

Quantitative Analysis of Lip Appearance After V-Y Lip Augmentation

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Objective: To quantitatively analyze the changes in the 3-dimensional appearance of the lips after V-Y lip advancement for lip augmentation.

Design: A retrospective single-blinded study of patients who had a V-Y lip augmentation from January 1999 to December 2001. Standardized anterior and lateral pre-operative and postoperative digital photographs of patients were analyzed using digital imaging software to quantify postoperative changes.

Results: There were statistically significant increases in the vertical height of the upper red lip (75%) and in the

area of the upper red lip (66%). The upper and lower lip projection increased by approximately 40%. The vertical distance from the apex to the trough of Cupid's bow increased by 56.7%.

Conclusions: The V-Y lip advancement for lip augmentation increases the parameters that characterize the fullness of the upper lip and enhances the vermilion "pout" and projection of the upper and lower lip. It also increases the curvature of Cupid's bow.

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THE LIPS ARE AN ESSENTIAL component of facial symmetry and aesthetics. Anthropometric studies have shown that wider and fuller lips in relation to facial width as well as greater vermilion height are a mark of female attractiveness.¹ Vermilion lip hypoplasia disrupts facial harmony and can result in the perception of nasal tip or mandible overprojection. Such vermilion hypoplasia when not present in youth is often present with aging. Gonzalez-Ulloa² has described the changes of the lip with aging, including a less exposed vermilion and a relative loss of vermilion bulk.

*For commentaries
see pages 178 and 179*

The projection and relative size of the upper and lower lips are as significant to lip aesthetics as the proportion of the lip to the rest of the facial structures. Other important dimensions include the relative vertical length of the upper "red" lip to the length of the philtrum, or upper "white" lip. This is clearly demonstrated in the senile lip with relative philtral excess and an atrophic upper red lip. On the

anterior view, the upper red lip height should be less than the lower red lip height, and the upper lip should project approximately 2 mm more than the lower lip on profile.

Review of the literature over the past 20 years reveals a plethora of case reports and presentations of innovations and new techniques³⁻¹⁰ but a dearth of studies analyzing how these new techniques change the critical 3-dimensional characteristics of the lips: (1) upper and lower lip projection; (2) the contribution of the white and red lip to upper lip appearance; (3) upper and lower red lip area on frontal and lateral view; and (4) the curvature of Cupid's bow. In the present study, we quantitatively analyze the 3-dimensional changes in lip appearance after V-Y lip advancement for lip augmentation. This procedure differs essentially from lip augmentation with a biologic "filler" in that it involves local flap rearrangement of the soft tissues of the lips. Better defining how this procedure changes particular aspects of lip appearance will allow the facial plastic surgeon to tailor lip surgery, whether it be the atrophic senile lip or the normal lips of a younger attractive patient requesting aesthetic enhancement.

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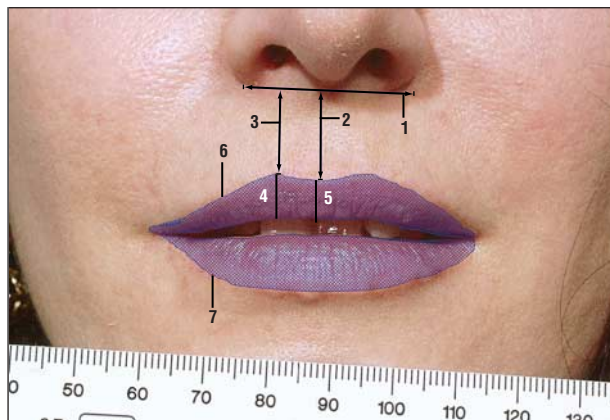


Figure 1. Measurements of lip appearance on frontal view: (1) reference line at nasal base; (2) medial upper "white" lip length; (3) lateral upper white lip length; (4) lateral upper red lip length; (5) medial upper red lip length; (6) upper red lip area; and (7) lower red lip area. Units on the ruler are millimeters.

METHODS

A retrospective single-blinded study of patients who had a V-Y lip augmentation from January 1999 to December 2001 was performed. This study was blinded in that many patients had a V-Y augmentation of one lip and a different procedure, such as a dermal fat graft, on the other lip at the same time. Standardized anterior and lateral preoperative and postoperative digital photographs of patients were analyzed using the Mirror Suite imaging software analysis tools (Canfield Scientific, Fairfield, NJ). The lip measurements taken to analyze postoperative changes were based on the work of Romo et al.¹¹ One additional measurement used in this study was the vertical distance from the apex of Cupid's bow to its trough.

