millard's incision and Delaire's functional method are shown in Figs. 1, 2, 3, 4 and 5, 6, 7, 8 respectively.

Discussion

Cleft lip is one of the most common congenital deformities in the oral and maxillofacial region. Although the morbidity is much lower, the deformity obviously affects the appearance and functions (such as sucking, speaking, breathing, etc.) of patients because of its seriousness. Treatment for cleft lip patients is complex. It is hard to achieve good results and the outcome is less acceptable. Multidisciplinary management is an important pathway to improve therapeutic effectiveness, but many patients cannot accept the multidisciplinary management due to various factors, such as equipment, technique, communication, familial economic status, etc. [16]. The specific goals of treatment include the standardized aesthetic appearance of the lip and nose; primary and secondary palate closure; normalized language, speech and hearing; airway patency;

class I occlusion and normal masticatory function; healthy teeth and periodontium; normal psychosocial development. As for the repair of the unilateral cleft lip, Campbell et al. [17], added the creation of the upper lip with appropriate vertical length and symmetry, repair of underlying structures with normal muscle function and primary treatment of associated nasal deformities.

Spatial relationship and function of the muscular elements, particularly those that cause this deformity, has to be understood for a functional correction of the cleft lip [18]. Clinically we found that improvement in the lip length was better in Modified Millard's group of patients when compared to Delaire's functional group. This may be attributed to the "BACK CUT" which helps in the additional rotation of whole philtral-dimple column [10]. In 1964 Millard advocated a sharp turn down in the rotation incision in the form of "BACK CUT", which he emphasized, could overcome the problem of vertical shortness. In spite of the nearly perfect results potentially obtainable by using rotation-advancement method for incomplete and narrow clefts, its use in wide unilateral clefts had been questioned by many authors [10, 19]. Asensio [19] has described a modification of the rotation-advancement method, which was simple and allows to obtain adequate vertical height on the lateral side, without sacrificing horizontal length of the lateral vermillion [19].

Table 3 Comparison of mean lip length, nasal height and nasal width in patients with cleft lip who were operated with Modified Millard's and Delaire's functional method

	Lip length		<i>P</i> value	Nasal height		<i>P</i> value	Nasal width		<i>P</i> value
	Modified Millard's	Delaire's		Modified Millard's	Delaire's		Modified Millard's	Delaire's	
Pre-op non cleft side	10.22 ± 2.39 (9–16)	8.28 ± 0.67 (7–9)	0.032*	4.00 ± 2.29 (3–10)	3.06 ± 0.17 (3–3.5)	0.235	6.78 ± 1.39 (5–9)	5.83 ± 1.06 (5.0–7.5)	0.125
Pre-op cleft side	6.83 ± 1.90 (4–10)	5.78 ± 0.62 (4.5–6.5)	0.133	2.67 ± 0.97 (2–5)	2.28 ± 0.36 (2–3)	0.276	17.06 ± 5.75 (10–29)	15.11 ± 2.71 (9–18)	0.372
Post-op cleft side	10.17 ± 2.42 (8.5–16)	8.33 ± 0.94 (7–10)	0.050*	3.56 ± 1.51 (2–7)	2.89 ± 0.33 (2–3)	0.214	8.56 ± 2.28 (5–12)	7.89 ± 1.69 (6–12)	0.492
Significance	F = 52.300 <i>P</i> < 0.001**	F = 52.764 <i>P</i> < 0.001**	–	F = 6.201 <i>P</i> = 0.010*	F = 18.366 <i>P</i> < 0.001**	–	F = 25.755 <i>P</i> < 0.001**	F = 53.331 <i>P</i> < 0.001**	–
% Change in pre-op non cleft side to pre-op cleft side	–33.17 %	–30.2 %	–	–33.3 %	–25.5 %	–	+151.6 %	+159.2 %	–
% Change in post-op cleft side from pre-op cleft side	+48.90 %	+44.1 %	–	+33.3 %	+26.8 %	–	–49.8 %	–47.8 %	–
% Change in post-op cleft side from pre-op non cleft side	–0.49 %	+0.60 %	–	–11.0 %	–5.6 %	–	+26.3 %	+35.3 %	–

Table 4 Qualitative analysis according to Steffensen's criteria

Characteristics	Group	Good n (%)	Average n (%)	Poor n (%)	<i>P</i> value
White roll match	Millard's	5 (55.6)	3 (33.3)	1 (11.1)	1.000
	Delaire's	4 (44.4)	4 (44.4)	1 (11.1)	
Vermilion match	Millard's	5 (55.6)	4 (44.4)	0 (0)	1.000
	Delaire's	6 (66.7)	3 (33.3)	0 (0)	
Scar appearance	Millard's	5 (55.6)	3 (33.3)	1 (11.1)	1.000
	Delaire's	6 (66.7)	3 (33.3)	0 (0)	
Cupid bow	Millard's	3 (33.3)	5 (55.6)	1 (11.1)	0.294
	Delaire's	1 (11.1)	8 (88.9)	0 (0)	
Lip length	Millard's	6 (66.7)	3 (33.3)	0 (0)	0.347
	Delaire's	3 (33.3)	6 (66.7)	0 (0)	
Nostril symetry	Millard's	1 (11.1)	4 (44.4)	4 (44.4)	0.430
	Delaire's	2 (22.2)	6 (66.7)	1 (11.1)	
Alar dome	Millard's	2 (22.2)	0 (0 %)	7 (77.8)	1.000
	Delaire's	1 (11.1)	1 (11.1 %)	7 (77.8)	
Alar base	Millard's	5 (55.6)	4 (44.4 %)	0 (0)	0.294
	Delaire's	7 (77.8)	1 (11.1 %)	1 (11.1)	

