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**The Reconstruction of the Central
Tubercle in Bilateral Cleft Lips : Bilateral
Lateral Mucosal Advancement flap with
Reinforcement of the Orbicularis Oris
Muscle**

양측성 구순열환아에서
양측가쪽점막피판술과 입둘레근의 강화를
활용한 윗입술중앙의 재건

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ABSTRACT

Introduction: There are various methods to correct the whistle deformity in bilateral cleft lip. In case of the central deficiency with concomitant lateral excess, local tissue rearrangement can be used to reposition the lateral tissue. We designed bilateral lateral advancement flap with reinforcement of the orbicularis oris muscle.

Methods: 13 bilateral cleft lip patients with whistle deformity from July 2009 to February 2017 underwent our method of tubercle formation. Vertical measurements of upper lip were recorded. Augmentation percentage was documented using follow-up measurements compared with preoperative measurements. The average follow-up period was 16.2 months (range, 9-26 months)

The axis of the flap and central incision were placed on the red line(wet-dry vermilion border). Dissection was performed through the submucosal plane. After entire dissection, inter-orbicularis oris muscle suture on both medial edge of the flap was performed. In case it was necessary, back-cut incisions on both curvature of the central orbicularis oris could facilitate central augmentation. Elevated superior and inferior trap-door flaps were trimmed to make natural central lip line along with the lateral mucosal flaps. Both lateral parts of vermilions were closed in V-Y advancement fashion

Results: The vertical height of central tubercle(T) had a mean increase of 136.9 percent, which was significantly different from preoperative measurement.($p < 0.05$) There were no surgical complications.

Conclusions: Our surgical method is safe, useful and effective to correct the whistle deformity of the central deficiency with concomitant lateral excess.

Announcement

Some of the contents has been submitted as article in the journal.

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INTRODUCTION

The whistle deformity, deficiency in the central part of the border in repaired cleft lip, is common in bilateral cleft patients. It can occur secondary to failure to fill the central tubercle with lateral vermilion flaps during primary lip repair, severe scar contracture across the vermilion and diastasis of the orbicularis oris muscle at the base of the nose, or a combination of these.¹ These patients showed typical findings of whistle deformity, including notching of the upper lip, volume deficiency of central tubercle and bulging on the lateral segment.² (Fig.1)

Figure 1. The whistle deformity



Local axial-based flaps using the excess tissue in the lateral lip can correct all the stated problems. Several techniques had been developed including Kapetansky technique³, Kapetansky-Juri⁴ technique, Lateral vermilion border transposition flap⁵ and Whistle flap⁶.

In 1971, Kapetansky reported an axial-based double pendulum flaps that permit direct transfer of lateral lip segments medially for augmentation of the central defect.³ Juri reported modification of the Kapetansky technique because it did not shape the central part of the lip sufficiently. He used thicker lateral flaps and undermining them more, so that they can be turned in the shape of an L at the central lip.⁴ Matsuo described an anteromedially based flaps that were transposed into a straight or lambdoidal incision in the midposterior prolabium. But there is a disadvantage that the continuity of the

orbicularis oris muscle around the vermillion border is destroyed.⁵ Grewal reported wide-hinged island swing transposition labial enhancement flap that called Whistle flap. However, it required surgical skills training to achieve natural central lip element.⁶

We tried to develop a simple, anatomical and functional technique for whistle deformity. We present a Bilateral Lateral Mucosal Advancement flap with Reinforcement of the Orbicularis Oris Muscle for correction of whistle deformity in bilateral cleft lip patients. It could reduce scar formation to avoid unnecessary dissection around the flaps. Natural continuity of orbicularis oris muscle and wet-dry vermillion junction were maintained by axial based flap design.

PATIENTS AND METHODS

13 bilateral cleft lip patients with whistle deformity from July 2009 to February 2017 underwent our method of tubercle formation. The same senior surgeon performed the surgeries for all patients at Seoul National University Hospital. 12 patients were male, and 2 patients were female. The average age at the time of surgery was 21.0 years (range, 18-36 years). Standard facial photographs were obtained just before and after the surgery. The average follow-up period was 16.2 months (range, 9-26 months).

