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편측 완전 구순열에서 직선봉합법과
회전신전법 수술 후 입술 대칭의 비교

**Upper Lip Symmetry after the Straight Line Repair
of Unilateral Complete Cleft Lip
: in Comparison with the Rotation-Advancement Repair**

2019년 2월

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하 정 현

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Upper Lip Symmetry after the Straight Line Repair
of Unilateral Complete Cleft Lip
: in Comparison with the Rotation-Advancement Repair

by

Jeong Hyun Ha

A thesis submitted to the Department of Medicine in partial fulfillment of the requirements for the Degree of Master of Science in Medicine (Department of Plastic and Reconstructive Surgery) at Seoul National University College of Medicine

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Abstract

Upper Lip Symmetry after the Straight Line Repair of Unilateral Complete Cleft Lip : in Comparison with the Rotation-Advancement Repair

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Introduction: Rotation-advancement repair has been the most widely used technique for unilateral cleft lip repair. Recently, we have used a straight-line repair technique with assumption that it could minimize upper lip asymmetry when muscle reorientation is performed properly. The purpose of this study was to compare the results of these two techniques for cleft lip repair.

Methods: We conducted a retrospective cohort study of patients with unilateral complete cleft lip who underwent cheiloplasty at Seoul National University Children's Hospital from January 2009 to January 2017. The patients were divided into two groups according to cheiloplasty technique:

rotation-advancement repair (RAR group) or straight-line repair (SLR group). Outcomes were evaluated by assessing 12 to 48-month follow-up photographs using three methods : (1) glance impression using a five-point scale, (2) Manchester Scar Scale, and (3) indirect anthropometry

Results: A total of 39 patients with unilateral complete cleft lip were analyzed: 19 in the RAR group (12 males, 7 females) and 20 in the SLR group (12 males, 8 females). The glance impression ($p=0.336$) and Manchester Scar Scale ($p=0.667$) scores did not differ significantly between groups. According to the symmetry ratio (SR; cleft side value / noncleft side value) assessed by indirect anthropometry, vertical lip height (sbal-cph), horizontal lip length (cph-ch), and Cupid's bow width (cph-ls) did not differ significantly between groups ($p=0.411$, $p=0.496$, and $p=0.879$, respectively). Preoperative lip height discrepancy was not significantly correlated with the postoperative vertical lip height (sbal-cph).

Conclusions: Straight-line repair method can be regarded as a successful tool for symmetric repair of unilateral cleft lip without causing a short lip deformity. Since skin incision type did not affect the surgical outcome, muscle reorientation appears to be more important for cleft lip repair than skin incision.

Keywords: Straight line repair, unilateral cleft lip, cheiloplasty

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ch, cheilon, the point located at each labial commissure; cph, crista philtri landmark, the point on each elevated margin on the philtrum just above the vermilion line; ls, labiale superius, the midpoint of the upper vermilion line; sbal, subalar, labial insertion of the alar base20

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Introduction

The ultimate goal of unilateral cleft lip repair is achieving facial symmetry. That is, for ideal results, the philtral column, Cupid's bow, and vermilion should mirror the noncleft side. Anatomical cleft lip repair can be performed by reorienting the abnormally oriented muscle and mucocutaneous tissue. Cheiloplasty techniques have evolved through skin incision modifications to achieve an appropriate vertical lip height.

Historically, the technique for unilateral cleft lip repair has progressed from straight-line repair (SLR) to geometric-design repair[1-4] to rotation-advancement repair (RAR) with many modifications. One of the most widely used techniques is Millard's rotation-advancement technique, for which numerous variations have been described. The traditional Millard's technique produces a transverse alar base scar, which is more conspicuous in Asians[5]. Moreover, it leaves a scar crossing the philtral column, which interrupts the normal anatomical boundaries and prevents mirroring of the noncleft side philtral column[6]. Because of the complex scar caused by the rotation-advancement method, many authors [5, 7-9] have recently reported techniques avoiding a transverse alar base incision. These days, Fisher's technique has gained its popularity due to short learning time for technical maturation. [10, 11]

Our group has used the rotation-advancement technique with various rotation incisions, without a transverse alar base incision. However, the C-flap of the modified rotation-advancement method sometimes resulted in a complex scar with three-point closure points, which sometimes led to an unaesthetic scar. Consequently, we tried C-flap

trimming during skin closure, which produced favorable outcomes. Ultimately, to make the scar even less conspicuous, we used a straight-line incision without creating a C-flap with the assumption that it could minimize postoperative scar when muscle reorientation is performed properly.

