Lip Augmentation Using Sternocleidomastoid Muscle and Fascia Grafts

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Objective: To report a new technique for long-term cosmetic lip augmentation and demonstrate that sternocleidomastoid (SCM) muscle and fascia grafts have long-term persistence.

Methods: Measurements of vermilion show and lip projection were taken from before and after photographs of 25 consecutive patients who underwent SCM muscle and fascia augmentation of the lips with concurrent cervicofacial rhytidectomy and were compared with a control group of 25 cervicofacial rhytidectomy patients who did not undergo lip augmentation. All patients had a minimum follow-up period of 1 year.

Results: At a mean follow-up period of 2 years, mean upper and lower lip vermilion show increased 20% to 24% from baseline ($P < .001$), and mean upper and lower lip projection increased by 0.90 to 0.99 mm from baseline ($P < .001$).

Conclusions: Lip augmentation with SCM muscle and fascia grafts results in long-term enhancement of vermilion show and lip projection. The surgeon must account for some degree of postoperative graft resorption and atrophy when determining the size of the grafts to be transplanted. With careful patient selection and surgical technique, SCM muscle and fascia implantation is a valuable tool when treating the aging lip.


Since ancient times, women have used plant dyes and colored clays to enhance their lips. The lips have been known to attract attention because their shape and thickness express differences in character and mood and because they are a sexual symbol.¹ A comparison of photographs of fashion models with those of nonmodel hospital employees revealed that upper and lower lip height was significantly greater in models than in nonmodels.² Senescence of the lips is associated with a lengthening of the white lip and a flattening of the philtrum,³ accompanied by a decrease in the amount of vermilion show and an inversion of the lips with decreased lip projection.

These progressive age-related changes lead many patients to seek lip augmentation procedures, often as their main concern in the midst of an aging face and neck. As Wall and Adamson⁴ point out, dissatisfaction in patients presenting for lip augmentation arises from the vertical height of either the upper or lower red lip or both, insufficient projection of the upper lip, inadequate definition of the contour of the Cupid’s bow, or insubstantial labial volume (ie, pout). We have certainly found this to be true in our patient population, which has a substantial number of aging white women seeking comprehensive facial rejuvenation with subtle lip enhancement.

The quest for the ideal permanent lip augmentation procedure has been fraught with challenges. Some of these include resorption, asymmetry, foreign body reaction, extrusion, unnatural feel or appearance (either short-term or long-term), and cyst formation. A literature review revealed that a heterogeneous group of autogenous and nonautogenous materials have been used for lip augmentation: autologous dermis grafts,⁵ silicone,⁵ V-Y advancement flaps,⁶,⁷ temporalis fascia grafts with or without muscle,¹,⁸ expanded polytetrafluoroethylene (ePTFE),⁹,¹² autologous breast implant capsule,¹³ autologous fat,¹²,¹⁴ galea and subgaleal grafts,¹⁵ fascia lata,¹⁰ acellular dermis (AlloDerm; LifeCell Corp, Branchburg, New Jersey),¹⁴,¹⁷,¹⁸ superficial musculoaponeurotic system (SMAS) grafts,⁶,¹⁹ and deepithelialized eyelid skin with orbicularis muscle.¹² Other procedures such as vermilion advancement and nasal base resection have also been described. Until a technique or device is developed that can overcome the shortcomings of these procedures, plastic surgeons...
must decide which achieves optimal results in their hands, based on their skill and experience.

In 1996, the senior author (R.W.M.) began using autologous sternocleidomastoid (SCM) muscle with overlying fascia harvested during a concurrent rhytidectomy for permanent lip augmentation. Long-term augmentation was noted by both the surgeon and his patients. However, the technique was never described in the literature. In a commentary on an article about lip rejuvenation, Collins briefly mentioned the use of fascia grafts obtained from the neck at the hairline or mastoid region to successfully bulk up an atrophied upper lip. Unfortunately, there is a relative paucity of objective data and analysis in the lip augmentation literature. Our goal is to explain the technique, demonstrate objectively that this procedure has longevity in enhancing the degree of vermilion show and lip projection attained, and highlight potential pitfalls. This is another tool in the plastic surgeon’s armamentarium to combat the aging lip, which along with every other technique has some limitations, yet is effective in our practice.

