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Orbicularis Oris Muscle Z-Plasty Modified Millard's Technique Versus Modified Millard's Technique For Unilateral Cleft Lip Repair: A Randomized Clinical Trial

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Aim: In a trial to attain the most possible aesthetic result of obtaining a repaired lip with the least sacrificing scar and reasonable lip height at the first operation, in the current study a z-plasty was just incorporated in orbicularis oris muscle to generate the predetermined lip length while maintaining the Millard curvilinear skin incision with no transverse scar.
Materials and Methods: A double blinded, randomized controlled trial in which a group of 30 nonsyndromic unilateral cleft lip patients were randomized into two equal groups. Group A: undergone orbicularis oris muscle z-plasty modified Millard's technique, Group B: undergone modified Millard's technique. Six months postoperatively the height of philtral ridge, nostril width and scar width were assessed using computer software, all the measurements were carried out digitally on the taken standardized photographs by blinded assessors. Comparison of mean age and weight values in the two groups was carried out by Student's t-test. The repeated measures ANOVA test was used for comparison of cleft and non-cleft sides within the same group, the two groups as well as the changes by time in each single group. The significance level was set at $P \leq 0.05$.
Results: No significant differences were found in philtrum length, nostril width or scar width between the two groups at 6 months follow up postoperatively.
Conclusion: Both modified Millard's technique and orbicularis oris muscle z-plasty modified Millard's technique are successful interventions in transforming nose and lip aesthetics and function. After surgical lip repair, both groups had matching aesthetics.

Keywords: Unilateral cleft lip and nose, Cheiloplasty, Rotation- advancement technique, Repair techniques, Surgical outcome.

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Introduction

Cleft lip and palate (CL/P) represents the most common facial birth defect.[1] The immediate and long term sequelae of this anomaly and its management include potential difficulties with feeding, swallowing, speech and hearing. Moreover, affected psychosocial development and behavioral issues. Murray and colleagues [2] postulated that children with cleft lip anomaly tend to spend more time alone and show more negative interactions toward peers. These children have increased risk of developing a lower self-image and behavioral problems.[3]

The ultimate challenge in the CL/P discipline is to merge reconstructive fundamentals with a keen aesthetic sense to regain both normal form and function, this was stated by Millard as the "ideal beautiful normal". Although improved repair techniques have generated better outcomes, still, there are significant challenges remain, which fuel cleft surgeons to continue refining their methods of repair. The final chapter has yet to be written.[1] Although the ultimate goal for cleft surgeons is complete lip symmetry, one of this critical symmetry component is the philtral height. A number of surgical techniques and modifications have been innovated in an attempt to generate surgically a lip of desirable length, however, this came at the expense of generating unsatisfactory scars that disrupt the philtral column, often quite visibly marking the patient for the rest of his life as have been born with an anomaly.[4-7]

The three eras of cleft lip repair design essentially include the straight-line repair, geometric, and rotation-advancement techniques.[8] Until the 1930s, through either straight or broken incision lines, most repairs were performed by paring the cleft margins in a straight line closure. Demke and Tatum [9] reported that, in a recent U.S. survey of 269 North American cleft teams, 1% only of present surgeons use the strict straight line design for complete cleft lip.[1, 8] Straight-line techniques often failed to adequately level the Cupid's bow, realizing this remarkable drawback led to the development of techniques designed to incorporate tissue from the lateral element into the medial element shortened edge.[1] Geometric LeMesurier and Tennison designs (quadrangular and triangular flap techniques respectively) which both introduced tissue into the lower part of the lip, enjoyed a great deal of popularity in the 1950s and early 1960s.[3, 10] They were the milestones that ingeniously solved the dilemma of vertical height deficiency and incredibly balanced the Cupid's bow in cleft lip repair; however, this came at the expense of the created scars that disturbed the philtral column continuity often quite visibly.[6]

A paradigm shift began when Millard[11] introduced his rotation advancement technique in 1955. He was quietly unsatisfied with the results he gained with the LeMesurier technique. He claimed that one philtral column, three-fourths of a normal Cupid's bow, in addition to the philtral dimple were all intact on the medial cleft element, but aberrantly rotated upward. He decided that these precious intact structures should not be violated, but rather released from their superior mal-attachments and rotated downward into their normal position.[12]

Without the reliance on an exact geometric measurements and the ability to tailor and trim flaps or 'cut as you go' throughout surgery, the rotation advancement technique was presented as a versatile innovative repair modality.[9] Over all other methods, Millard's technique have distinct advantages: simple, flexible, sacrifices the least amount of tissue, and places the scar in a strategic position mimicking the normal philtral column. Moreover, with Millard technique, the tension of the closure is placed

under the alar base that allow for better molding of the underlying alveolar bone and reduction of the alar flare. However, there remain some instances where failure to maintain adequate lip height occur.[10, 13, 14]