Vertical upper lip measurements were recorded by three independent examiners of images in the preoperative and follow-up periods. Vertical upper lip measurements consisted of the vertical distance of the white roll to the vermilion bottom at the central tubercle(T), Cupid's bow points(CB), and midlateral lip(MLL) (five vertical measurements per lip)⁷ (Fig.2) Augmentation percentage was documented using follow-up measurements compared with preoperative measurements.⁶

Figure 2. Vertical upper lip measurements. Distances recorded were from the white roll to the vermilion bottom. T, tubercle; CB, Cupid's bow points; MLL, midlateral lip.

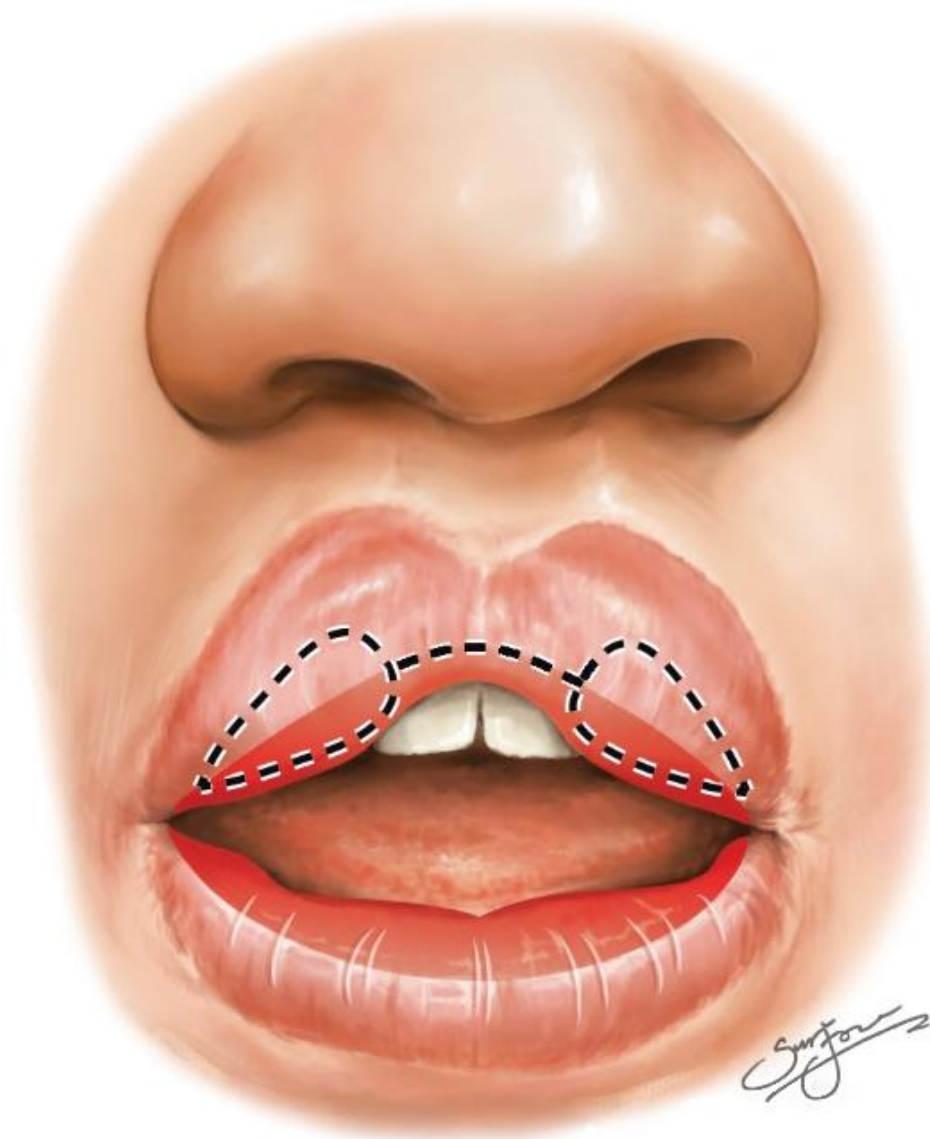


Surgical techniques

Under general anesthesia, we designed bilateral lateral mucosal advancement flaps on the upper lip. The axis of the flap was placed on the red line (wet-dry vermilion border) ⁸. The medial border of lateral flaps was determined at the beginning point of whistle deformity due to the deficiency of the orbicularis oris muscle on central tubercle. A vertical length of each flaps was as long as about a half of the vermilion. When there were obvious differences between both vermilion heights, we corrected the asymmetry by adjusting the height of lateral mucosal flap.