The purpose of this study was to evaluate the effectiveness of SLR and to compare outcomes of two different operative techniques: RAR and straight-line repair. We evaluated photographs obtained 12 to 48 months after surgery.[12] Evaluations were performed at least 1 year after surgery because upper lip symmetry after that time is generally maintained until adulthood[13, 14]. Photographs were not analyzed beyond 48 months postoperatively to minimize selection bias. In our institute, we usually perform secondary deformity correction at 5 or 6 years of age when needed and, therefore, restricting the follow-up time to 48 months ensured that the patients were assessed before corrective surgery. We only included patients with unilateral complete cleft lip to assess whether straight-line repair is effective even in these patients with severe abnormalities, who are more likely to exhibit postoperative lip deformities.

Method

We performed a retrospective cohort study of patients with unilateral complete cleft lip who underwent cheiloplasty at Seoul National University Children's Hospital from January 2009 to January 2017. We excluded patients with syndromic conditions or accompanying craniofacial anomalies, such as blepharophimosis, congenital ptosis, chromosomal abnormalities, or syndromic gene mutations. Patients lacking follow-up photographs at 12 to 48 months postoperatively were also excluded. After receiving approval from the Seoul National University Hospital Institutional Review Board (IRB No. H-1805-094-946), we reviewed the patients' demographic data, medical information, and photographs.

Operative Techniques

The patients were divided into two groups according to cheiloplasty methods: (1) RAR group, and (2) SLR group (Figure 1). We did not use presurgical orthopedics in all patients. Incision was made along the cleft edge in both techniques. In RAR, we used additional rotation incision ending up at the midcolumellar base, and eliminated transverse ala base incision. In both techniques, additional small incision was made at mucocutaneous junction of the lateral nasal wall, which was 90-degree from the cleft margin of lateral segment. Orbicularis oris muscle was fully detached from alar base, and alar base was totally detached from maxilla. L-flap was inserted into the 90-degree

incision of lateral nasal wall to maintain the anteriorly repositioned alar base. L-flap and M-flap were used to form nasal floor. And secure orbicularis muscle repair maintained medially repositioned alar base. Incision was made at the junction between pars marginalis and pars peripheralis[15] of the medial segment orbicularis oris muscle, and the muscle from lateral segment was inserted into the gap to prevent short lip and notching deformity. The pars peripheralis of orbicularis oris muscle was coronally split and sutured in a vertical mattress to form a philtral column[16].

Evaluation

Perioperative and follow-up photographs of postoperative 12 to 48 months were used for evaluation. Randomized photographs were evaluated by six doctors with sufficient experience in plastic surgery including one professor, three fellows, and two residents. To reduce interobserver variability, each parameter was rated three times by each rater, on a different day. Outcomes were evaluated using three methods: (1) five-point scale of glance impression [17, 18], (2) Manchester Scar Scale[19], and (3) indirect anthropometry. We compared the average scores of each method.

(1) Glance Impression Using Five-point Scale

Glance impression was evaluated using a five-point Likert scale, rating the subjective aesthetic outcome. Raters were asked to rate the photographs from one to

five, with one representing the best result, and five indicating the worst. Five-point scale evaluation of glance impression reflects the overall aesthetics of the face, which is directly associated with psychological well-being[17].

(2) Scar Assessment Using Manchester Scar Scale

Each scar was evaluated according to the Manchester Scar Scale [19]. Scar color, contour, and distortion, and whether the scar was matte or shiny were rated. Overall assessment using a visual analogue scale was also included in the Manchester Scar Scale, with 0 indicating an excellent scar and 10 representing a poor scar. The total score ranged from 0 to 24.

