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Original Article

White Roll Vermilion turn down flap in primary unilateral cleft lip repair: A novel approach

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ABSTRACT

Aim: Numerous modifications of Millard's technique of rotation – advancement repair have been described in literature. This article envisions a new modification in Millard's technique of primary unilateral chieloplasty. **Material and Methods:** Eliminating or reducing the secondary deformities in children with cleft lip has been a motivating factor for the continual refinement of cleft lip surgical techniques through the years. Vermilion notching, visibility of paramedian scars and scar contracture along the white roll are quite noticeable in close-up view even in good repairs. Any scar is less noticeable if it is in midline or along the lines of embryological closure. White Roll Vermilion turn down Flap (WRV Flap), a modification in the Millard's repair is an attempt to prevent these secondary deformities during the primary cleft lip sugery. This entails the use of white roll and the vermilion from the lateral lip segment for augmenting the medial lip vermilion with the final scar in midline at the vermilion. **Result:** With an experience of more than 100 cases of primary cleft lip repair with this technique, we have achieved a good symmetry and peaking of cupid's bow with no vermilion notching of the lips. **Conclusion:** WRV flap aims to high light the importance of achieving a near normal look of the cleft patient with the only drawback of associated learning curve with this technique.

KEY WORDS

Unilateral chieloplasty; WRV flap; whistle deformity; embryological cleft lip repair; turn down flap; modified Millard's repair; Primary cleft lip repair; secondary cleft lip deformity

INTRODUCTION

Surgical methods for repairing unilateral cleft lips have advanced continuously over the past few decades. Although a multitude of approaches have been described, the rotation-advancement technique described by Dr. D. Ralph Millard in 1957 remains the most popular worldwide. This technique releases the malformed medial lip segment from its columellar attachment and

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rotates it into normal position. The lateral lip segment is advanced with the alar base across the cleft. Since its introduction, this procedure has been performed by innumerable surgeons worldwide. With experience, many cleft surgeons tend to further modify this technique for better outcome. This continuing evolution of the surgical technique is just a reflection of a plastic surgeon's struggle to combine reconstructive principles with a good aesthetic sense to restore both form and function with beauty. Any modification in the procedure which allows normal facial growth and development, near-normal facial appearance and lessens the need for future secondary procedures should be every cleft surgeon's goal. The operating surgeon must have full understanding of the embryological and anatomical factors guiding the repair of cleft lip and should seek to improvise and make an attempt to normalise all the tissues involved in the cleft lip.

This article approaches a complex challenge in cleft lip surgery. It is our hope that the reader will take away some fundamental truths while reading this article, asking questions while learning some answers, with an open mind to envision the contents of this paper.

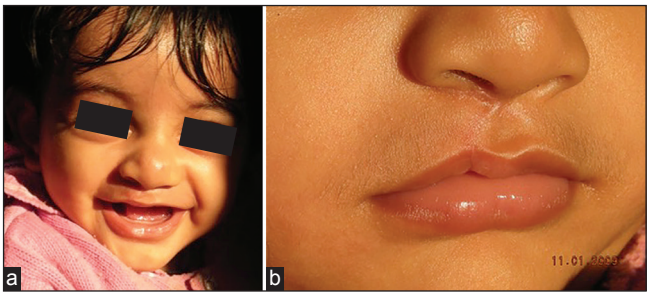

Figure 1: (a) Child with repaired cleft lip showing good symmetry with no noticeable deformity at a distance. (b) Close-up view of the same child showing vermilion notching and a visible paramedian scar

Figure 3: Secondary cleft lip deformity showing inadequate vermilion on medial lip segment

This study was carried out in a high volume centre which receives a large number of children with clefts ranging from minor to severe in nature. During our initial years of practicing Millard's repair as our preferred technique for cleft lip repair, few observations were made. Vermilion notching was visible in the close-up view, even in nicely repaired lips [Figure 1]. Paramedian scars over the vermilion in continuation with the philtral line scar are often visible [Figure 2]. In many cases, scar contracture was seen pulling the white roll up and distorting the Cupid's bow. Sometimes medial hypoplastic vermilion or partial loss of medial vermilion due to previous surgery demand procedures to augment and/or replace the lost medial segment [Figure 3].