A line was drawn parallel to the red line between both lateral mucosal flaps. (Fig.3)

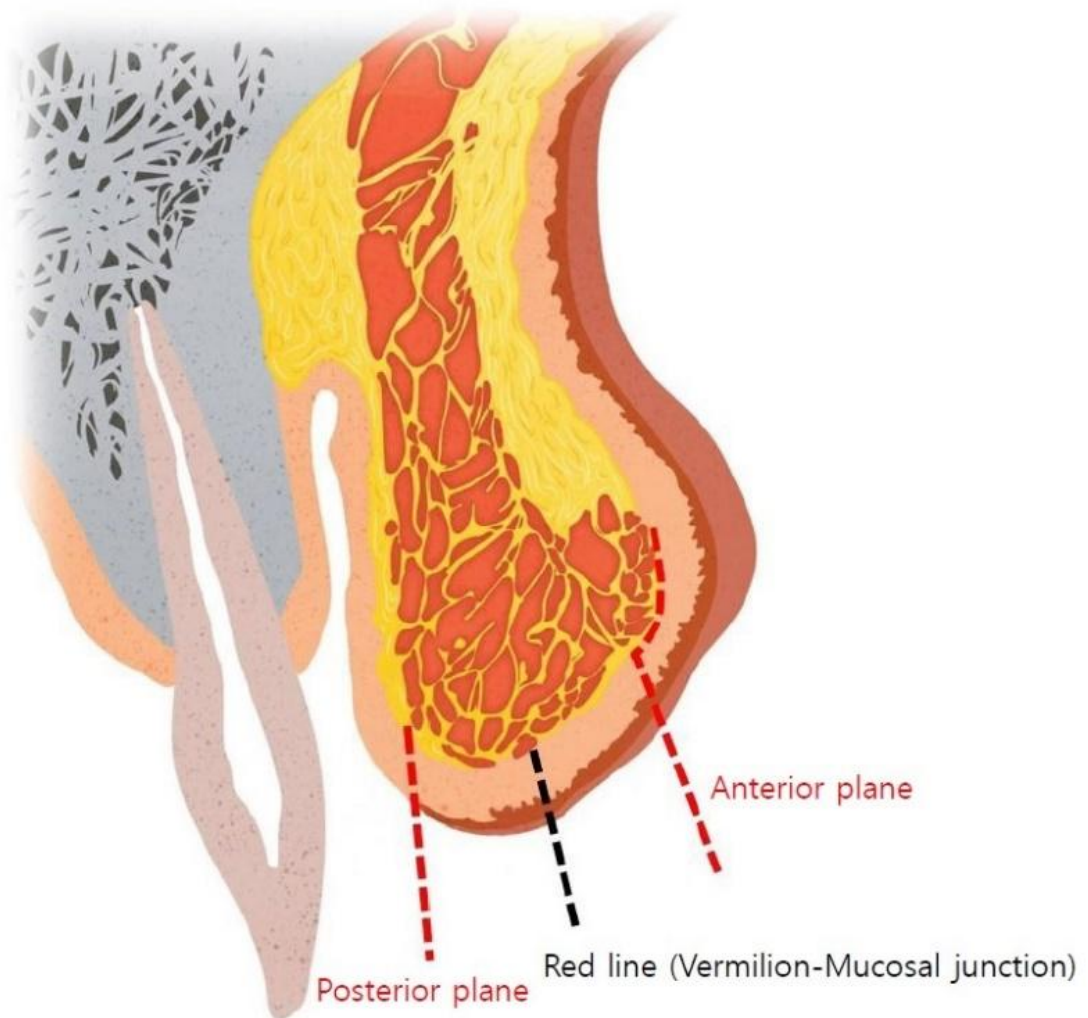
Figure 3. Schematic flap design.