(3) Indirect Anthropometry (Photogrammetry)

Eight landmarks were defined for indirect anthropometry. Lip height was measured by vertical lip height (subalare to Cupid's bow peak distance [sbal-cph]). Horizontal lip length and Cupid's bow width were determined by measuring the Cupid's bow peak to cheilon (cph-ch) and labiale superius to Cupid's bow peak (cph-ls) distances, respectively.[9, 20] (Figure 2)

For each value, we calculated the symmetry ratio (SR) and symmetry index (SI). SR[21] was calculated as the cleft side value divided by the noncleft side value: $SR =$

cleft side value / noncleft side value. SI[22] was calculated as the square of the difference between 1 and SR: $SI = (1 - SR)^2$.

Statistical Analysis

Each parameter was compared between the RAR and SLR groups. Statistical analyses of 2×2 contingency tables of categorical variables were performed using the Fisher's exact test. For continuous variables, we used the Mann-Whitney test for comparisons. Correlations between preoperative lip height symmetry and postoperative outcomes were analyzed using the linear regression test. All statistical tests were two-sided, and significance was defined as $p < 0.05$. All analyses were performed using the Statistical Package for the Social Sciences for Windows Version 21.0 (IBM, Chicago, IL, USA).

Result

Patient Characteristics

A total of 123 patients with unilateral complete cleft lip (with or without cleft palate/alveolus) underwent cheiloplasty during the study period. Six patients were excluded because of concomitant other anomalies, and 78 patients were excluded because they lack of follow-up photographs. After exclusion criteria were applied, 39 patients were included in the analysis: 19 underwent modified rotation-advancement repair (RAR group; 12 males, 7 females) and 20 underwent straight-line repair (SLR group; 12 males, 8 females) (Table 1). All operations were performed by one experienced plastic surgeon (Sukwha Kim). Mean age at the time of surgery was 3.97 months (range, 2–6 months) and mean age at the time of the follow-up photograph was 38 months (range, 12–48 months).

Photogrammetric Analysis

We compared the average score of each parameter of the follow-up photographs. Glance impression scores did not differ significantly between the two groups (1.05 and 1.01 for the RAR and SLR groups, respectively) ($p=0.336$). The Manchester Scar Scale score also did not differ significantly between the two groups (11.02 and 11.06 in the RAR and SLR groups, respectively) ($p=0.667$).

Average SR values for horizontal lip length (cph-ch) were 0.91 and 0.89 for the RAR and SLR groups, respectively, which were not significantly different ($p=0.496$) (Table 2). Average SR values for Cupid's bow width (cph-ls) were 1.05 and 1.01 for the RAR and SLR groups, respectively, which were also not significantly different ($p=0.879$). Average SR values for vertical lip height (sbal-cph) were 0.88 and 0.90 in the RAR and SLR groups, respectively, which were not significantly differently ($p=0.411$). Representative preoperative and postoperative figures are depicted in figure 3 and figure 4.

Correlations between the preoperative lip height (sbal-cph) SI and postoperative outcomes were analyzed. Preoperative lip height SI did not affect postoperative lip height SI in either the RAR group ($p=0.091$) or SLR group ($p=0.944$). Preoperative lip height SI also did not affect the five-point scale glance impression scores ($p=0.976$ and 0.470 in the RAR and SLR groups, respectively) or the Manchester Scar Scale scores ($p=0.473$ and 0.493 in the RAR and SLR groups, respectively).

Discussion

Unilateral cleft lip repair has evolved since straight-line repair was first described in the 1930s. Traditional straight-line repair could not achieve an adequate lip height. Straight-line repair with a curvilinear or angled incision by Rose and Thompson produced an adequate lip height when straightened out; however, it produced a short lip deformity because of scar contracture and possibly insufficient muscle manipulation. Subsequently, geometric- designed repairs using upper and lower triangular flaps or quadrangular flaps were developed[1-4]. The location of the flaps varied, but vertical lip height was easily achieved through the use of a geometric- designed repair. However, the resultant scar disrupted philtral continuity, which was often visible.