Though the values were not statistically significant, post-operative nasal height and width improvement could be seen in Delaire's group when compared to Millard's group. Millard's group of patients also showed good improvement in post-operative nasal width when compared to pre-operative nasal width of cleft side. But there was constriction of the nostril on the cleft side, giving

appearance of small nostril. Salyer states that early well-executed surgery releases a potential for more normal growth and development. A displaced, malaligned and deformed cartilage of the nose does not correct itself. As the cartilage and overlying skin become more mature, surgical correction becomes more difficult. Deficiencies do not get better on their own. The early surgical contouring

Figs. 1–2 Illustrations for modified Millard's incision. Anatomical land marks and incision lines respectively

Figs. 3–4 Illustrations for Delair's functional method. Anatomical land marks and incision lines with wide subperiosteal dissection

Figs. 5–8 Cleft lip repair using modified Millard's incision. Pre-op frontal view, incision design, post-op frontal view, post-op worms eye view respectively

Figs. 9–12 Cleft lip repair using Delaire's functional method. Pre-op frontal view, incision design, post-op frontal view, post-op worms eye view respectively

or repositioning can be more easily performed in the younger patient. The symmetry is maintained by subsequent growth and development [20].

Rotational advancement technique is not the ultimate solution for every cleft case, but can be applied effectively to all cleft deformities with specific adaptations for the correction of wide clefts. Mehrotra and Pradhan in 2010 have suggested some modifications based on their results. To achieve a good lip pout in bilateral cases, tunneling of orbicularis oris muscle into the central lip fragment was a modification made. Also, an additional stay suture was placed to hold the sutured line in cases of tension on lip [18].

Horswell and Pospisil in their study compared the results of Delaire Cheilorhinoplasty and Millard's Rotation Advancement. They studied 33 children, aged 4–5 years of whom 16 underwent Delaire's procedure and 17 underwent Millard's procedure. They assessed the nasal symmetry in the two groups using photographs and found that the Millard's group tended to have more asymmetrical noses and greater tip deviation. Delaire's theory that muscular action around the perinasal region is important for development seems to be supported with these findings [21].

Nasal parameters like nasal symmetry, alar dome and alar base in case of Delaire's appears to be better than

Modified Millard's group. This may be attributed to sequential sub-periosteal dissection, mobilization and reapproximation of the transverse nasalis, levators of the lip, and orbicularis bands to the caudal septum and nasal spine. The nostril sill is restored by the myrtiformis placement along with the transverse nasalis reapproximation [13].

Re-establishing a natural and symmetric-appearing lip and nose is best achieved when lip and nasal subunits are preserved and incisions hidden along lines parallel to highlights and shadows around the philtral, columellar and alar subunits; restoring shape and function to the underlying muscular sling while minimizing potential growth disturbances [22]. Schendel stated that the Delaire technique of surgical lip repair provides a superior nasal result as seen by this study [23]. This result is however primarily from the initial treatment of the deformity based on the principles elucidated here and not from subsequent growth and development which remains to be proven by a study of older children (Figs. 9, 10, 11, 12).

Cleft lip surgery has evolved from a geometrically defined "cookie-cutter" type approach to a more adaptable repair using "cut as you go" principles outlined by Millard's elegant rotation-advancement technique and recent Delaire's functional method. Skin flap design has lead to a

better understanding of the underlying musculature that is disrupted by the cleft and the importance of realignment of the individual bundles to create a functional repair. With a better understanding of the anatomy, cleft surgery currently results in an excellent lip repair but is marred by a residual cleft nasal deformity. Early pre-surgical nasoalveolar molding with an appliance and postoperative long-term nasal stenting may improve the long term outcome, with the ultimate goal to remove the most common stigmata of a facial cleft and the accompanying cleft nasal deformity.

Conclusion

The overall clinical white roll, vermilion match and cupid bow appearance in case of both the skin incisions was satisfactory. Lip length improvement was better in case of modified Millard's incision which is attributed to "BACK CUT". Nasal symmetry improvement could be seen in Delaire's functional method due to correction of the abnormal insertions of the underlying musculature. So it was found that one technique was essentially as good as the other.

Compliance with Ethical Standards

Official permission, Ethical clearance and Informed consent The study protocol was reviewed and cleared by the Institutional Review Board and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments. After explaining the purpose and details of the study, a written informed consent was obtained from the parents of minor children and the patients themselves who fulfilled the eligibility criteria.

Conflict of interest None.

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