In bilateral cleft lip repair by Veau III method, we realised that the fall and smoothness of the white roll and vermilion was quite preserved and the repair exhibited no vermilion notching and scars over the vermilion region [Figure 4]. This gave us the idea to develop a

Figure 2: Visibility of paramedian vermilion scars in an operated patient

Figure 4: Non-noticeable midline scar and absence of any vermilion deformity in bilateral cleft lip repair even in close-up view

similar technique even in unilateral lips. Subsequently, we modified the Millard's technique and incorporated the White Roll Vermilion turn down flap (WRV flap) from the lateral lip segment to be used for the construction of the vermilion and white roll on the medial lip segment.

We have performed more than 100 cases using this technique till date and the results are promising, consistent with a satisfactory aesthetic outcome. The only drawback observed was in terms of the learning curve associated with this technique.

PROCEDURE

(Operating video link: https://www.youtube.com/watch?v=S2lriycJ-fc&feature=youtu.be).

After the child is intubated and draped, the marking is done as per Millard's rotation-advancement technique.

The markings for the WRV turn down flap are as follows [green marking in Figure 5a]. On the medial lip segment, a line is drawn just above the white roll from the point designated as the white roll at the height of Cupid's bow on cleft side (point 3) to the point marked as depth of the Cupid's bow (point 1). A line is drawn perpendicular to the point 1 across the vermilion and mucosa which ends in the midline at the frenulum.

On the lateral lip segment, point 3' is marked after matching the vermilion and white roll thickness with that of the medial lip segment. A line is drawn just above the white roll from this point to point 1' (distance between point 3' and 1' should equal the distance between point 1 and 3) along the white roll. Similar to medial lip segment, a perpendicular line is drawn from point 1' across the vermilion with a curvilinear or wavy marking following the mucosal crease.

After the markings, the area is infiltrated with Xylocaine with adrenaline solution (1:100000). After incising as per Millard's technique, the incision is then made on the medial lip segment from point 3 to point 1 just above the white roll carrying it down across the vermilion in the midline. The vermilion, part of orbicularis muscle within the incision line and the red lip portion is transected, and superior labial arteries cauterised. The orbicularis muscle is then judiciously dissected off the overlying skin and underlying mucosa. On the lateral lip segment, the incision is made from point 3' to point 1' just above the white roll carrying it across the vermilion till the maxillary border at the gingivo-buccal sulcus. The red lip portion is then transected. WRV flap is raised by deepening the incision and including muscle in the flap. A small triangle of skin and muscle between the incision of the Millard's technique on the lateral lip and the incision for the turndown flap is excised.

Rest of the steps of the procedure are done as per Millard's technique.

With the approximation of the lateral nasal lining and the advanced alar base with the septal mucosal flap, the nasal floor is repaired. The peri-oral orbicularis muscle is sutured across the cleft with 4-0 vicryl suture with little difference in our technique. The first suture between the muscles is placed at the nasal sill. The second suture approximates the muscle underlying the points 3 and 3'. After this approximation, muscle and skin closure lies in orientation and remaining muscle is sutured [Figure 5b].

The WRV flap of the lateral lip segment is used for the construction of the white roll and vermilion on the cleft side. The thickness and length of the vermilion flap of the lateral lip segment is compared with that of the medial side. If the thickness is more, a small portion of the muscle is excised. If the length of the flap is more, it is trimmed to appropriate dimensions. It's always better to err on the thicker side than on the thinner side.

Skin closure is done by suturing point 3 to point 3' and point 1 to point 1'. Care should be taken not to place any sutures over the white roll. Sutures are placed 1-mm below or above the white roll at these points [Figure 5c].

The lip is approximated using interrupted 6-0 monofilament nylon suture. The approximation of the white roll with the skin at the philtrum between point 1 and 3 is done either by one-half buried mattress suture or a loose non strangulating single simple suture [Figure 5d]. The final suture line lies at the philtral column for the skin portion and in the midline for white roll, vermilion and mucosa.