After geometric-designed repairs, a revolutionary change occurred when Millard described the rotation-advancement repair. This technique could provide adequate Cupid's bow balance without interrupting philtral continuity. Millard's technique became the predominant method worldwide, and many modifications were reported by Cutting, Mohler, Stal and others [6, 23, 24]. According to Mohler's analysis[6], Millard's technique resulted in a scar that was asymmetric to the noncleft side at the philtral ridge. It also produced a complex scar, including a transverse alar base scar with three-point closure points. Subsequent modifications attempted to improve the postoperative scar. Mohler modified the rotation incision, which continued higher to the columellar base, with a 90-degree back-cut to improve the philtral scar. Recently,

Nakajima[8, 25] and Philip et al.²² reported a rotation-advancement technique without a transverse alar base incision, which is the conspicuous component of the postoperative scar. Nakajima also did not use a transverse alar base incision, while using a triangular flap for lip height. Nakajima further modified his method using a semicircular flap, instead of a triangular flap, and called the technique “straight line repair”, with the goal of producing a simple and straight ideal cleft lip scar. Fisher’s technique, which uses Rose-Thompson effect and lower triangular flap, also avoided incision disrupting the borders of anatomical subunits.

We have also performed a modified rotation-advancement repair, without transverse alar base incision, to generate a less obvious scar. However, the three-point closure point near the columellar base produced a complex scar. A scar at the columellar base has also been reported by Mulliken[26]. We subsequently trimmed most of the C-flap during skin closure, which resulted in a simpler scar. C-flap trimming resulted in favorable outcomes, which lead us to further try a straight-line incision, without forming a C-flap. In this study, we compared the results of our rotation-advancement repair and straight-line repair. The key points in the straight-line repair design was 1) determining the midline according to the labial frenulum and 2) setting the cupid’s bow width no greater than 2.5mm, in order to avoid wide philtrum. Muscle rearrangement and repair were performed using the same technique during both repair methods.

In this study, outcome assessments were performed both subjectively and objectively, evaluating glance impression of general appearance, lip measurements, and the

surgical scar. The glance impression score, reflecting overall facial aesthetics, including symmetry, did not differ between methods. Objective measurements of symmetry, using indirect anthropometric measurements, also did not differ between methods. Scar evaluation using the Manchester Scar Scale (which is appropriate for evaluating linear surgical scars and has demonstrated a high correlation between photographs and clinical evaluation[27]) likewise did not differ between groups. Moreover, follow-up results did not vary according to preoperative vertical lip height discrepancy. That is, straight-line repair was a successful repair method in patients with considerable lip height discrepancy. This implies that during unilateral cleft lip repair, muscle reorientation (the “framework”) is the key step, rather than the skin incision or skin flap repositioning. Although straight-line repair has previously exhibited several shortcomings, including short lip deformity and blunting of the Cupid’s bow[28] (Chait, Pfeifer, Delaire), we have achieved favorable results, comparable to those of the rotation-advancement method. Appropriate muscle manipulation including radical release of abnormal insertion and small incision at the junction of pars marginalis and pars peripheralis could result in upper lip symmetry in unilateral complete cleft lip after SLR. We believe SLR can be successfully applied to unilateral complete cleft lip patients, without complexity in design and long experience for technical maturation.

There are limitations in this study. First, because of the retrospective study design, many patients lacked follow-up photographs during the targeted postoperative period and were thus excluded. Second, the evaluation was performed by an indirect method, via photographic assessment. However, photographic analysis has its benefit in a

young population because direct anthropometric evaluation can be limited and difficult unless patients are sedated. Moreover, we could not identify the proportion of subjects undergoing secondary correction because the follow-up period was not long enough in some patients, especially in SLR group. Therefore, we could not compare the rates of secondary deformity correction. Lastly, we focused on analyzing the upper lip, and further study is therefore required to assess the effects on the nose.

Conclusion

Straight-line repair method can be regarded as a successful tool for repair of unilateral cleft lip without causing a short lip deformity. Since the skin incision type did not affect the surgical outcome, muscle reorientation appears to be more important for cleft lip repair than skin incision.