After an incision along with the design, dissection was performed through the submucosal plane superficial to the orbicularis oris muscle. When extending the dissection superiorly, the white roll should be preserved. The labial vessels could be

exposed during posterior plane dissection. But it is not necessary to perverse the vessels because our minimal dissection plane makes better blood supply of the flap. (Fig.4)

Figure 4. Drawing of sagittal section of upper lip



After submucosal dissection on central tubercle area, deficient orbicularis oris muscle was exposed. (Fig.5)

Figure 5. Intraoperative view (after dissection)



Trap-door flaps are elevated superiorly and inferiorly. After entire dissection, inter-orbicularis oris muscle suture on both medial edge of the flap was performed with Monosyn 4-0 to augment the deficient muscle and move the flap medially. (Fig.6,7) In case it was necessary, back-cutting incision on both curvature of the central orbicularis oris could facilitate central augmentation⁹. Unnatural lateral lip shape after medial advancement of both lateral mucosal flaps could be resolved by additional lateral subdermal and submucosal dissection.

Figure 6. After submucosal dissection. Blue dots indicate the point of inter-oribularis oris muscle suture for muscle reinforcement on both medial edge of the lateral flaps.

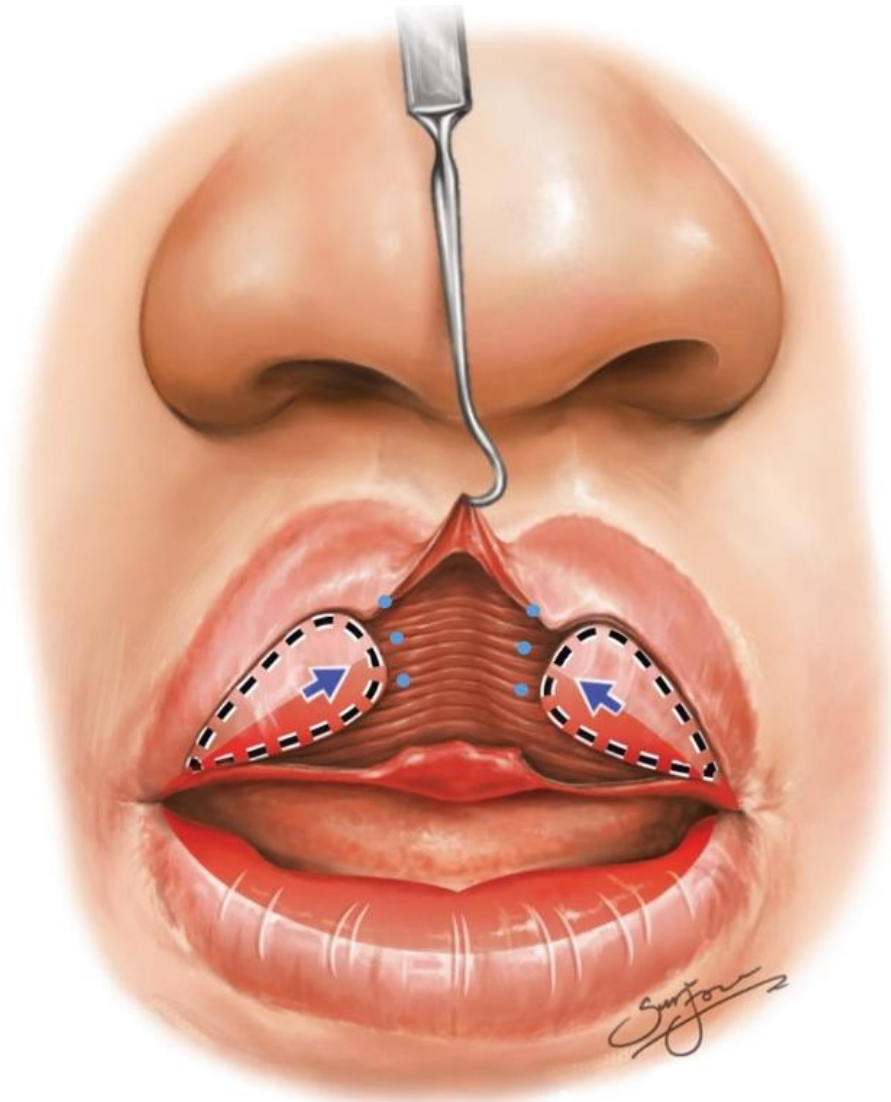
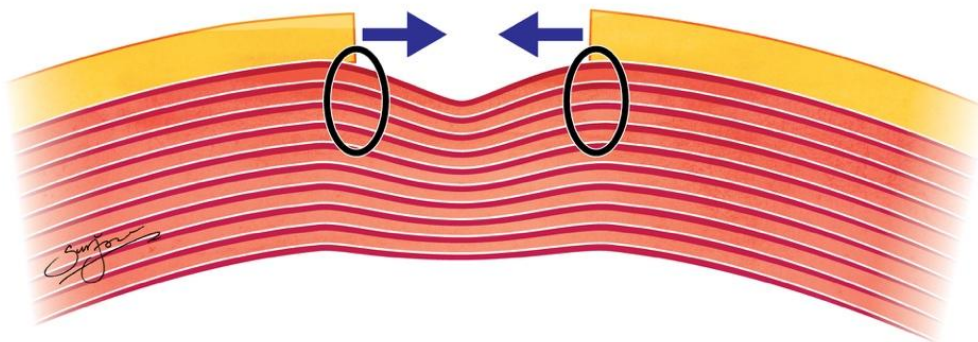


