Growth of the Unilateral Cleft Lip

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Growth discrepancies have frequently been noted following *surgery* for the repair of *clefts* of the *lip*. A long lip is often noted months or years after LeMesurier, Tennison, or Asensio repair, whereas a short lip is noted after the Millard repair.

We evaluated the problem by measuring 112 unrepaired unilateral complete cleft lips in a homogeneous population. Patients of all ages from newborn through adults were included.

The study showed that a cleft lip has ten to twenty per cent greater growth in the transverse direction parallel with the orbicularis muscle than in the vertical direction perpendicular to the muscle. Thus, procedures such as those of LeMesurier and Asensio that transpose tissue from transverse to vertical will lead to excessive vertical growth.

Lip growth is slightly decreased along the cleft margins but does not account for the short lip seen after the original Millard repair. Lip shortness occurs soon after repair because of scar contracture but tends to resolve with the passage of time.

An occasional problem with cleft lip repairs is a discrepancy in vertical height of the lip as measured from nose to vermilion. The LeMesurier (1949), Asensio (1974) (Figure 1), and occasionally the Tennison (1952) techniques result in too long a lip on the repaired side (Brauer, 1959; Laub, 1974; Pool, 1959; Randall, et al., 1974; Tennison, 1952). Conversely, the Millard repair (Figure 2) may result in too short a lip (Millard, 1968; Pool, 1959). We present a study of growth of unrepaired cleft lips as one possible explanation for the problem.

We postulated that growth was greater in the transverse than in the vertical direction (Figure 3). The transverse direction is defined as being parallel with the vermilion-cutaneous white line and the orbicularis muscle and vertical as being at an angle to these landmarks. The muscle adjacent to the cleft is abnormally oriented. It is parallel to the cleft margin. We found that transverse tissue did grow more than vertical tissue. Thus, transposition from transverse to vertical could cause progressive lengthening of the repaired cleft lip (e.g. the LeMesurier and Asensio techniques).

We also postulated that growth was less in the region adjacent to the cleft than in the region lateral to the cleft because of mesodermal deficiency. This did not prove to be true. Therefore, growth retardation does not explain the short-lip occasionally seen with the Millard repair or the straight line (Rose-Thompson) repair.

There are many factors other than differential lip growth which may contribute to the occasional shortness of vertical dimension in the Millard repair as originally described and the excessive length in the Asensio repair (or the LeMesurier repair). These are: 1) distortion by abnormally positioned labial muscles; 2) surgical error in planning; 3) technical errors; 4) slough of the advancement flap tip; and 5) scar contracture. However, we did not study the influence of these factors.

Method

PATIENT POPULATION. To test these hypotheses, we evaluated lip growth potential by measuring 112 unrepaired unilateral complete cleft lips (clefts of the primary palate). Measurements were taken directly from the patient on the operating table prior to surgical repair (Figure 4). There were ten newborns, nine adults (over age fifteen), at least six patients for each year between one and ten, and at least four patients for each year between ten and fifteen. There were seventy-three males and thirty-nine females, all of Honduran ethnic background (a relatively

