

Modified Placement of C-flap in Unilateral Cleft Lip Repair to Avoid Alar Base Scar - A Retrospective Study

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Abstract

Introduction: In spite of several techniques, Millard's approach for the correction of cleft lip still is widely used. Although versatile, it has certain drawbacks including scar contraction, short lip and notching. A modification of the 'C' arm helps to address this drawback. The purpose of this study was to describe the qualitative and quantitative outcomes of the author's modification of Millard's C flap. **Materials and Methods:** Archival photographic records of cleft lip repairs and post-operative photos of cases treated by author were screened. Anthropometric measurements of the height and width of the lip, the height of the vermilion and the width of the alar base were considered. The outcome was quantified by comparing the ratio of each feature between the cleft and normal sides. The quality of cleft lip repair was assessed using the Steffensen criteria. Appropriate statistical tests were performed. **Results:** In all, 233 cases with a mean age of 4.46 ± 0.91 years and 106 (45.5%) males formed the study group. The mean lip height ratio was 0.936 ± 0.04 , the mean lip width ratio was 0.938 ± 0.037 , the mean vermilion height ratio was 0.9433 ± 0.35 while the mean alar base width ratio was 0.932 ± 0.35 . The physical parameter ratios' mean difference between the normal side and the cleft side was below 0.06 mm. **Discussion:** The mechanism behind the drawback of the classical Millard's technique is discussed and compared with present modification. The authors' modification shows that modified Millard's technique produces better aesthetic outcomes.

Keywords: Cleft lip, congenital facial deformity, Millard's C flap, Millard's rotational flap

INTRODUCTION

Cleft lip is a common congenital facial deformity that requires surgical correction at young age. Several types of corrective procedures have been noted in the recorded surgical literature. Till date, there is no uniform consensus on the best repair type even for the different phenotypes of the cleft lip.^[1] Customisation for every patient has been the key for success. The type of repairs includes straight-line or broken-line incisions, curvilinear incisions, to geometrical approach-based flaps of LeMesurier and Tennison. Later disruption in cleft lip treatment came with Millard introducing his more rationalised rotation-advancement repair. Essentially, this technique rotated the flap of the medial lip with advancement of the lateral lip that does not disrupt aesthetic subunits except at the columellar base.^[1] Several modifications were introduced for this flap method by various authors. The next important upgrade was proposed by Fisher and is described as the anatomical subunit approximation technique. It aims to create an 'ideal line of repair' along cleft-ipsilateral lip's peak of the Cupid bow to the base of the nose, mimicking the non-cleft half of philtral

column.^[1-3] The technique demands to use anthropometric measurements between definable anatomic points. It inserts 'lateral segment triangles' above the vermilion border and at the mucosal-skin junction. These triangles serve to dampen the repair line tension and facilitate to lengthen the lip for symmetry. Modifying the Noordhoff point to a slightly lateral position improves the lateral lip component's vertical height deficiency while decreasing vermilion transverse length.^[1-3]

Modification of Millard's rotational flap is still widely used in spite of advantages conferred by the Fisher's technique.^[4] This manuscript aims to describe a 'C' shaped modification of

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traditional Millard flap that author has been using successfully as well as to assess its outcome in terms of aesthetics and symmetry as compared to the contra-lateral, normal labial morphology and appearance [Figure 1].

MATERIALS AND METHODS

This is a retrospective audit from the archival reports of the hospital. As the study collected depersonalised, retrospective data from archival photos with no direct human data being collected and analysed, the ethical committee permission requirement was waived off. Patients who were operated for isolated, non-syndromic unilateral complete cleft lip (involving nasal sill) with the modified Millard 'C' approach at the author's centre between 1995 and 2020 with a minimum of one year follow-up were included for this study. Only those patient records that had sufficient data and high-resolution quality of 1 year or later post-operative photograph were included for the study. Print photographs were scanned at good reasonable resolution to be studied. The syndromic, bilateral cleft lip or those with other con-committal facial clefts or patient records that lacked photographs or patients who were operated with other type of incisions were excluded from the study.

Author's technique

The Millard rotation-advancement repair was performed with modifications as outlined below [Figure 2].