Figure 7. Inter-oribularis oris muscle suture (cross-sectional view)



Elevated superior and inferior trap-door flaps were trimmed to make natural central lip line along with the lateral mucosal flaps. (Fig.8) Lateral part of vermilions were closed in V-Y advancement fashion. Other vermilions were closed evenly with PDS 6-0 as illustrated. Red line of medial border of both lateral mucosal flaps should be matched for natural feature. (Fig.9)

Figure 8. Medial advancement of Both lateral mucosal flaps. The Yellow parts indicate the trimming area of superior and inferior trap-door flaps.

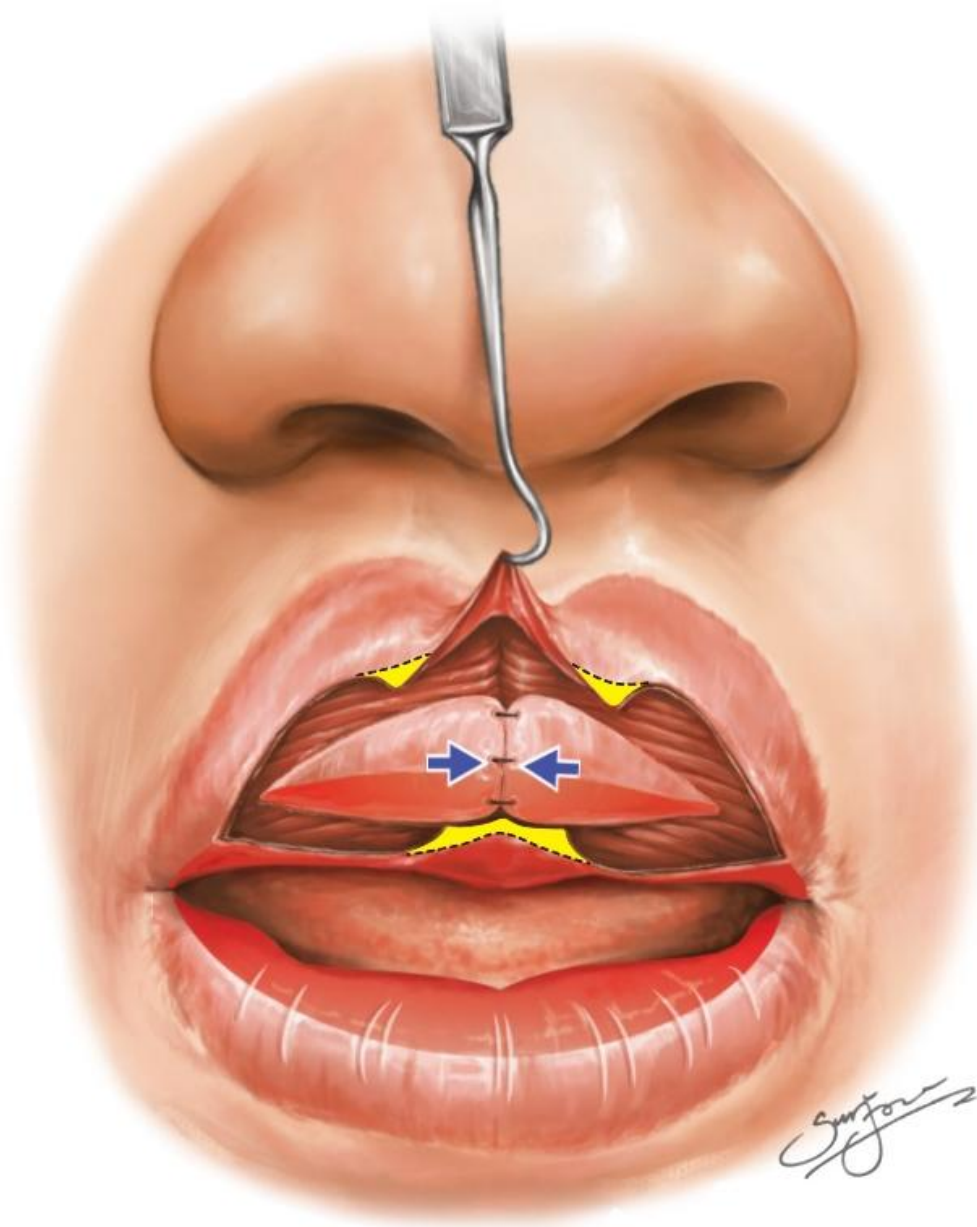


Figure 9. Postoperative view.



Statistical Analysis

Data were expressed as means \pm standard deviation(SD). A paired t-test was used to determine the significance between preoperative and follow-up measurements. A value of $p < 0.05$ was considered statistically significant. Statistical analyses were performed using SPSS 23.0 (SPSS Inc., Chicago, IL, USA).

RESULTS

Postoperative measurement values compared with preoperative measurement values showed mean 136.9 ± 12.7 percent increase in vertical height of central tubercle. ($p < 0.05$) Postoperative measurement values compared with preoperative measurement values showed mean 112.8 ± 9.9 percent increase in vertical height of both Cupid's bow points. ($p < 0.05$) Postoperative measurement values compared with preoperative measurement values showed mean 104.4 ± 8.0 percent increase in vertical height of both midlateral lip. ($p > 0.05$) (Table.1)

There were no surgical complications – partial or total necrosis of the flaps, wound dehiscence, infection, hypertrophic scar and functional lip problems. (Fig.10,11)

Table 1. Upper Lip Augmentation Measurement Outcomes. (n=13)

Vertical Measurements	Augmentation* (%)