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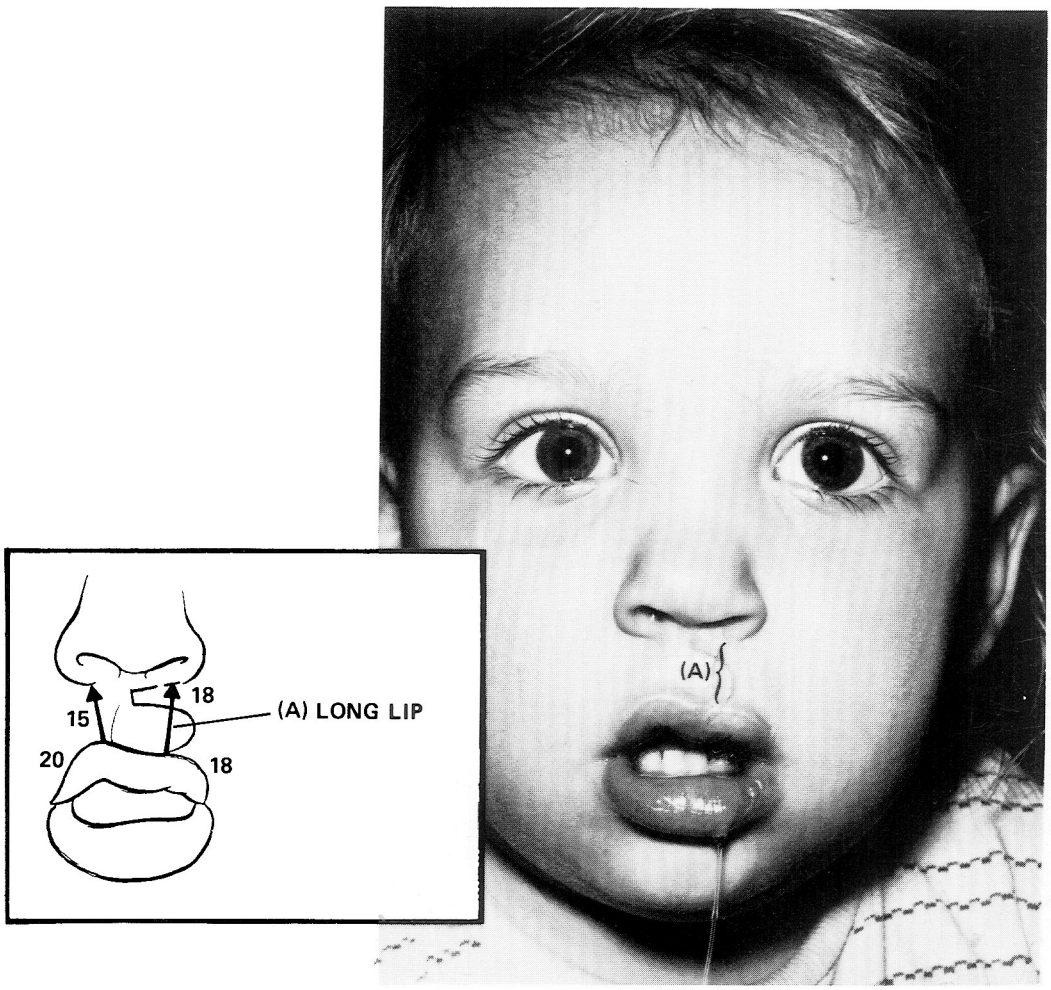

FIGURE 1. The Asensio and the LeMesurier repairs can result in a long lip on the repaired side. The lip appears symmetrical immediately following surgery, but months or years later the lip has lengthened in a vertical direction. This we believe is a result of transverse to vertical, thus increasing the growth potential.

homogeneous population of Indian and Spanish descent). No apparent differences between males and females were noted. Therefore, they were combined. The lip dimensions for each age group were averaged, and this average measurement was used as the basis for comparison.

Thus, a lip growth potential is projected by "cross-sectional study" of a homogeneous ethnic group at different ages. Ideally, a longitudinal study should be done, but the obvious social limitation of not repairing the lip prevents this from being carried out. The study of unrepaired lips eliminates the variable of other surgical factors such as scar and muscle reposition.

DEFINITION OF MEASUREMENTS (FIGURES 3 AND 4)

Transverse

Measurements parallel with the vermilion-cutaneous junction. (Coincidentally, the underlying muscles are parallel with the transverse direction.)

C = c to p (the white line from oral commissure (c) to philtral ridge (p) on the non-claft side.)

C′ = c′ to w (the white line from oral commissure (c′) to "attenuation" of the white line (w).)

L = p′ to s (cleft margin from philtral peak (p′) to nasal septum (s).)