Now Millard's innovative original principle is considered the "gold standard" by which other repairs are judged. Of all other techniques, no one has gained as much popularity and no one has withstood the test of time as Millard's design. In a recent survey of leading cleft centers worldwide, 84 percent use Millard's technique in unilateral cleft lip repair. Many further refinements have been proposed since the introduction of the rotation-advancement repair, including those by Byrd,[15] Cutting,[16] Mohler,[17] Mulliken,[18] Stal,[12] and others.[6, 12]

Z-plasty is one of the most widely used and well-known versatile maneuvers in the speciality. Simple yet incredibly effective. It consists of two generated identical flaps that is triangularly fashioned and synchronously transposed with each other, recruiting tissue from one axis to be redistributed into another axis to create the aimed lengthening effect along the central limb axis.[14]

This study aimed to attain the most possible aesthetic result of obtaining a repaired lip with the least sacrificing scar and reasonable lip height at the first operation, a z-plasty in this study was just incorporated in orbicularis oris muscle (OOM) to generate the predetermined lip length while maintaining the Millard curvilinear skin incision with no transverse scar in patients with unilateral cleft lip (UCL).

Materials and Methods

A randomized controlled study was conducted on a group of thirty patients (22 males and 8 females) were born with unilateral nonsyndromic cleft lip with or without cleft palate. Their age ranged from 3 to 6 months with mean age 125 day. Patients were selected from department of plastic pediatric surgery outpatient clinic, the Specialized Pediatric Hospital – Faculty of medicine – Cairo University. This study has been approved by the Ethical Committee of Scientific Research- faculty of Oral and Dental Medicine-Cairo University. Patients were randomized equally into 2 groups by means of sealed envelopes; Group A (study group): undergone orbicularis oris muscle z-plasty modified Millard's technique. Group B (control group): undergone modified Millard's technique.

For both groups, the same surgical procedure steps were carried out except for Z-plasty designing in group A. The rotation advancement design appropriate markings were done. According to the discrepancy in height between the lateral and medial lip elements, the Z-plasty and the length of its arms have been individually tailored, and in accordance, the base width of the inferior triangle was tailored to be performed in the orbicularis oris muscle layer (Figure 1).

Fig. 1: (Left) A clinical photograph shows Z-plasty markings. (Right) A diagram illustrates Z-plasty incisions in orbicularis oris muscle

Using methylene blue-filled needle, the needle head passed through skin to orbicularis oris muscle and mucosal side marking a point on both cleft sides drawing an equilateral triangle with its vertical limb has been marked along the cleft margins.

The lateral and medial lip elements were surgically released with mucosal incision at the gingivolabial sulcus using a number 15 blade scalpel to free the abnormally attached and displaced lip tissue from the underlying

bone. Careful dissection of the orbicularis oris muscle was carried out from its abnormal attachments. For advancement and rotation flaps, a full thickness incisions were performed, followed by 3-4 mm of dissection and release of the skin from the underlying orbicularis oris muscle (Figure 2).

Fig. 2: Clinical photographs for control group show: (Left) markings related to the rotation advancement design. (Right) dissection of orbicularis oris muscle from overlying skin.

By the release of orbicularis oris muscle from the overlying skin, the points previously marked using methylene blue for the Z-plasty appeared and Z-plasty cutting was carried out including the OOM and inner mucosa in both medial and lateral elements with no any involvement of the overlying skin. This step generated two triangular flaps in both medial and lateral segments.

The closure began by OOM in a simple interrupted manner with 4-0 vicryl sutures. In the study group, the Z's were transposed to be sutured each to their previously and properly determined position reconstituting the orbicularis oris muscular sphincter (Figure 3).

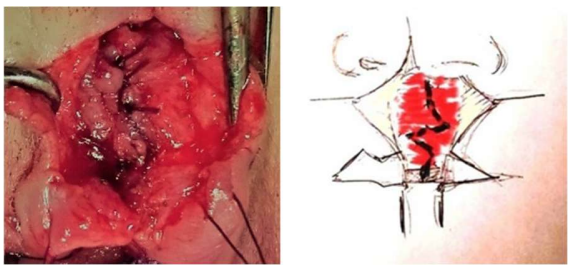

Fig. 3: A clinical photograph and a diagram show closure of orbicularis oris muscle in study group.

Finally, by 6-0 PDS the skin was sutured with precise approximation of the white roll. Then 5-0 vicryl sutures were placed in the vermilion followed by the mucosal side of the lip. Six months postoperatively standard photographs were obtained, and objective measurements were performed from the obtained photographs using the ruler as a control reference in order to evaluate the height of philtral column and nostril width in addition to scar width using the Image J program (National Institutes of Health, Bethesda, MD). (Figure 4 & 5).

Fig. 4: Pre-operative and post-operative frontal views for study group.