The following measurements were taken on frontal-view digital photographs (**Figure 1**): (1) upper red lip area; (2) lower red lip area; (3) medial upper white lip (philtral) length (ie, the distance from a reference line at the nasolabial junction to the center of the vermilion); (4) lateral upper white lip (philtral) length (ie, the distance from a reference line at the nasolabial junction to the vermilion at the apex of Cupid's bow); (5) medial upper red lip length (ie, the vertical distance from the apex of Cupid's bow to the oral commissure); (6) lateral upper red lip length (ie, the vertical distance from the midline trough of Cupid's bow to the oral commissure); and (7) the vertical distance from the apex to the trough of Cupid's bow.

The following measurements were taken on the lateral digital photographs (**Figure 2**): (1) lateral upper red lip area; (2) lateral lower red lip area; (3) upper lip projection (ie, the distance of a line drawn from the upper lip vermilion to a reference line starting at the nasal tip and ending at the pogonion; the line drawn from the vermilion meets the reference line at an angle of 90°); and (4) lower lip projection (ie, the distance of a line drawn from the lower lip vermilion to a reference line starting at the nasal tip and ending at the menton; the line drawn from the vermilion meets the reference line at an angle of 90°).

All digital photographs were standardized to a millimeter ruler placed next to the lips. All values were analyzed as absolute values and as a positive or negative percentages of preoperative values. Comparison of preoperative and postoperative values and determination of statistical significance were determined using the *t* test and assuming unequal variances.

For this procedure, the V-Y advancement flap is performed as described by Samiiian,¹⁰ with some modifications. Perioperative antibiotics are given. Anesthesia is maintained with intravenous sedation, infraorbital and mental nerve blocks, and

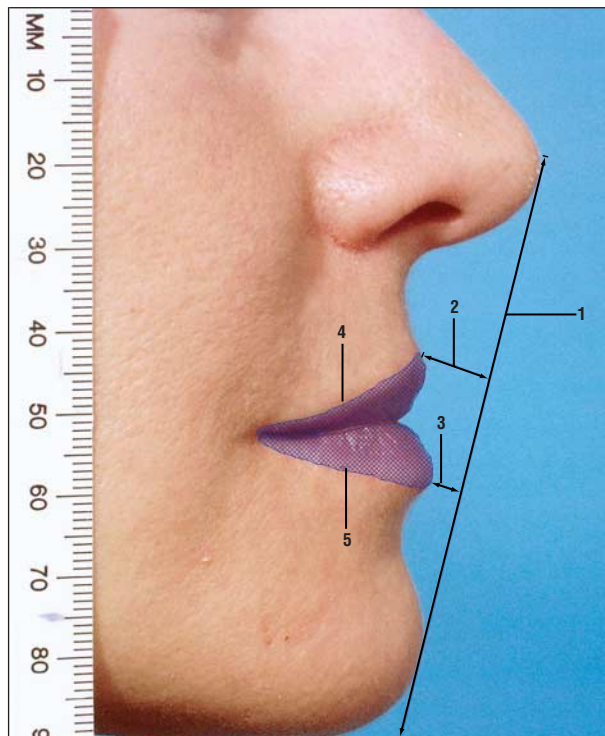


Figure 2. Measurements of lip appearance on lateral view: (1) reference line starting at the nasal tip and ending at the menton; (2) upper lip projection; (3) lower lip projection; and (4) lateral upper "red" lip area; and (5) lateral lower red lip area. Units on the ruler are millimeters.

infiltration along the line of the incision. The marking is performed intraorally to create a "W" for each lip treated, with the base of the W oriented toward the lip sulcus and the tips toward the vermilion mucosal junction. The lateral arms of the W extend to the oral commissure. The incision is made to just below the submucosa. These incisions define 3 "V's," which results in 3 V-to-Y advancement flaps with 2 V's oriented with their bases toward the gingivobuccal sulcus and 1 oriented toward the oral commissure (**Figure 3** and **Figure 4**).

The plane of dissection of the musculomucosal flaps is within the superficial obicularis oris. The flaps are elevated to just underneath the vermilion border so that there is no buckling of the flap at the oral commissure. Care is taken to preserve all cutaneous nerves (**Figure 5**). Closure is performed with a 4-0 Vicryl suture (Ethicon Inc, Somerville, NJ) in an interrupted fashion, starting at the base of each V advancing it to a Y. The sutures are placed 2 mm apart, and 2 or 3 sutures are placed in the advancement closure, depending on how much augmentation is required (**Figure 6**).