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Table 1. Patients' demographics

Characteristics		Operation method	
		Rotation-advancement repair	Straight-line repair
Age, months	Average (range)	4.21 (3-7)	3.75 (2-6)
Cleft side	Right	5	4
	Left	14	16
Sex	Male	12	12
	Female	7	8
Diagnosis	Cleft lip alone	0	1
	Cleft lip and alveolus	4	7
	Cleft lip and palate	15	12
Follow-up period, postoperative months	Average (range)	35 (12-48)	31 (12-48)

Table 2. Statistical analysis of cleft lip repair methods

Characteristics		Operation method		p-value
		Rotation- advancement repair	Straight-line repair	
5-point Likert Scale		2.77 ±0.92	2.46 ±0.70	0.336
Manchester Scar Scale		11.02 ±3.62	11.06 ±2.63	0.667
Indirect anthropometry	Vertical lip height (sbal-cph) SR	0.88 ±0.07	0.90 ±0.06	0.411
	Horizontal lip length (ch-cph) SR	0.91 ±0.13	0.89 ±0.10	0.496
	Cupid bow width (cph-ls) SR	1.05 ±0.22	1.01 ±0.10	0.879

Data are mean ± standard deviation.

SR, symmetry ratio (calculated as cleft side value / noncleft side value).

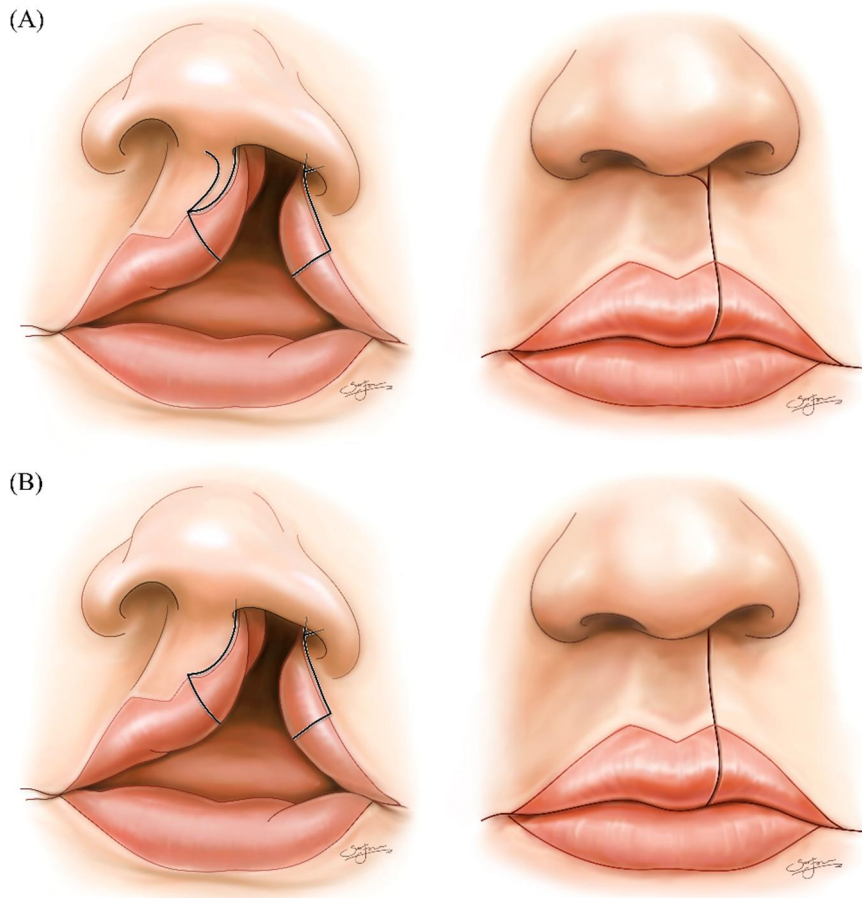


Figure 1. Schematic illustration of (A) rotation-advancement repair and (B) straight-line repair in unilateral complete cleft lip