**METHODS**

**DESIGN AND ANALYSIS**

A retrospective review was conducted using preoperative and minimum of 1-year postoperative photographs of 25 consecutive patients who underwent SCM muscle and fascia grafting to the lips with concurrent cervicofacial rhytidectomy. For a control group, 25 consecutive patients with preoperative and minimum of 1-year postoperative photographs who underwent cervicofacial rhytidectomy without any lip procedure were used. Written informed consent for the study and the surgical procedure was obtained from each patient. Exclusion criteria included any injectable and/or surgical fillers in the lips or perioral skin resurfacing less than 6 months prior to the date of preoperative photography, which was done 1 to 14 days prior to surgery.

For each patient, the frontal and right lateral views were analyzed. Canfield’s Mirror Imaging Software version 7.1.1 (Canfield Scientific Inc, Fairfield, New Jersey) was used for analysis. To adjust for inevitable slight differences in distance from the subject to the camera, the images were calibrated through the Mirror Imaging Software using a mean intercanthal distance of 30 mm on front view and a mean auricle height of 60 mm on right lateral view. The software was then used to take the following measurements of each patient’s preoperative and postoperative frontal view: right and left upper lip vermilion show (distance from the apex of Cupid’s bow to stomion) and right and left lower lip vermilion show (distance from the stomion to lower lip vermilion border at the vertical plane of the apex of Cupid’s bow). On the right lateral view, according to a technique described in the literature, a line was drawn between the subnasale and pogonion. The anterior-most projection of the upper and lower lip was measured along a line drawn at a 90° angle to this reference line. Any patient who had concomitant chin augmentation was excluded from the study because of the accompanying change in pogonion position. After the data were collected, a change was calculated for each patient with postoperative minus preoperative measurements. Mean changes were then calculated in each group, and then the mean changes were compared between groups using either the unpaired t tests or Mann-Whitney tests, depending on whether those changes were normally distributed. Each patient’s medical chart was also reviewed to determine if there were any complications related to the lip augmentation procedure.

**SURGICAL TECHNIQUE**

During our cervicofacial rhytidectomy, an SMAS flap is developed after making an incision in the SMAS extending from the malar eminence across the angle of the mandible and continuing inferiorly along the anterior border of the SCM muscle. After a sub-SMAS elevation, the SMAS is suspended and suture overlapped onto the portion of the SMAS superior to the SMAS incision. Thus, no SMAS tissue is excised or available for SMAS augmentation of the lips. Instead, a segment of SCM muscle and fascia is harvested from the mastoid process inferiorly along the posterior border of the SCM muscle. The average length of the segment harvested is 7 cm, but this is determined by asking the patient to smile preoperatively and calculating the horizontal length of graft material required to fill from one corner of the mouth to the other. The diameter of the graft varies based on the patient’s desires and the surgeon’s estimate of the expected degree of graft resorption. After harvesting the SCM fascia with underlying muscle, hemostasis is achieved with bipolar cautery, and the donor defect is closed primarily with a running 2-0 polidoxanone suture. The graft is placed in a saline-soaked gauze pad, and the cervicofacial rhytidectomy is then completed. A single incision is made just inside the mucosa along each corner of the mouth. A tunnel is developed with a blunt dissecting scissors within the superficial orbicularis oris muscle from one corner to the other, using the same incision for the upper and lower lip tunnels. The tunnel is made sufficiently wide to avoid graft compression and to allow fluid side-to-side movement of the graft. A 3-0 nonabsorbable polypropylene (Prolene; Ethicon Inc, Somerville, New Jersey) suture is used on either end of the graft to help tease it back and forth. An alligator forceps is passed through the tunnel, used to grasp one of the 3-0 Prolene sutures, and then the graft is gently pulled through until symmetric positioning is accomplished. The grafts are intentionally left slightly longer than the distance from one corner of mouth incision to the other and tucked lateral to the corner of mouth incisions. The Prolene sutures are removed. The corner of mouth incisions are closed with simple interrupted 4-0 chromic gut sutures, taking care not to incorporate the grafts into the wound closure. Antibiotic ointment is applied and patients are asked to limit their mouth opening for the first 2 weeks postoperatively. After this, all normal oral functions can be resumed with no limitations. Of note, every patient who undergoes this procedure is pretreated with valacyclovir hydrochloride, 500 mg by mouth twice daily, beginning 1 day preoperatively and continuing for 7 days.