Fig. 5: Pre-operative and post-operative frontal views for control group.

Results

Exploration of numerical data normality were made by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro- Wilk tests). All data showed parametric (normal) distribution. The presentation of numerical data was done as mean, standard deviation (SD), median, minimum, maximum and 95% Confidence Interval. Comparison of mean

age and weight values in the two groups was carried out by Student's t-test. The repeated measures ANOVA test was used for comparison of cleft and non-cleft sides within the same group, the two groups as well as the changes by time in each single group. When ANOVA test was significant, Tukey's test was used for pair-wise comparisons. The significance level was set at $P \leq 0.05$. IBM® SPSS® Statistics Version 20 for Windows was used for statistical analysis. In the current study there was insignificant difference at 3 and 6 months postoperatively between the two groups in philtrum length, scar width or nostril width.

A. Demographic data

There was no statistically significant difference between gender distributions as well as mean age in the two groups. The male to female ratio of infants in the study group was 80% versus 66.7% in the control group with P-value equals 0.682. The mean age in the study group was 128.5 ± 23.7 days versus 122.1 ± 20.9 in the control group with P-value of 0.445.

B. Comparison between study and control groups

There was no statistically significant difference between cleft side mean philtrum length, nostril width or scar width in the study and control groups. Table (1)

Table 1: Mean, standard deviation (SD) values and repeated measures ANOVA test results for Philtrum, length nostril width and scar width comparison for cleft side between study and control groups at six months postoperative follow up.

	Study		Control		*P*-value
	Mean	SD	Mean	SD	
Philtrum length	9.9	1.6	9.7	1.1	0.597
Scar width	1.13	0.30	1.40	0.54	0.105
Nostril width	7.4	1.0	7.5	1.0	0.327

***: Significant at $P \leq 0.05$**

Discussion

For the cleft surgeons, although complete lip symmetry is the ultimate goal of the repaired lip, the philtral tubercle height represents one of the most critical components of this symmetry. As argued by Millard a 1-mm disharmony in the height of the lip is far more appealing to the eye than a 2 to 3 mm horizontal lip length discrepancy.[3] Up till now, no one surgical lip repair technique consistently produces the desired aesthetic and functional ideal results.[16, 18]

Millard's technique with its great merit of not violating the philtral segment with unnatural scars represents a significant advance, elegantly overcoming many of the previously described methods' limitations. However, there remain instances particularly in patients with wide cleft lips where the lip fails to maintain the aimed adequate height.[3, 11]

The Z-plasty repair is specifically advantageous as it is simple, readily applicable and allows precise calculation of the exact final length of the diagonals. An additional gaining from Z-plasty is that straight scars are avoided which is quietly beneficial in minimizing the post-operative contracture and distortion of the repaired lip.[14, 19]

Results of the current study compared to results of the previous trials in which a comparison to modified Millard's technique was done, varying results and conclusions were presented. Similar to the results of the current trial, Mabrouk, et al[20] found no statistically significant difference in philtral lip height when compared modified Millard technique with white roll vermilion (WRV) flap technique in unilateral cleft lip repair. On the other hand, Reddy, et al[21] when compared the technique of Millard versus Pfeifer, they found in their study a significant difference between the two repairs where Pfeifer technique showed better lip length and this was against the results of our study.

In the present study when scar and nostril width were assessed, there was no significant differences in outcome found between the two techniques and this was in accordance with the results of the trial carried out by Reddy, et al.[21]

One of the probable reasons for the reached matching results between the study and control groups is that all surgical repairs were carried out by the same skillful surgeon. The talent and experience of the surgeon in management of defects with higher severities may be a reason for the control group obtained acceptable results.[22]

Despite the absence of statistical significant differences between the study and control groups, patients with wide and severe defects might gain some benefit from orbicularis oris muscle z-plasty modified Millard's technique. A cleft with lesser degree of severity might simplify the surgical procedure and better improve the outcome.[23] Further studies specifically including wide cleft defects may be needed to better investigate this hypothesis using larger sample size and longer follow up period.

Conclusions

The z-plasty modified Millard technique presented in the current study was selected based on previously described successful repairs and sound principles. Both modified Millard's technique and orbicularis oris muscle z-plasty modified Millard's technique are successful interventions in transforming nose and lip aesthetics and function. After surgical lip repair, both groups had matching aesthetics.

Funding

This randomized controlled trial was self-funded. No grants were received from any funding agency.

Data Availability

The data sets for this study are available upon request through contacting the corresponding author via e-mail.

Ethics Approval and Consent to Participate

This study has been approved by the Ethical Committee of Scientific Research- faculty of Oral and Dental Medicine-Cairo University. After full explanation of surgical procedure a written informed consent was obtained from parents or guardians for participating in the study and for publication of this article and accompanying images.

Competing Interests

The authors have no conflict of interest to declare

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