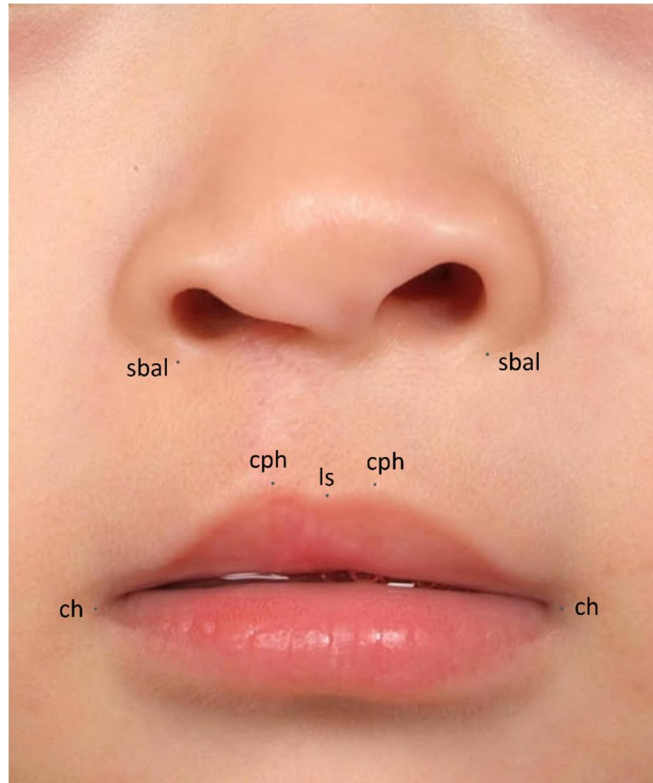


Figure 2. Anthropometric markings for measurements Vertical lip height (sbal-cph), horizontal lip length (ch-cph), cupid's bow width (cph-ls) are measured.

ch, cheilion, the point located at each labial commissure; cph, crista philtri landmark, the point on each elevated margin on the philtrum just above the vermilion line; ls, labiale superius, the midpoint of the upper vermilion line; sbal, subalare, labial insertion of the alar base

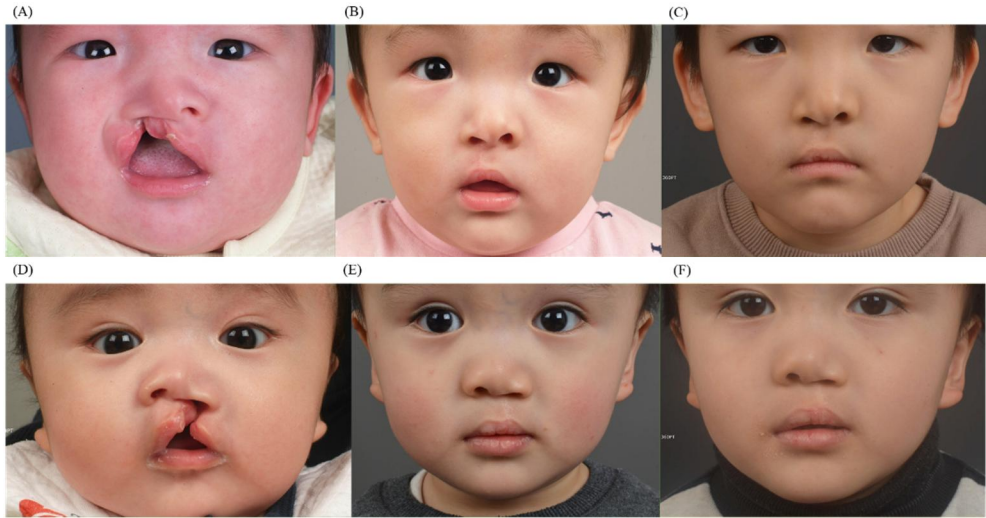


Figure 3. Photographs of patients who underwent straight-line repair for unilateral complete cleft lip Male patient with a right unilateral complete cleft lip and palate (A) before surgery (at 3 months of age), (B) 7 months postoperatively, and (C) 47 months postoperatively. Male patient with a left unilateral complete cleft lip and alveolus (D) before surgery (at 4 months of age), (E) 15 months postoperatively, and (F) 37 months postoperatively