1. The normal features of the lip are identified and by using the anthropometric measurements of the lip, the anatomic points are marked. An outline of the modified rotation advancement flap is drawn using methylene blue
2. After the markings, local anaesthetic with epinephrine (1:200,000) is diluted and infiltrated. A small quantity of local anaesthetic can be administered as infra-orbital nerve block on the cleft side, to help with the post-operative pain management
3. On the medial segment, a curvilinear incision is made

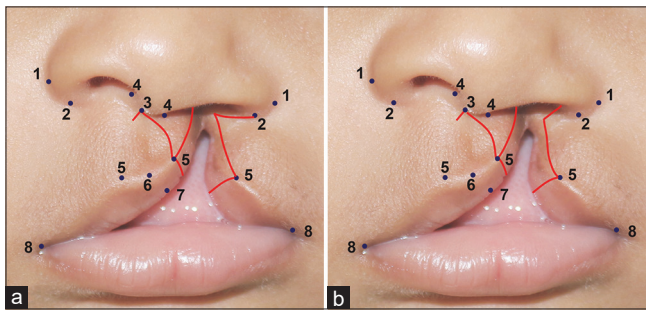


Figure 1: (a) Anthropometry of the lip shown in Millard's technique, (b) Anthropometry of the lip-author's modified technique. (1) Alare (ala) – Lateral most point of the ala of the nose, (2) Subalare (sbal) – Inferior most point of ala of the nose, (3) Subnasale – midpoint of the columella (it is the angle between columellar base and upper lip), (4) Crista philtri superior (cphs) – Superior peak of cupid's bow on the normal and affected sides, (5) Crista philtri inferior (cphi) – Inferior peak of cupid's bow on both normal and cleft affected sides, (6) Labiale superius (ls) – Midpoint of the cupid's bow trough, (7) Stomion (sto) – Midpoint of free margin of the upper lip, (8) Cheilion (ch) – Labial commissure

4. From the midpoint of the columella (Point 3), a small back cut incision is performed stopping short of the normal philtral column
5. A vertical releasing incision is performed on the oral mucosa, starting from the Cupid's bow towards the alveolus. This technique facilitates the elevation of medial flap and also releases the alveolar mucosa from the cleft segment
6. The initial incision is accompanied by subcutaneous dissection directed towards the columella, resulting in the formation of the C-flap. Care is taken to ensure the detachment of the C-flap from the lip, while maintaining its connection to the side of the columella and anterior nasal spine. If there is any abnormal attachments in the nasal septum, they are subsequently released
7. On the lateral segment, the incision is extended from the Cupid's bow (point 5) superiorly along the vermilion border towards the alar base, within the nasal vestibule. In Millard's rotation-advancement flap, this incision is extended around the alar base in a curvilinear shape. In our proposed modification, the incision is extended inwardly within the nasal vestibule (this is the most significant modification). This modification, allows for easier advancement of the lateral cleft segment, as well as enables the advancement and rotation of the C-flap, above the nasal sill and then suturing it within the nasal floor. It is beneficial to recreate or augment the nasal sill, reduce the tension along the flap and facilitates proper approximation of the muscles
8. On the labial sulcus, a releasing back incision is performed, above the attached gingiva to establish an adequate gingivobuccal sulcus. In addition, the lateral part of the upper lip is separated from the cleft segment
9. On the cleft side, the nasal mucosa is meticulously dissected from the nasal cartilage. The bilateral nasal mucosal flaps are sutured together using interrupted chromic sutures to seal the anterior nasal floor
10. The muscles of the upper lip and the mucosa are dissected from the free edge of the cleft, forming a muscular plane and free mucosal layer
11. The cleft lip closure starts with closure of the inner lip mucosa using interrupted Vicryl sutures 5-0. The bilateral freed muscles are sutured together and reconstructed to stimulate the philtral column
12. The vermilion and the skin are closed with interrupted nylon sutures
13. At this moment, the C-flap is rotated and advanced above the nasal sill and sutured inside the nasal floor
14. The remaining lip mucosa and oral mucosa are closed using interrupted sutures. To stabilise the repaired anterior nasal floor and avoid nostril stenosis, a bolster is placed at the cleft side's nostril.