Simple dressing is done and sutures are removed after 5-7 days.

RESULTS

The evaluation of results was done by the plastic surgery team, anaesthetists, smile train coordinator (owing to

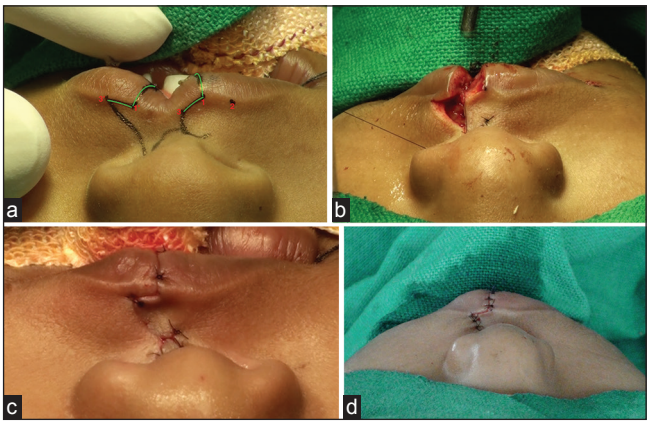

Figure 5: (a) Marking of White Roll Vermilion turn down flap (green marking). (b) Geometric orientation of the flap after the key muscle sutures. (c) Close-up view showing the fall of the lip and symmetry achieved after the skin sutures are placed across the points mentioned. (d) After final suturing

Figure 6: (a) Pre-operative photograph of a 4-month-old child with unilateral cleft lip deformity, (b) 1-week post-operative, (c) 1-month post-operative and (d) 4 months post-operative

their work experience with different cleft surgeons) and non-related attendants. Assessment was done in terms of symmetry achieved, visibility of notching and scars, fall and flow of the white roll and vermilion and form of the Cupid's bow. The initial results were quite encouraging when comparison was done with earlier repairs. Better symmetry is achieved in terms of a balanced protrusive vermilion, smoothness of the curve of Cupid's bow and a continuous regular outline and flow of white roll from lateral to medial when traced by the gazing eye following one corner of the lip to another. This article attempts to present a modification in Millard's repair and our experience with it in more than 100 cases. Prospective evaluation and analysis is required to grade the content of this article and our team is already in process to standardise the parameters, collect data and evaluate the results with the focus on detailed analysis and comparison of different techniques used for primary repair of unilateral cleft lip.

Three children operated with WRV flap method as a primary repair [Figures 6-8] and one re-do/revision case [Figure 9] with secondary deformity are shown with their long-term follow-up pictures as illustrations of this technique.

DISCUSSION

The rotation-advancement repair has historically produced excellent results and is currently the most common technique used for unilateral cleft lip repair.[1,2] In 1955, Dr. Ralph Millard was using Le Mesurier's technique for unilateral cleft lip repair but he developed rotation-advancement repair thereafter as he was not satisfied with the results. His surgical philosophy was accepted worldwide and still remains unchallenged. Triangular flaps dominated during the 1960s and its variations such as Fisher repair are still popular today. Numerous modifications of Millard's technique by Noordhoff, Mulliken and Mohler and many others are used by 84% of the surgeons.[3] Lazarus *et al*. objectively and subjectively assessed five different types of repair (Millard's, David Z-plasty, Modified Z-plasty, Tennison Randall triangular flap and Nakajima-Yoshimura straight line) and found similar results with all with the exception of high rate of shortened lips with Millard's technique.[4]

The primary aim of cleft lip repair is to produce functional continuity of the orbicularis muscle, recreate symmetry, reconstitute Cupid's bow, produce a slight pout of the tubercle, balance the white roll and vermilion and achieve nasal symmetry. The benefits of Millard repair are that it preserves the Cupid's bow and does not violate the philtral column. To achieve a normal look is the ultimate goal of a cleft surgeon. This repair is known for its flexibility allowing the surgeon to modify components of the repair throughout its execution.[5]