**RESULTS**

The mean postoperative follow-up photograph in the SCM graft group was taken at 25 months, with a mean of 21 months in the control group. In patients with a mean intercanthal distance of 30 mm and a mean auricle height of 60 mm who underwent SCM muscle and fascia lip augmentation, the right upper lip vermilion show mean change was -0.86 mm (20% increase from baseline); the left upper lip vermilion show mean change was 0.96 mm (22% decrease from baseline); the right lower lip vermilion show mean change was 1.30 mm (23% increase from baseline); and the left lower lip vermilion show mean change was 1.33 mm (24% increase from baseline)
Table. Measurements of Vermilion Show and Lip Projection in Patients Who Underwent SCM Muscle and Fascia Augmentation of the Lips With Concurrent Cervicofacial Rhytidectomy Compared With a Control Group of Cervicofacial Rhytidectomy Patients Who Did Not Undergo Lip Augmentation

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Muscle Transfer Patients (n=25)</th>
<th>Control Group Patients (n=25)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right upper lip vermilion show, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>4.35 (1.81)</td>
<td>4.87 (1.28)</td>
<td>.001</td>
</tr>
<tr>
<td>Postop</td>
<td>5.22 (1.83)</td>
<td>4.96 (1.25)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.86 (0.87) (20% increase)</td>
<td>0.10 (0.25)</td>
<td></td>
</tr>
<tr>
<td>Left upper lip vermilion show, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>4.42 (1.68)</td>
<td>4.90 (1.34)</td>
<td>.001</td>
</tr>
<tr>
<td>Postop</td>
<td>5.38 (1.73)</td>
<td>4.92 (1.21)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.96 (0.76) (22% increase)</td>
<td>0.03 (0.37)</td>
<td></td>
</tr>
<tr>
<td>Right lower lip vermilion show, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>5.55 (1.75)</td>
<td>5.84 (1.15)</td>
<td>.001</td>
</tr>
<tr>
<td>Postop</td>
<td>6.86 (1.73)</td>
<td>5.75 (1.10)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1.30 (1.00) (23% increase)</td>
<td>-0.08 (0.37)</td>
<td></td>
</tr>
<tr>
<td>Left lower lip vermilion show, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>5.52 (1.65)</td>
<td>5.68 (1.08)</td>
<td>.001</td>
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<tr>
<td>Postop</td>
<td>6.85 (1.79)</td>
<td>5.62 (1.01)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>1.33 (1.03) (24% increase)</td>
<td>-0.06 (0.30)</td>
<td></td>
</tr>
<tr>
<td>Lateral upper lip projection, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preop</td>
<td>1.93 (1.36)</td>
<td>2.22 (1.28)</td>
<td>.001</td>
</tr>
<tr>
<td>Postop</td>
<td>2.92 (1.61)</td>
<td>2.07 (1.23)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.99 (0.60)</td>
<td>-0.16 (0.25)</td>
<td></td>
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<tr>
<td>Lateral lower lip projection, mm</td>
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<td></td>
<td></td>
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<tr>
<td>Preop</td>
<td>0.80 (0.67)</td>
<td>1.57 (1.28)</td>
<td>.001</td>
</tr>
<tr>
<td>Postop</td>
<td>1.71 (1.51)</td>
<td>1.42 (1.25)</td>
<td></td>
</tr>
<tr>
<td>Change</td>
<td>0.90 (0.70)</td>
<td>-0.15 (0.36)</td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: Postop, postoperation; Preop, preoperation; SCM, sternocleidomastoid.

a Data are given as mean (SD) unless otherwise indicated.