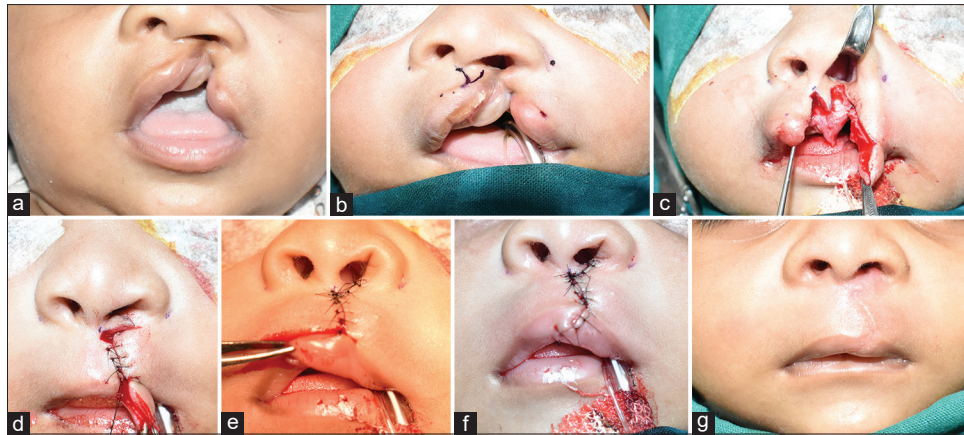


Figure 2: (a) Unilateral cleft lip - Pre-operative, (b) Drawing of the incision line for the creation of 'C'-Flap, (c) Intraoperative view showing the release of cleft defect on the medial and lateral cleft segment, (d) Layerwise closure of the lip (mucosa, muscle and skin), (e) Rotation of the C-flap into the nostril and closure with the nasal mucosa (the modification), (f) Closure of the vermilion and its border, (g) Post-operative view of the cleft lip repair

Data collection

Besides the basic demographic details of gender, age (in months at time of surgery, nearest to 2 decimals), cleft width (if gap is ≤ 10 mm, it is narrow, >11 mm would be a wide cleft), presence of lip-lip Simonart's band (present/absent)^[5,6] were noted down. From the ≥ 1 year post-operative follow-up images, four anthropometric parameters were measured using the post-operative photographs: lip height, lip width, vermilion height and alar base width [Figure 3]. These parameters cleft side to the non-cleft side for use as a quantitative measure of outcome for each patient. This enabled the patients to serve as their own control. Standard measurements of lip height, lip width, vermilion height and alar base width using standard Adobe Photoshop CS6 software (Adobe Systems Inc., San Jose, California, USA) using pixels to create an aesthetic ratio of the cleft side to the non-cleft side for use as a quantitative measure of outcome for each parameter [Figure 3].^[5]

Qualitative analyses of cleft lip repair were evaluated for cutaneous roll symmetry, vermilion symmetry, scar appearance, Cupid's bow symmetry, lip length, nostril symmetry, alar dome symmetry and alar base symmetry according to the Steffensen criteria [Table 1].^[7] All cleft lip operations were performed by a single surgeon under general anaesthesia. The principal author had been in practice for 25 years before the patients were analysed for the rotation-advancement repair.

Statistical analysis

The recorded data were entered into and analysed using PSPPP Software (version 1.6.2), available from Free Software Foundation (2022), Boston, MA, USA (<https://www.gnu.org/software/pspp/>). The continuous variables were represented by means, whereas categorical variables were reported by the frequency and percentage. Normality was the Shapiro–Wilk test was used to determine the normality of all the continuous variables. The physical parameter ratios were compared to a mean of 1.0 using a one sample *t*-test. $P < 0.05$ was considered statistically significant.