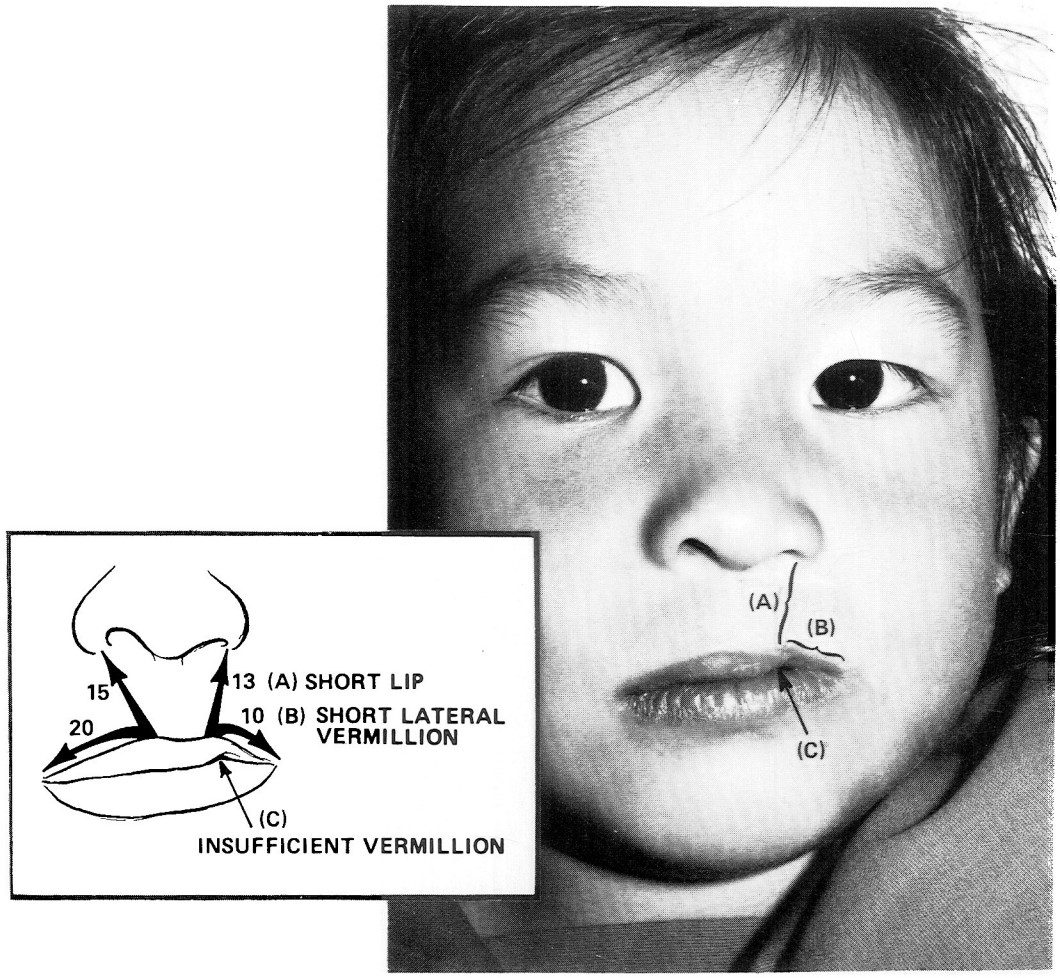

FIGURE 2. The original Millard repair often resulted in a short lip. This problem was thought to result from decreased growth potential. However, our study would indicate that a short lip is the result of early scar contracture which tends to resolve in several years and of errors in the technical application of the original description by Millard. New variations of the rotation-advancement technique minimize the problem.

L′ = v′ to w (cleft margin from "attenuation" of white line nasal vestibule (v′).)

Vertical

Measurements that extend from the vermilion cutaneous junction toward the nasal ala or columella.

P′ = p′ to b′ (philtrum peak on the cleft side (p′) to the base of the columella (b′).)

P = p to b (philtrum peak on the non-cleft side (p) to the base of the columella (b).)

A = p to a (philtrum peak on the non-cleft side (p) to the base of the ala (a).)

A′ = w to a (attenuation of white on the cleft side (w) to the base of the ala (a′).)

Results and Conclusions

The measurements for representative age groups are given in Table 1. For example, the average alar height on the non-cleft side (A) was 10 mm with a variation from 7 to 13 mm. Whereas the alar height on the cleft side (A′) was 8 mm with variations from 6 to 10 mm. The average measurements for other ages (6 mo., 1 year, 3 years, 6 years, and adults) are also indicated.

The adult alar height averaged 18 mm on the non-cleft side and 12 mm on the cleft side. Thus, the difference between average newborn alar heights and average adult heights represents an average growth potential.