COMMENT

Free muscle grafts have met with varying success in the past. The first free muscle graft was performed in 1871 by Benjamin Howard, MD, when he treated an extensive arm burn wound with 3 muscle grafts from the biceps of the opposite arm. Of the 3 grafts, 2 survived and “remained healthy and permanent.” Critics of free muscle grafting cite an unpredictable “take” rate and state that successful muscle grafts require an intact neurovascular supply. There have been some excellent studies on the process of survival of denervated and freely auto-transplanted skeletal muscle. Schiaffino and colleagues performed a study in which the peroneus longus muscle of cats was first denervated and then transplanted 3 weeks later. The muscles were then removed 2, 8, or 15 days after transplant and analyzed by electron microscopy. Of note, denervation was first performed to allow the muscle fibers to survive as structural entities by decreasing the size of the fibers, making metabolic exchanges easier and reducing their energy requirements. Their conclusion after analyzing the muscles after 8 days was that 2 distinct processes occur: survival of transplanted fibers at the periphery of the graft and regeneration of new muscle fibers following breakdown of the originally transplanted fibers in the central areas. Hakelius then followed this experiment with a clinical study in which denervated extensor digitorum brevis and palmaris longus muscles were used to treat patients with...
facial paralysis, with 107 transplants performed in 89 patients. Twenty-five of the grafts were then evaluated by electromyography, and all showed signs of reinnervation at 2 to 3 month follow-up examination. Clinically, the muscle grafts around the mouth gave some mobility to the paralyzed half of the lips, and the results to improve eyelid function were “satisfactory.”

As Miller\(^2\) pointed out, it is difficult to prove survival of a free muscle graft solely based on clinical examination. The problem with electromyography is that there is some uncertainty in placement of the electrodes, and adjacent, normally innervated muscle can produce normal action potentials that confound the results. We would agree with his observation that replacement of muscle with fibrous tissue may be the explanation for clinical improvement. Marvin Shuster, MD, used orbicularis oculi muscle for the frown lines and stated that the purpose of inserting strips of muscle into the face is not to animate the face but simply to serve as a filler.\(^2\) He noted that although muscle certainly atrophies, it may also persist because of its increased vascularity.

In our series of patients who underwent SCM muscle and fascia transfer to the lips, it was not practical to denervate the SCM muscle prior to muscle transfer. All had SCM muscle and overlying fascia harvested during a cervicofacial rhytidectomy. Our rhytidectomy technique involves a limited supra-auricular extension, making it difficult to take a generous temporalis muscle and fascia segment without significantly extending the scar. In addition, since there is no SMAS excision, there is no extra SMAS available to use for lip augmentation.

Harvesting the posterior and superior aspect of the SCM muscle near its insertion into the mastoid process has not resulted in any limitation in head movement, postopera-

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**Figure 1.** Preoperative frontal (A) and lateral (B) views; 3-week postoperative frontal (C) and lateral (D) views; and 1-year postoperative frontal (E) and lateral (F) views.
tive pain, or spinal accessory nerve injury as compared with the control group. Because the donor defect in the SCM muscle is sutured edge to edge, there have been no contour deformities in this region. Muscle and fascia are harvested together en bloc to provide enough bulk to the graft to achieve the desired augmentation and also to use the increased vascularity of muscle to increase graft “take.” Lassus\(^1\) also mentions leaving muscle attached to temporalis fascia to improve thickness of the graft and its take. One criticism of our study is that we did not perform SCM fascia grafts without muscle, which would have helped to delineate the role of muscle incorporation in terms of graft take. However, this would have significantly limited the amount of lip augmentation material available to our patients.

The technique presented herein has been performed most commonly in conjunction with cervicofacial rhytidectomy, but has certainly been performed as a standalone procedure many times. The same horizontal limb of the rhytidectomy incision is performed in the hair-bearing scalp to access this portion of the SCM, but the patient must be counseled about a donor site incision that would not be required with a nonautologous implant material. The postoperative recovery after SCM fascia and muscle grafts to the lips is straightforward. After the first month of lip swelling, the patient should expect that the lips will still be slightly swollen. The senior author’s experience has been that approximately 75% of the immediate intraoperative lip fullness is maintained at 1 month postoperatively, while approximately 50% of the immediate intraoperative lip fullness is maintained at 1 year postoperatively. This will be slightly variable among surgeons but provides a baseline estimate for those surgeons with little experience with this procedure. Further critical studies would be helpful in precisely quantifying this change. Although patients notice exaggerated swelling for the first 2 weeks postoperatively, most are thrilled with their degree of augmentation at 1 month, and some are even reticent about any further diminution in size. It is only with experience and listening to a patient’s preoperative desires that one can judge the appropriate size of grafts required and anticipate the degree of resorption and atrophy postoperatively.