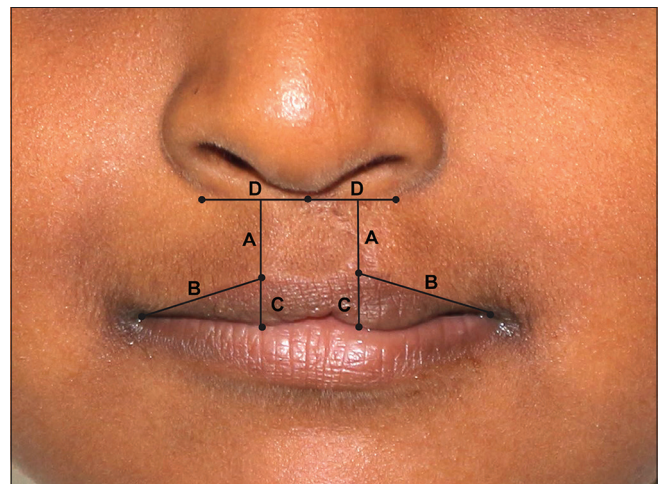


Figure 3: Standard anthropometric measurements on the patient: (A) Lip height; (B) Lip width; (C) Vermilion height; and (D) Alar base width

RESULTS

Of all the records retrieved from the archives, 233 were fulfilling the inclusion and exclusion criteria set. Of this, 106 (45.5%) were male and the overall age was 4.46 ± 0.91 (Range: 3–6) months. Of this, 131 (56.2%) had left-side cleft involvement. Of this, the mean lip height ratio was 0.936 ± 0.04 , the mean lip width ratio was 0.938 ± 0.037 , the mean Vermilion height ratio was 0.9433 ± 0.35 , while the mean alar base width ratio was 0.932 ± 0.35 . The distribution of the cutaneous roll symmetry, vermilion symmetry, scar appearance, Cupid's bow symmetry, lip length, nostril symmetry, alar dome symmetry and alar base symmetry according to the Steffensen criteria are listed in Table 1. The pre-operative width of the cleft lip status and presence of Simonart's band when compared with the studied Steffensen criteria, all the outcome parameters was statistically significant [Tables 2 and 3]. The timing of surgery appears to influence the cutaneous roll symmetry, Vermillion symmetry, scar appearance, Cupid's bow symmetry, lip length and nostril symmetry while the alar parameters were not significant [Table 4].

Table 1: The demographics and outcome parameters observed in the study cohort

	<i>n</i> (%)
Sex	
Male	106 (45.5)
Females	127 (54.5)
Mean age (months) (range)	4.46 ± 0.91 (3–6)
Laterality	
Left	131 (56.2)
Right	102 (43.8)
Width of the cleft	
Normal	214 (91.8)
Wide	
Persistence of the lip to lip Simonart's band	
Persistence	49 (21)
Absent	184 (79)
Cutaneous roll symmetry	
Good	225 (96.6)
Average	8 (3.4)
Vermillion symmetry	
Good	213 (91.4)
Average	16 (6.9)
Poor	4 (1.7)
Scar appearance	
Good	228 (97.9)
Average	2 (0.9)
Poor	3 (1.3)
Cupid's bow symmetry	
Good	220 (94.4)
Average	9 (3.9)
Poor	4 (1.7)
Lip length	
Good	213 (91.4)
Average	17 (7.3)
Poor	3 (1.3)
Nostril symmetry	
Good	218 (93.6)
Average	10 (4.3)
Poor	5 (2.1)
Alar dome symmetry	
Good	218 (93.6)
Average	12 (5.2)
Poor	3 (1.3)
Alar base symmetry	
Good	219 (94.0)
Average	13 (5.6)
Poor	1 (0.4)

The physical parameter ratios of lip height, lip width, vermilion height and alar base width were compared to a mean of 1.0 using a one sample *t*-test. The mean difference between the normal side and the cleft side was below 0.06 mm [Table 5].

DISCUSSION

With deeper understanding of local anatomy and improvement in surgical armamentarium, a wide variety of flaps and methods