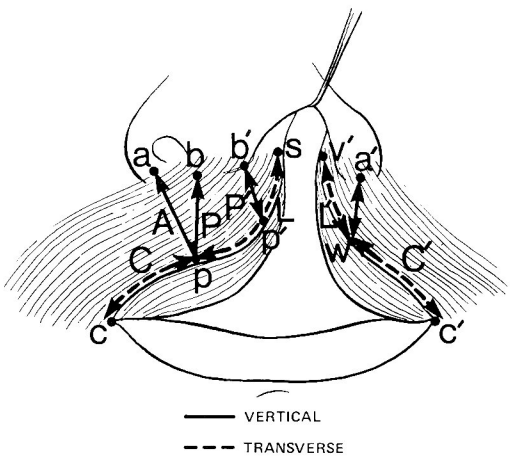

FIGURE 3. The transverse tissue (C,C′, L and L′) with greater growth potential is parallel with the underlying muscle and the vermilion-cutaneous white line. The vertical tissue (P′P, A′A) with less growth potential is at an angle to the muscle and white line.

Measurements for philtral height, lateral lip width, and cleft margin are also listed in Table 1. Based on these measurements, comparisons were made between the alar and philtral growth potential (vertical dimensions) and cleft margin and lateral lip growth potential (transverse dimensions).

1. Transverse measures

Lateral lip

a. In the newborn and at all ages there is an *absolute tissue deficiency* in the transverse direction on the cleft side, as compared to the normal non-cleft side. The lateral vermilion length on the cleft side (C′ = 14) is 82% of that on the non-cleft side (C = 18).
b. However, the rate of growth of the cleft side is the same or greater than the non-cleft side. The cleft sides double in length from birth to adulthood (14 mm length grows to 28 mm which is a 100% increase) whereas the non-cleft side 18 mm grows to 33 mm which is an 82% growth.

Cleft margins

a. The dimensions along the cleft margins (L) and (L′) are equal (6 mm).

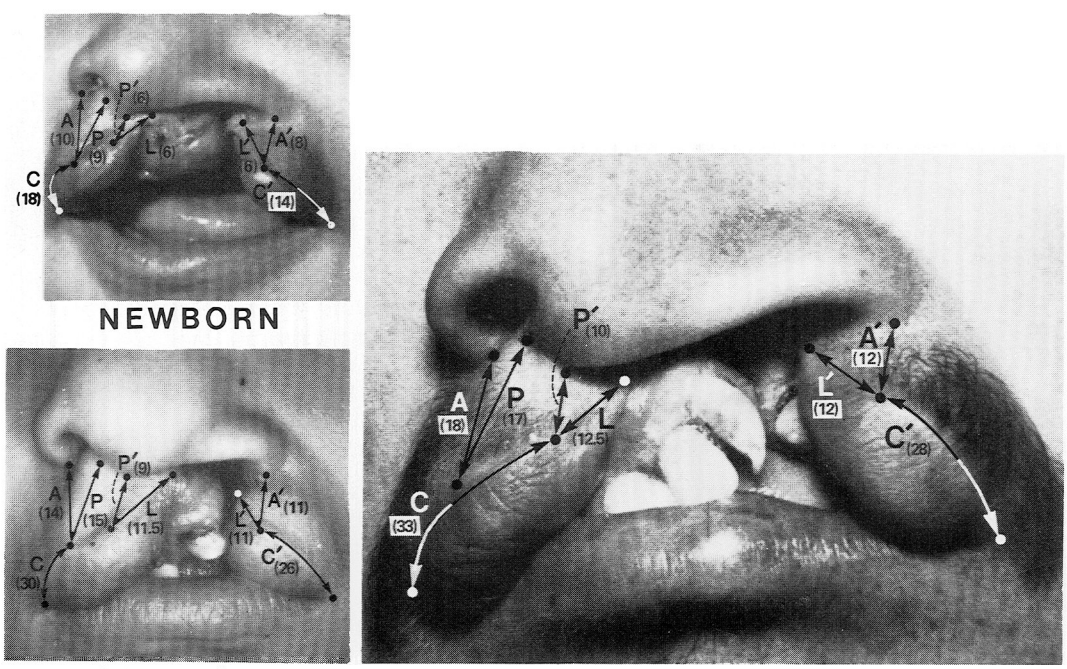

FIGURE 4. These are examples of the measurements used to evaluate lip dimensions. The actual measures were taken prior to surgery with the patient anesthetized. There is some distortion by photography, but the tendency for slower growth in a vertical direction in the unrepaired lip can be appreciated.