T	136.9 ± 12.7
CB, left	111.8 ± 10.4
CB, right	113.8 ± 10.0
MLL, left	104.6 ± 9.8
MLL, right	104.3 ± 6.6
Lateral projection	115.0 ± 9.3

T, central tubercle; CB, Cupid's bow; MLL, midlateral lip

* Follow-up mean measurement . preoperative measurement x 100

Figure 10. An 18-year-old men with bilateral cleft lip and palate with central whistle deformity. Preoperative view(top) and 1-year postoperative view(bottom).



Figure 11. A 23-year-old men with bilateral cleft lip and palate with central whistle deformity. Preoperative view(top) and 1-year postoperative view(bottom).





DISCUSSION

There are various methods to correct the whistle deformity in bilateral cleft lip, which can be mainly divided into three categories, such as fillers or autologous graft, distant flap and local advancement flaps. If there is no disparity in vermilion between the lip segments and adequate amounts of vermilion are present, this region can be augmented using fillers (hyaluronic acid, collagen) or autologous graft (free fat graft, dermal fat graft, palmaris longus graft and temporoparietal fascial graft).

When the central tubercle vermilion is severely deficient and there is no available local tissue, it is effective to make an attempt on distant flaps involved Abbe flap^{10 11 12} and tongue flap¹³. Lastly, the tongue flap can provide 'nonlike' tissue to replace vermilion, and therefore is a last option.¹⁴

In case of the central deficiency with concomitant lateral excess, local tissue rearrangement can be used to reposition the lateral tissue. Several methods have been introduced, such as double V-Y advancements¹⁵, Kapetansky techniques^{3 9}, Kapetansky-Juri technique⁴, deepithelialized mucosal-submucosal flap¹⁶, propeller flap¹⁷, Bilateral lateral transposition flaps^{5 18} and whistle flap⁶.