Table 2: The outcome measures classified by the width of the cleft lip

	Narrow cleft width, <i>n</i> (%)	Wide cleft width, <i>n</i> (%)	<i>P</i>
Cutaneous roll symmetry			
Good	214 (95.1)	11 (4.9)	≤0.001
Average	0	8 (100.0)	
Vermillion symmetry			
Good	210 (98.6)	3 (1.4)	≤0.001
Average	4 (25.0)	12 (75.0)	
Poor	0	4 (100.0)	
Scar appearance			
Good	214 (93.9)	14 (6.1)	≤0.001
Average	0	2 (100.0)	
Poor	0	3 (100.0)	
Cupid's bow symmetry			
Good	213 (96.8)	7 (3.2)	≤0.001
Average	0	9 (100.0)	
Poor	1 (25.0)	3 (75.0)	
Lip length			
Good	205 (96.2)	8 (3.8)	≤0.001
Average	9 (52.9)	8 (47.1)	
Poor	0	3 (100.0)	
Nostril symmetry			
Good	208 (95.4)	10 (4.6)	≤0.001
Average	1 (10.0)	9 (90.0)	
Poor	5 (100.0)	0	
Alar dome symmetry			
Good	201 (92.2)	17 (7.8)	≤0.001
Average	12 (100.0)	0	
Poor	1 (33.3)	2 (66.7)	
Alar base symmetry			
Good	201 (91.8)	18 (8.2)	≤0.001
Average	13 (100.0)	0	
Poor	0	1 (100.0)	

are being used to surgically treat isolated, complete, unilateral cleft lips. The outcomes of such surgeries are varyingly reported. Millard's technique and its modifications (rotation and advancement group) although versatile and time tested are reported to result in a short cleft-side lip when used to close wide clefts while Tennison–Randall technique leaves behind a residual scar.^[1–4] Anatomical subunit approximation Fisher's hybrid technique using 25 landmarks forms a near exact mirror image of normal philtrum to the cleft side philtrum.^[1] At times, it is not sufficient to get enough tissue to approximate from lateral flap due to the limitation of straight method compromising the quality. There is no single advised method. There are several factors that dictate the choice of approach.

The Millard's technique and its modifications are reported to provide excellent results with narrow clefts but is compromised in wide cleft. This emanates from 'cut-as-you-go flexibility' in narrow clefts and lack of the same in wide clefts.^[8] Hence, in narrow clefts, aesthetic outcome is achieved. In wide clefts, however, the radian of rotation, philtral length and volume of

Table 3: The outcome parameters studied by the presence of Simonart's band

	Simonart's band present, n (%)	Simonart's band absent, n (%)	P
Cutaneous roll symmetry			
Good	41 (18.2)	184 (81.8)	≤0.001
Average	8 (100.0)	0	
Vermillion symmetry			
Good	33 (15.5)	180 (84.5)	≤0.001
Average	16 (100.0)	0	
Poor	0	4 (100.0)	
Scar appearance			
Good	44 (19.3)	184 (80.7)	≤0.001
Average	2 (100.0)	0	
Poor	3 (100.0)	0	
Cupid's bow symmetry			
Good	36 (16.4)	184 (83.6)	≤0.001
Average	9 (100.0)	0	
Poor	4 (100.0)	0	
Lip length			
Good	30 (14.1)	183 (85.9)	≤0.001
Average	16 (94.1)	1 (5.9)	
Poor	3 (100.0)	0	
Nostril symmetry			
Good	34 (15.6)	184 (84.4)	≤0.001
Average	10 (100.0)	0	
Poor	5 (100.0)	0	
Alar dome symmetry			
Good	38 (17.4)	180 (82.6)	≤0.001
Average	8 (66.7)	4 (33.3)	
Poor	3 (100.0)	0	
Alar base symmetry			
Good	43 (19.6)	176 (80.4)	0.041
Average	5 (38.5)	8 (61.5)	
Poor	1 (100.0)	0	

the advancement flap are progressively limited. Furthermore, Millard techniques and its modifications are traditionally associated with scar contraction, short lip and notching. This problem emanates from the aberrant positioning of the orbicularis oris muscle.^[1] Normally, the perioral musculature fibres insert into the skin contributing to formation of the paired philtral column. This provides the oral competence and lip function. At the philtrum, there is a crossing over of the muscle fibres. In unilateral cleft lip, the orbicularis oris attaches to the anterior nasal spine and the foot plates of the medial crura while in the normal side the orbicularis oris is attached to the anterior nasal septum, nasal sill and periosteum of the piriform aperture on the cleft side. The repositioning of the orbicularis oris is essential for the surgical treatment of unilateral cleft lip. Proper form creation is essential for recreation of function and aesthetics.^[1] Millard's approach of flaps allowed the realignment of the muscle from vertical to horizontal position,

Table 4: The influence of the age of the surgery and the studied outcome parameters