TABLE 1. Comparison of dimensions at different ages of unrepaired unilateral complete clefts

	newborn	*6 MO.*	*1 YR.*	*3 YR.*	*6 YR.*	*adult*
Vertical Measure						
Non-cleft ALA (A)	10 ± 3 mm	11 ± 3	12 ± 2	13 ± 5	14 ± 3	18 ± 5
Cleft ALA (A′)	8 ± 2 mm	9 ± 3	10 ± 2	10.5 ± 3	11 ± 2	12 ± 3
Non-Cleft Philtrum (P)	9 ± 2 mm	10 ± 2	12 ± 1	13 ± 3	15 ± 3	17 ± 5
Cleft Philtrum (P′)	6 ± 2 mm	7 ± 1	7.5 ± 1	8 ± 1	9 ± 2	10 ± 3
Transverse Measures						
Cleft Margin (L′)	6 ± 2 mm	7 ± 3	8 ± 4	9 ± 4	11 ± 4	12 ± 4
Cleft Margin of Prolabium (L)	6 ± 1 mm	7 ± 2	8 ± 4	9.5 ± 3	11.5 ± 3	12.5 ± 4
Non-Cleft Lateral Lip (C)	18 ± 4 mm	20 ± 4	21 ± 3	23 ± 3	30 ± 3	33 ± 4
Cleft Lateral Lip (C′)	14 ± 3 mm	16 ± 3	17 ± 2	20 ± 3	26 ± 4	28 ± 4

b. The margins double in length from newborn to adulthood (12 mm).

2. Vertical measures

Philtrum

a. In the newborn there is an absolute deficiency of philtral height at the cleft. The cleft side philtrum (P′ = 6) is 67% of the normal non-cleft philtrum (P = 9).

b. Moreover, the growth of the cleft-side philtral columns is slightly less than the non-cleft side so that in the adult P′ = 10 or a 67 per cent growth rate and P = 17 which is an 89 per cent growth rate.

c. This vertical growth is less than transverse growth.

Alar

a. In the newborn there is an absolute deficiency of lip height at the cleft side ala. The cleft side is 8 mm and the normal non-cleft side is 10 mm.

b. The growth of the cleft side alar height is only to 12 mm and the non-cleft side grows to 18 mm. Thus, there is only 50 per cent growth in the vertical dimension from the alar base to the vermilion on the cleft side compared to the normal side's 80 per cent growth. These measures of vertical height are similar to those described by Clifford and Pool (1959) and Pool (1966) in both cleft lips and normal lips.

Discussion

On the normal side of the lip there is a 100 per cent growth rate or a doubling of lip width, whereas with both vertical heights (alar and philtral) there is 80 per cent and 89% growth which is less than double. We conclude that the normal lip will grow more in a transverse than in the vertical direction.

When the vertical growth is compared to transverse growth on the cleft side, we see that transverse growth is slightly less than normal (82 per cent) whereas the vertical growth is significantly less (67 per cent at the philtrum and 50 per cent at the ala).

Therefore any operative procedure that takes tissue from greater growth potential of transverse planes and transposes tissue to low growth potential planes may result in excessive vertical growth. This may be the reason that the Asensio, LeMesurier, and triangular flap repairs can be longer on the cleft side (Figure 5).

This study does not determine the reason for the differential growth of lip skin. Are the ectoderm of the skin and mesoderm of the muscle genetically abnormal in the region of the cleft? Are the different growth rates of vertical and transverse tissues genetically de termined? Or is the growth retardation related to dynamic forces such as the absence of skin tension and the displaced muscle? It is our belief that abnormal skin tension and abnormal muscle position contribute significantly to alterations of tissue growth. The basis for this is:

1. Bilateral clefts with very small prolabia will "stretch" to nearly double their transverse width within a short period after lip repair. This cannot be explained by growth changes but must be a result of tension. This dynamic force results from a transverse muscle pull (although there is no muscle in the prolabium of the bilateral cleft lip) as well as from intrinsic skin tension across the cleft.
2. Any area of the body that is non-func-