RESULTS

From January 1999 to December 2001, 8 patients, 6 women and 2 men, had a V-Y lip augmentation. The mean patient age was 32 years (range, 22-54 years). A total of 11 lips were augmented, 7 upper lips and 4 lower lips. On average, the digital photographs were taken 11 months after the procedure for analysis. The size of this series is comparable to that published by Samiiian,¹⁰ who described this surgical procedure and reported qualitative results on 8 patients.

Patient satisfaction within this series was high: all 8 patients were pleased with the results (**Figure 7** and **Figure 8**). Four of the 8 patients had prior lip augmen-

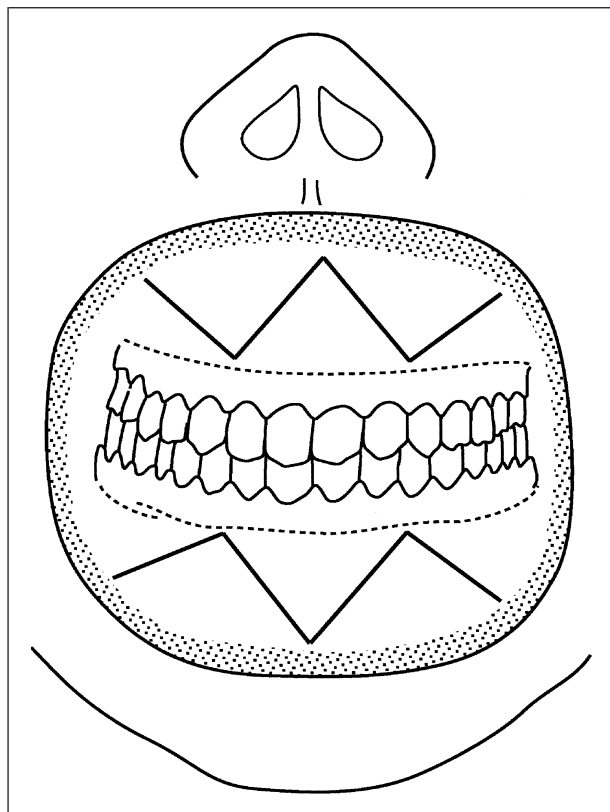


Figure 3. Diagrammatic representation of incision line for V-Y lip augmentation. Note the 3 separate V-to-Y advancements.



Figure 4. Photograph of upper lip V-Y incision marking. The lower lip external marking reflects the internal incision.

tation procedures, acellular dermal graft or dermal fat graft lip augmentation, but wanted larger, "pouty" lips.

All 8 patients consistently experienced a prolonged postoperative course. During the first week, swelling, stiffness, and numbness of the lips were significant, making it difficult to speak and drink. This initial phase was noted to last between 3 and 5 weeks. This was the most difficult phase for the patients. After 6 weeks, patients were encouraged to start stretching the lips, smiling, and rolling and massaging the lips between the thumb and index finger. This relieved tightness and prevented scar contracture at the gingivobuccal sulcus. Initial swell-

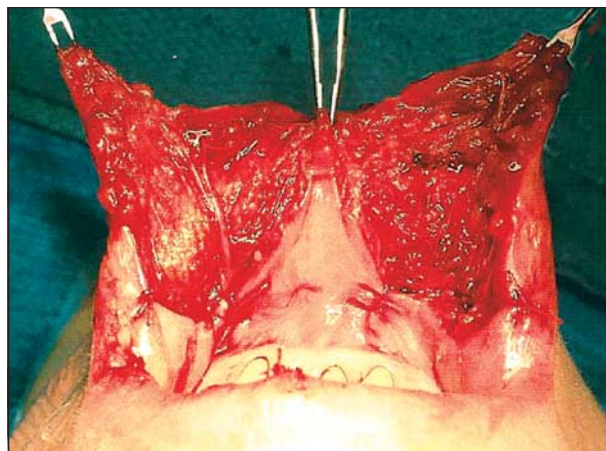


Figure 5. The musculomucosal flaps are elevated to just underneath the vermilion border. Note the preservation of the cutaneous nerve on the right side of the flap.