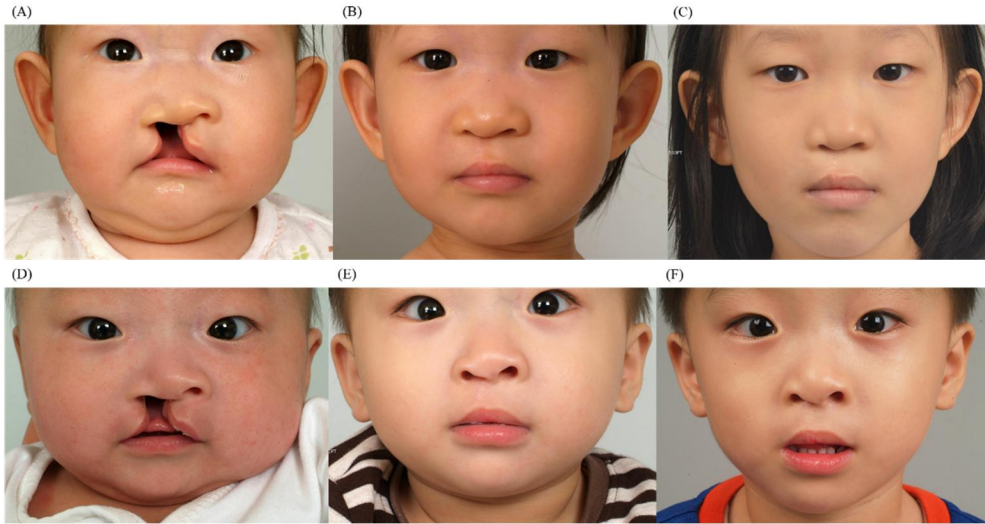


Figure 4. Photographs of patients who underwent rotation-advancement repair for unilateral complete cleft lip Female patient with a right unilateral complete cleft lip and palate (A) before surgery (at 4 months of age), (B) 12 months postoperatively, and (C) 5 years postoperatively. Male patient with a right unilateral complete cleft lip and palate (D) before surgery (at 4 months of age), (E) 8 months postoperatively, and (F) 31 months postoperatively

국문초록

연구 배경

편측 구순열의 구순성형술 방법 중 회전신전법은 가장 널리 쓰인 방법 중 하나이다. 그러나 최근 저자들은 술후 흉터를 최소화하기 위해 직선봉합법을 시도하였다. 본 논문을 통해 직선봉합법과 회전신전법 두가지 구순성형술 방법의 결과를 비교해 보고자 하였다.

연구 방법

본 연구는 2009년 1월부터 2017년 1월까지 서울대학교 어린이병원에서 편측 완전 구순열에 대한 수술적 치료를 시행한 모든 환자를 대상으로 후향적 코호트 연구를 시행하였다. 환자들은 수술방법에 따라 회전신전법과 직선봉합법 두 군으로 나누었다. 결과에 대한 평가는 직관적 평가를 반영하는 5점 척도, 맨체스터 흉터 척도, 간접 인체측정법을 사용하였다.

연구 결과

총 39명의 환자에 대해 분석을 시행하였고, 이 중 19명은 회전신전법 (남 12명, 여 7명), 20명은 직선봉합법 (남 12명, 여 8명) 군에 속했다. 직관적 평가의 5점 척도($p=0.336$)과 맨체스터 흉터 척도 ($p=0.667$)는 두 군

간 유의한 차이를 보이지 않았다. 간접 인체측정법을 통해 계산된 대칭 비율 (구순측 / 정상측) 에서는 수직 입술 높이 (sbal-cph)와 수평 입술 길이 (cph-ch), 그리고 큐피드 활 너비 (cph-ls)는 두 군간 유의한 차이를 보이지 않았다 (각각 $p=0.411$, $p=0.496$, $p=0.879$). 수술전 입술 높이 차이를 고려해보았을 때, 이는 수직 입술 높이 (sbal-cph) 와의 유의한 상관관계는 없었다.

결론

편측 완전 구순열 환자에서 직선봉합법을 사용하여 짧은 입술 기형을 초래하지 않고 성공적인 결과를 얻을 수 있었다. 또한 편측 완전 구순열의 수술에서 피부 절개선보다는 근육의 재배치가 가장 핵심적이라는 결론을 내릴 수 있겠다.

주요어 : 직선봉합법, 편측 구순열, 구순성형술

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