	Mean age at time of surgery	P
Cutaneous roll symmetry		
Good	4.54 ± 0.91	0.031
Average	5.24 ± 0.4	
Vermillion symmetry		
Good	4.5 ± 0.92	0.003
Average	5.02 ± 0.4	
Poor	5.71 ± 0.09	
Scar appearance		
Good	4.54 ± 0.9	0.037
Average	5.72 ± 0.04	
Poor	5.48 ± 0.1	
Cupid's bow symmetry		
Good	4.52 ± 0.91	0.025
Average	5.12 ± 0.51	
Poor	5.4 ± 0.67	
Lip length		
Good	4.52 ± 0.93	0.041
Average	4.95 ± 0.45	
Poor	5.42 ± 0.53	
Nostril symmetry		
Good	4.52 ± 0.92	0.036
Average	5.24 ± 0.5	
Poor	4.89 ± 0.61	
Alar dome symmetry		
Good	4.56 ± 0.92	0.846
Average	4.47 ± 0.71	
Poor	4.8 ± 0.63	
Alar base symmetry		
Good	4.56 ± 0.91	0.454
Average	4.55 ± 0.92	
Poor	5.7	

repositioning and reapproximation. Abnormal healing may lead to fibrosis and scarring of the muscle. The bulge along the cleft side nasal region still needs to be eliminated and also there is a need to lengthen the cleft side lip. For this, the Rose-Thompson effect (a design of concave excisions of the cleft margins to provide length when closing in a straight line) is created.^[1,9,10] This is traditionally placed below or at the nasal sill. In the present modification, it is placed above the nasal sill by modulating the triangular and 'C' flap. This would recreate the proper nasal sill, eliminate the bulge and reduce the tension in the straight line component of the flap. Furthermore, the method would facilitate proper approximation of the underlying musculature as the 'C' flap is positioned higher and not along the muscle attachment area. This essentially negates the negative aspects of the Millard's basic design. The outcomes of the present study indicates that the current author's modification have yielded positive outcomes.

From the qualitative aspect, it was observed that width of cleft and Simonart's band play an essential role in the

Table 5: The difference of the anthropometrics ration compared with the 'Standard 1'

	<i>t</i> -statistics	Significant (two-tailed)	Mean difference	95% CI of the difference	
				Lower	Upper
Lip height	-26.58	0.000	-0.061	-0.0660	-0.0569
Lip width	-24.73	0.000	-0.06095	-0.0658	-0.0561
Vermillion height	-24.94	0.000	-0.05671	-0.0612	-0.0522
Alar base width	-26.25	0.000	-0.06003	-0.0645	-0.0555

CI: Confidence interval

outcome with wider clefts compromising the Steffensen parameters^[5,6] [Table 2]. The presence of Simonart's bands indicates abnormal positioning of the tissues and the connective tissue activity. The success of the surgeries is much pronounced in the absence of these bands [Table 3]. This indicates that when the Simonart's bands are present, the outcomes need to be carefully assessed as its presence can influence the aesthetic and functional outcome.

Age of surgery appears to influence the aesthetics and functional outcomes of the philtrum-nose-labial-scar and length. However, the alar dome and base are not influenced by the age of surgery. The results in Table 4 indicate that the results of the Steffensen parameters are influenced definitely by age. Early cleft lip repair harness the sensitive, easily mouldable tissues. This comes from relative overproduction of hyaluronic acid and transforming growth factor- β in response to elevated circulating levels of maternal oestrogen in the babies. As the age increases, the pliability of the tissues are reduced, hence the repairing capabilities are reduced.^[11,12]

CONCLUSIONS

There is no single recommended ideal technique for unilateral cleft lip correction. Understanding the clefting phenomenon during cleft-o-genesis and by careful clinical examination can help the clinician and operating surgeon to choose the approach to cleft lip correction. In spite of several new techniques, Millard's technique and its numerous modifications have been widely used albeit with some concerns. Within the constraints of a retrospective study, the author's modification of the classic Millard's approach appears to provide better outcomes, both in qualitative and quantitative metrics. Further large scale approach on a larger sample size would help to verify the findings of this present study.

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Conflicts of interest

There are no conflicts of interest.

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