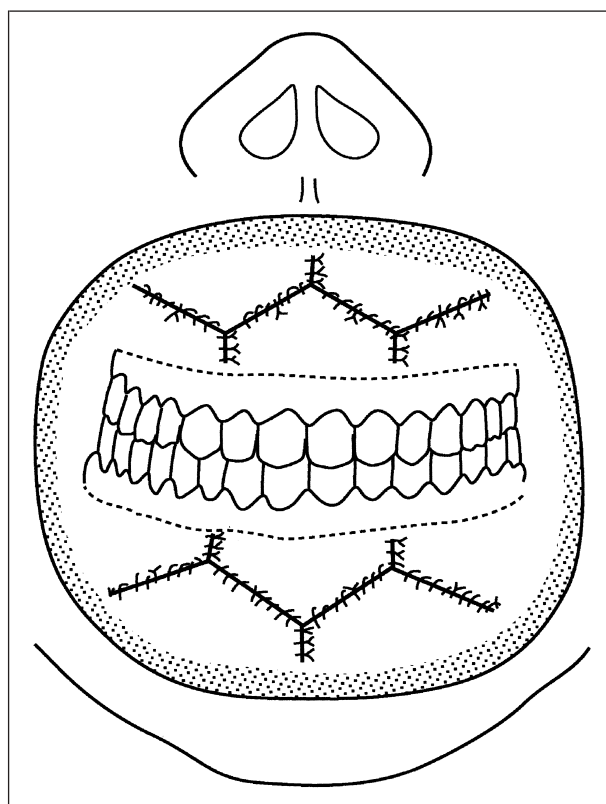


Figure 6. At the base of the V-Y advancement, the sutures are placed 2 mm apart. Two or 3 sutures are placed in the advancement closure, depending on how much augmentation is required.

ing usually took 3 months to resolve but can take up to 6 months. The swelling causes the lips to be fuller than desired, and patients often require reassurance during this period. Lip sensation returns to normal over 6 to 9 months. No painful neuroma, salivary gland cyst, or inclusion cyst was encountered.

The quantitative 3-dimensional changes after V-Y advancement flap lip augmentation including the changes in Cupid's bow are summarized in **Table 1** and **Table 2**. Postoperatively, the vertical lengths of the lateral and midline red lip were significantly increased by 75.0% (0.35



Figure 7. Preoperative (A and C) and 12-month postoperative (B and D) photographs of patient who underwent upper-lip V-Y lip augmentation.

cm; $P = .001$) and 55.0% (0.25 cm; $P = .02$), respectively. The lateral and midline white lip lengths were shortened by 15.1% and 7.8%, respectively, but this change was not statistically significant. The vertical distance from the apex to the trough of Cupid's bow was significantly increased by 56.7% (0.06 cm; $P = .001$). The upper- and lower-lip projections were significantly increased by 39.0% (2.4 mm; $P = .03$) and 48.7% (2.0 mm; $P = .01$), respectively. The frontal upper-lip area and lateral upper-lip area were significantly increased by 66.0% ($P = .04$) and 69.0% ($P = .04$), respectively, but the increases in the frontal lower-lip area of 33.0% and the lateral lower-lip area of 45.0% failed to achieve statistical significance.

COMMENT

Increased public demand for bigger and fuller lips has created the need for appropriate surgical procedures, but the solution is not always easy because all lip augmentation procedures are not created equal. The multitude of surgical methods for lip augmentation can generally be grouped into (1) those that involve the use of local flaps of the oral mucosa and perioral skin and (2) those that use either foreign or autologous material.

Procedures that augment the lips using soft tissue fillers (whether autologous fat/dermal fat grafts, allogenic dermis, or expanded polytetrafluoroethylene) change the fullness of the lips significantly but do not

change the shape of the lips predictably. Changes in lip projection and the curvature of Cupid's bow are often desired by patients, but such changes cannot be reliably delivered with soft tissue augmentation alone. Additionally, soft tissue augmentation with biologic soft tissue fillers does not always persist.

Review of the literature over the past 20 years reveals a plethora of case reports and presentations of innovations and new techniques³⁻¹⁰ but a dearth of studies analyzing how these new techniques change the critical 3-dimensional characteristics of the lips. Any studies that have attempted to describe more specifically these changes have done so in a qualitative fashion based on the surgeon's "eye" rather than by performing a quantitative analysis.

In this study we quantitatively analyzed the changes of the 3-dimensional appearance of the lips after V-Y lip advancement for lip augmentation. These included upper- and lower-lip projection, the contribution of the white and red lip to upper-lip appearance, upper and lower red lip area on frontal and lateral view, and the curvature of Cupid's bow.

On frontal view, there were statistically significant increases in the parameters that characterize the fullness of the upper lip (Figure 1). These included a 71% increase in the vertical height of the red lip over the apex of Cupid's bow, a 55% increase in the vertical height of the red lip over the trough of Cupid's bow, and a 66%



Figure 8. Preoperative (A and C) and 14-month postoperative (B and D) photographs of patient who underwent upper- and lower-lip V-Y lip augmentation.