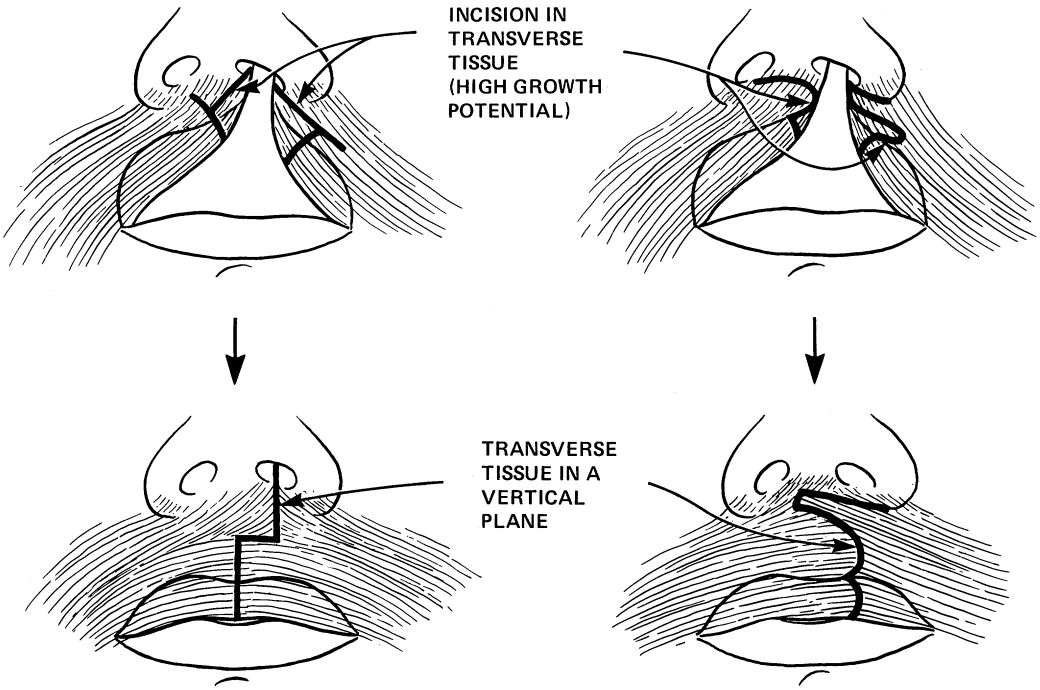

FIGURE 5. The LeMesurier, Asensio (and Tennison) techniques make incisions transversely and transpose the tissue (skin and muscle) vertically. The greater growth potential of transverse tissue can lead to progressive lengthening of the lip.

tional because of flaccid muscle paralysis (e.g. polio) will result in diminished growth of not only the skin but of underlying bone and all other structures as well.

3. Areas of tissue deficiency or excessive scarring will restrict growth.
4. In this study the transverse growth of tissues (L, L′, C, C′) *parallel* with muscle pull—even of those adjacent to the cleft—was nearly normal. Conversely, neighboring tissue that was perpendicualr to muscle had diminished growth.
5. We must make a distinction between the effect of muscle pull on normal skin and the effect on scar. It is generally accepted that scar will hypertrophy and shorten, causing an overall tissue contraction if there is a dynamic distracting force parallel with the scar. This could account for the shortening of the lip in the original Millard or Rose-Thompson repairs in which the muscle was not redirected. Those repairs result in muscle misdirected vertically parallel with the cleft scar. Our recent variations of the Millard repair with muscle reconstruction do not seem to produce a notable scar hypertrophy and short lip. Nonetheless, there is a possibly minor incremental genetic factor of lip growth that is greater transversely than vertically.

We also recognize that a long lip can be the result of surgical planning.

1. Inaccurate measurements can result in excessive lip length, but this would be noted at the time of operation.
2. Some *incomplete* clefts are longer than normal on the cleft side (Pool, 1966; Brauer and Wolf, 1977). (Remember that *complete* clefts are shorter.) In these longer than normal incomplete clefts, if tissue is not resected from the cleft side, a long lip will occur.

Summary

We have studied cleft lip growth potential by evaluation of a homogeneous population of unrepaired cleft lips. The non-cleft side of an unrepaired complete unilateral cleft has slightly more growth parallel to muscle in a transverse direction (100%) than perpendicu-

lar to muscle in a vertical direction (89 per cent philtral and 80% alar). The cleft side has a marked disparity of growth—82 per cent in the transverse direction and 67 per cent philtral and 50 per cent alar growth in the vertical direction. Therefore, transposition of tissue from transverse to vertical may result in excessive growth and a long lip. We theorized that muscle forces and skin tension are the most important factors controlling lip growth, but genetic tendencies have some contributing effect. Moreover, excessive length can occur because of errors in surgical planning and lack of recognition that unrepaired incomplete unilateral clefts are sometimes longer than normal.

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