During the embryological development process, the upper lip is formed by the fusion of maxillary prominences with the median nasal processes in the midline. After their fusion, intermaxillary segment arises from the medial nasal prominences and forms the nasal tip, columella and the philtrum. The vermilion, which is the transition zone between the lip skin and the mucosa, also develops from the maxillary processes, which fuse in the midline represented as frenulum[6,7] [Figure 10a]. The preferential

Figure 7: (a) Pre-operative photograph, (b) 1-week post-operative, (c) 1-year post-operative and (d) 5-year post-operative

Figure 8: (a) Pre-operative photograph of a child with cleft lip deformity, (b) close-up view, 1-year post-operative and (c) 3-year post-operative

Figure 9: (a) Intra-operative photograph of secondary cleft lip deformity showing loss of vermilion on medial lip segment, (b) marking of the White Roll Vermilion turn down flap, (c) after closure, (d) 3-month post-operative (worm's eye view), (e) 3-month post-operative (bird's eye view)

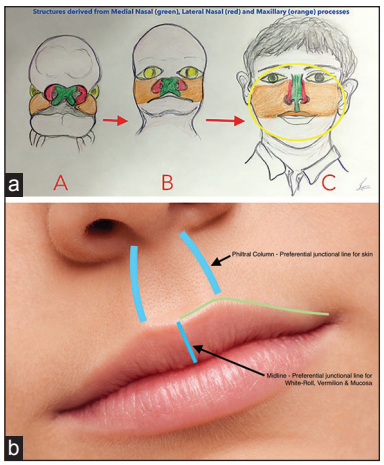

Figure 10: (a) Illustration showing development of vermilion from maxillary processes favouring midline closure of the vermilion, white roll and the mucosa (Adaptation from Langmans Medical Embryology. 6th ed). (b) Illustration showing the preferential junctional line for the upper lip. For skin portion, it should be the philtral column, and for white roll, vermilion and mucosa it should be midline

junctional line for skin is philtral column and for the white roll, vermilion and mucosa is midline [Figure 10b]; evident by the fact that in bilateral cleft lip repair, the scar lies in midline on the vermilion, which is barely visible even in close-up view.

It has been documented that 86% of the surgeons do not alter the type of technique depending on the preoperative cleft characteristics.[3] Design of the skin incision is an important factor for attaining a good outcome.[8] Numerous studies point out modifications made in the skin incision in rotation-advancement flap method to address different issues of nasal asymmetry, lip length and philtral scar but very few studies point out the need for modification or change required in the vermilion repair.

Reddy *et al*.[9,10] studied and compared the outcome of rotation-advancement repair, Pfeifer wave line incision and Afroze incision. They subjectively evaluated (not a randomised control trial) and inferred Afroze incision which is actually a combination of Millard and Pfeifer incision yields better results in terms of vermilion match, white roll match and scar appearance but equal to Millard's technique when nasal symmetry is compared and similar to Pfeifer incision when lip length is compared.

WRV flap addresses the issue of vermilion notching and scar appearance with a slight modification in the incision at the vermilion-skin junction preserving all the other elements of classic Millard's rotation-advancement flap.

Vermilion notching develops in repaired lips as a consequence of inadequate rotation of the medial lip segment, lack of bulk of muscle in the vermilion and scar contracture along the cutaneous or mucosal aspect of the lip.

In his original articles, Millard describes using a lateral vermilion flap to augment the attenuated medial vermilion.[11] This laterally based flap was fashioned as a tongue of posterior mucosa that was brought across into a relaxing incision on the medial side or it could be done as an anterior onlay or 'central tongue in dart'.[12] When the vermilion is attenuated, a posterior mucosal Z-plasty and/or a relaxing incision behind the thin area can be used to release the mucosa. These modifications were made only when needed. He had also stressed on the importance of performing inter-digitation at the junction of the white roll (vermilion-cutaneous junction), because when the vertical scar crosses this line, it causes an obvious break in colour and contour.[13,14] Byrd and Stal[1] used techniques similar to those of Millard, specifically the lateral triangular vermilion flap to augment the deficient medial vermilion. In contrast to lateral vermilion flap used by Millard, which consists of only mucosa, WRV flap has vermilion, orbicularis muscle and white roll as its components from the lateral lip segment. This flap is sutured in the midline across the cleft allowing more embryological and anatomical closure of the vermilion of the lip [Figure 11].