Table 1. Results of Quantitative 3-Dimensional Analysis of the Upper Lip After V-Y Advancement Augmentation*

Upper Lip	Preoperative Mean	Postoperative Mean	% Change	P Value
Midline white lip	1.66	1.54	-7.8	.23
Lateral white lip	1.60	1.39	-15.1	.11
Midline red lip	0.45	0.70	55	.001
Lateral red lip	0.47	0.82	75	.02
Apex to trough Cupid's bow	0.09	0.15	56.7	.001
Lip projection	0.64	0.39	39.0	.03
AP lip area, cm ²	1.90	3.15	66.0	.04
Lateral lip area, cm ²	0.38	0.70	69.0	.04

*Except as otherwise noted, data are centimeters.

increases in the area of the upper red lip. There were corresponding decreases in the vertical distance of the upper white lip of 15.8% over the apex of Cupid's bow and 7.8% over the trough of Cupid's bow, but these failed to achieve statistical significance. This was likely a result of the small sample size. The conclusion from these results is that there is an overall increase in the relative contribution of the red lip in upper-lip appearance.

In addition, the increases in the red lip over the apex of Cupid's bow are greater than the midline red lip. This is most likely the result of the orientation of the base of

Table 2. Results of Quantitative 3-Dimensional Analysis of the Lower Lip After V-Y Advancement Augmentation

Lower Lip	Preoperative Mean	Postoperative Mean	% Change	P Value
Lip projection, cm	0.41	0.21	48.7	.01
AP lip area, cm ²	2.15	2.86	33.0	.37
Lateral lip area, cm ²	0.40	0.58	45.0	.14

the central V toward the oral commissure and not toward the gingivobuccal sulcus as in the lateral 2 Vs (Figure 3). When the base of the V is oriented toward the oral commissure, it effects less advancement of the red lip outward. This conclusion is supported by the 56.7% increase in the vertical distance from the apex to the trough of Cupid's bow. This differential advancement results in an increase in the curvature of Cupid's bow.

The lower-lip area increased by 34% on frontal view, but this change was not statistically significant, likely because of the small sample size (n=4). The relatively greater mass of the lower lip may also resist the advancement of the muscolumucosal flaps; even if statistical significance is achieved with larger numbers, this may explain why the area of the upper lip was increased to a greater extent than the lower lip.

On lateral view, the upper-lip area increased by 69.0% ($P=.04$), and the lower-lip area by 45% ($P=.14$). As noted, the upper-lip area was increased to a greater extent than that of the lower lip. This finding may necessitate placing an additional 4-0 interrupted suture to advance the lower lip V, using a total of 4 sutures spaced 2 mm apart vs the 3 we used.

The upper- and lower-lip projection increased by 39.0% ($P=.03$) and 48.7% ($P=.01$), respectively (Figure 5). This increased projection enhances the vermilion pout on both the lateral and anterior views.

The present study reports results of patients with an average follow-up of 11 months (range, 7-20 months). Although further follow-up is necessary, the current analysis suggests that this method of lip augmentation has permanence, which is to be expected because it uses vascularized musculomucosal flap advancement to achieve augmentation rather than free autografts or allografts.

The major drawback of this procedure is the length of recovery. For the first 2 to 3 months, patients are often disappointed because of prolonged stiffness that inhibits their ability to smile and makes the lip look unnatural. Edema of the flaps is often slow to resolve, and patients must be reassured over these first few months that this is not the final result. In the final analysis, patient satisfaction was high: all 8 patients were pleased with the results.

In conclusion, we quantitatively analyzed the changes of the 3-dimensional appearance of the lips after V-Y lip advancement for lip augmentation. There were statistically significant increases in the parameters that characterize the fullness of the upper lip, including a 75% increase in the vertical height of the red lip and a 66% increase in the area of the upper red lip. The upper- and

lower-lip projection increased by approximately 40%, enhancing the vermilion pout on both lateral and anterior views. The vertical distance from the apex to the trough of Cupid's bow increased by 56.7%, resulting in an increase in the curvature of Cupid's bow. The mean follow-up was 11 months, and our results suggest that this is a permanent solution to lip augmentation. A relatively long postoperative course requires patient education and careful selection on the part of the physician.

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Quotable

If we want to solve a problem that we have never solved before, we must leave the door to the unknown ajar.

Richard P. Feynman (1918-1988)
US Physicist