Technically, harvesting the grafts and creating the tunnels does not add a significant amount of time when performed with a cervicofacial rhytidectomy. It is imperative to contour the grafts so that they are smooth and free of any muscle bulges that may be visible postoperatively. When creating the tunnel, it is helpful to dissect within the superficial orbicularis oris muscle to have more soft tissue covering overlaying the grafts and avoid submucosal contour irregularities. In addition, if larger grafts are used, the tunnels must be of sufficient width to avoid tearing the mucosa, especially at the insertion point. As mentioned in the review of lip augmentation cases with SMAs tissue by Leaf and Firouz,\(^3\) it is important to avoid suturing the ends of the graft into the closure to allow them to move freely and to avoid postoperative tethering on smiling or mouth opening. We have found that tucking the lateral ends of the grafts slightly lateral to the corner of mouth incisions helps counteract the natural tendency for the grafts to horizontally shorten. This allows preservation of lateral lip fullness.

Several of the problems that have been described with other lip augmentation procedures have not been encountered with this procedure. There have been no dermal cysts, which have been described with dermotfat grafts\(^1,8\); there is no 2- to 3-month period of prolonged stiffness or sensory changes, which accompanies V-Y mucosal flaps\(^7,13\); there is no allergic potential or risk of extrusion, which can occur with foreign materials; SCM muscle and fascia have a natural feel as compared with ePTFE, which is often palpable; and there are no size limitations with the SCM grafts as compared with ePTFE, which several authors have suggested requires small grafts to avoid complications.\(^9,10\)

The major challenge with any autologous material, and even with AlloDerm,\(^17,18\) is resorption. Because many of the products and techniques that are commonly discussed have undergone little long-term analysis beyond 1 year, we sought to critically analyze the results of SCM muscle and fascia transfer over a longer period. Based on the present study, patients who desire subtle, yet long-term lip augmentation can be counseled to expect approximately a 20% to 25% increase in vermilion show and approximately a 1-mm increase in lip projection at 2 years and longer from baseline.

Despite the aforementioned advantages, we have seen occasional asymmetries in the lips after SCM grafting. There are several possible explanations for this finding: the presence of slight contour irregularities in the grafts when they were implanted; asymmetric graft compression; differential resorption within a given graft; and/or a contribution from dynamic movement of the lips. Fortunately, these findings are rare. For those individuals...
with baseline asymmetry, placing a standard SCM graft will preserve that asymmetry, even with greater vermilion show and lip projection. However, the surgeon retains the flexibility of being able to directly contour the grafts to provide greater or lesser augmentation in a given region for correction of asymmetries. For patients who at baseline are thin lipped with minimal vermilion show, SCM grafts will have a proportional limited effect. An alternative technique such as vermilion advancement may be a more appropriate choice, with the compromise being the elimination of any white roll and a visible scar.

Our study has some limitations inherent with any retrospective review of photographs. There is always some variation in distance of the camera to the patient despite standardized views, although we have tried to account for this by calibrating the photographs to a constant value for the intercanthal distance and auricle height. We have used mean values for these 2 constants, but there is some variability of these reference distances between patients. However, it is more important to standardize an individual patient’s preoperative photograph to their own postoperative photograph to give an accurate measure of the change we are trying to define. Future prospective studies would include a ruler placed next to the face in each photograph in order to have a highly accurate scale for comparison. In addition, patient satisfaction with the procedure could be measured by a validated survey.

In conclusion, we have shown that lip augmentation with SCM muscle and fascia grafts results in long-term enhancement of vermilion show and lip projection. The donor material is readily harvested during a concurrent rhytidectomy, with minimal increased operative time. There is no donor site morbidity, and the material is readily incorporated by the lips. As with any lip augmentation procedure using autologous material, the surgeon must account for some degree of postoperative graft resorption and atrophy when determining the size of the grafts to be transplanted. Although there is no perfect solution when treating senescence of the lips, SCM muscle and fascia implantation is the permanent lip augmentation procedure of choice in our practice.

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Author Contributions: Dr Agarwal had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Agarwal and Maloney. Acquisition of data: Agarwal. Analysis and interpretation of data: Agarwal and Gracely. Drafting of the manuscript: Agarwal. Critical revision of the manuscript for important intellectual content: Agarwal, Gracely, and Maloney.

REFERENCES