The normal lip has two aesthetic important junctional line, white roll and red line. The junction line between skin and vermilion (cutaneo-vermilion junction line) was best described as 'White skin roll' by Millard.¹⁹ 'Red line' is the junctional line between vermilion and mucosa (vermilion-mucosal junction)⁸. During surgical procedure, we

should make an effort to maintain them.

Vertical transposition across the red line may occur a mismatch of wet and dry vermilion. Local axial-based flaps using the excess tissue in the lateral lip can achieve central fullness with balanced red line and anatomical continuity of orbicularis muscle.

We designed bilateral lateral advancement flap with reinforcement of the orbicularis oris muscle ; The axis of lateral mucosal flaps is on the red line. The central incision line between the flaps is also drawn on the red line. Previously existing mismatched red line can be corrected by our technique. After medial advancement of lateral mucosal flaps, adjusting the position of medial edge and trimming trap-door flaps can make the natural red line.

It is obvious that wide dissection during lip surgery may bring about scar contracture which makes unnatural results. Moreover, wide undermining over white skin roll can distort the line. In order to prevent it, we can restrict the range of anterior dissection plane until the white skin roll. Minimal dissection can achieve abundant blood supply to the lateral mucosal flaps. It might obstruct the flap from atrophy over time.

Most bilateral cleft patients with whistle deformity are lack of orbicularis oris muscle in the central portion of the repaired upper lip. Inter-orbicularis oris muscle suture on both medial edge of the lateral mucosal flap can augment the central deficient muscle and facilitate the medial advancement of the lateral flap successfully. This muscle suture can restore the muscle continuity and reduce the tension between the flaps.

After medial advancement of lateral mucosal flaps, we can add the dry vermilion by superior trap-door flap and the wet vermilion by inferior trap-door flap. By trimming the trap-door flaps, it is feasible to acquire a natural central lip appearance.

This efficient surgical method would contribute to the increase vertical length of central upper lip. In our 13 patients, postoperative vertical length of central tubercle(T) was increased by 136.9 ± 12.7 percent, which was significantly different from preoperative measurement.($p < 0.05$) There was no surgical complication, necrosis or shrink of the flaps, wound dehiscence, hypertrophic scar and functional lip problems. Therefore, this method is safe, useful and effective to correct the whistle deformity of the central deficiency.

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국문초록

서론: 양측성 구순구개열 환자에서 휘파람 변형(whistle deformity)에 대한 교정은 다양한 방법이 존재한다. 윗입술중양(tubercle)의 부족과 함께 가쪽과잉(lateral excess)이 존재할 경우 국소 피관술을 이용하여 재건할 수 있다. 본 연구에서는 양측 가쪽 전진피관술(bilateral lateral advancement flap)과 함께 입둘레근(orbicularis oris muscle)을 강화시키는 방법을 활용하였다.

방법: 2009년 7월부터 2017년 2월까지 휘파람변형(whistle deformity)의 재건술을 받은 13명의 양측성 구순구개열 환자를 대상으로 하였다. 윗입술의 수직 측정값들을 기록하였고, 수술 전후의 값을 비교하여 증가율을 계산하였다. 평균 추적조사기간은 16.2개월이었다. (9-26개월)

피관의 축(axis)과 절개선의 중심은 입술막피부경계(wet-dry vermilion border, red line)에 위치시켰다. 박리는 점막하면(submucosal plane)을 따라 이루어졌다. 이후 디자인된 피관의 안쪽 경계에 위치한 입둘레근끼리의 봉합을 시행하였다. 필요하지 중심부를 더욱 증가시키기 위해 입둘레근의 경계를 따라 back-cut 절개를 시행하였다. 거상된 위쪽과 아랫쪽의 trap-door 피관을 다듬어, 자연스러운 입술 라인을 형성하도록 하였다. 가쪽 입술은 V-Y 전진방식으로 봉합하였다.

결과: 수술 후 윗입술 중앙부의 수직 길이는 수술전과 비교하여 136.9%였고, 이것은 통계적으로 의미 있는 변화 수치였다.($p < 0.05$) 수술 후 문제를 일으킬 만한 합병증은 보고되지 않았다.

결론: 우리의 수술적 방법은 윗입술중양의 휘파람변형과 함께 가쪽과잉이 존재할 때 안전하고 유용하며 효과적으로 사용할 수 있다.

알림

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주요어 : 양측성 구순구개열, 윗입술중앙재건, 전진피관술

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