Mulliken executes three separate (laterally based) unilimb Z-plasties during the mucosal-vermilion-cutaneous closure. The first is placed at the mucosal join on the underside of the lip. The second unilimb Z-plasty is at the vermilion-mucosal junction to prevent notching.[2] This serves to augment the height of the medial vermilion and is similar to that described by Noordhoff.[15] The third is a small triangular flap (2-2.5 mm at its base) at the vermilion-cutaneous junction that carries white roll across the scar line and lowers the vermilion-cutaneous junction on the medial side of Cupid's bow.

WRV flap breaks the vermilion-cutaneous junction into zigzag closure both in vertical as well as in anteroposterior plane making it less prone for scar contracture, which is seen with straight line closure more often. It also provides a solution to the problem of vermilion notching owing to its muscle component and the prevention of scar contracture at the mucosal aspect.

There is no significant variation in this technique when done for secondary cases where vermilion of the medial lip segment is scarred, lost or deficient. It offers a reliable option to use vermilion with its white roll from the lateral segment for substitution on the medial side as no other method or technique can replace this tissue.

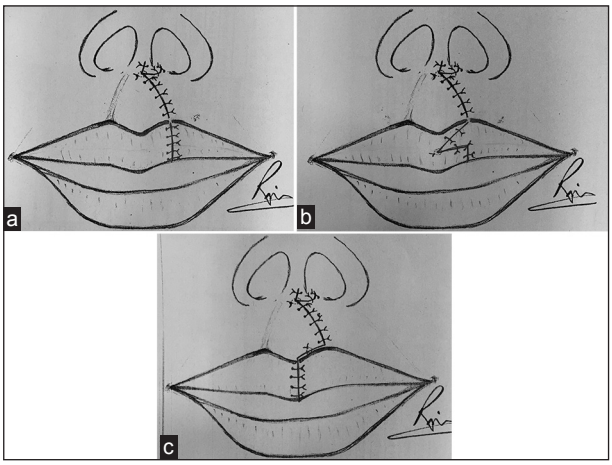

Figure 11: (a) Illustration showing final suture line after Millard's repair, (b) illustration showing final suture line after Noordhoff's repair, (c) illustration showing final suture line after White Roll Vermilion turn down flap

Disadvantage of this technique only includes associated learning curve as there is need for meticulous incision (preferably under magnification) just above the white roll in both the segments and not to err on the thinner side while raising the WRV Flap. If the incision on either or both of the segments is made below the white roll, it will lead to double white roll or no white roll in the reconstructed lip, respectively.

The aim of the technique in this article is to identify and develop an optimal incision design in cleft lip surgery. It would require prospective studies and statistical evaluation in future to grade the results when compared to conventional techniques. The Eurocleft study, a previously performed, large scale, multi-centric study has demonstrated that constancy of protocols in a centre leads to best outcomes.[16] Any technique or modification individually cannot necessarily produce the best results in all the patients but better results are achieved when they are analysed, and modifications are applied to operative principles based on experience. In presenting a modification, we hope to stimulate a discussion regarding the advantages of various techniques in cleft lip surgery.

CONCLUSION

Millard's rotation-advancement repair has had a major impact on cleft lip surgery since the 1960s. Critical analysis of post-operative results led to various modifications in the technique since then. Performing such modifications, while maintaining original surgical goals, has allowed the Millard's repair to remain the most popular method of cleft lip repair throughout the world. WRV flap technique

is effective in preventing and correcting many vermilion and white roll deformities with promising aesthetic outcome. WRV flap is now the preferred method at our centre for primary cleft lip repairs for restoring what Millard termed 'Ideal Beautiful Normal' and for building hope while building smiles.

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Conflicts of interest
There are no conflicts of interest.

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