Superior Sulcus Volumetric Rejuvenation Utilizing Dermis Fat Grafting

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BACKGROUND

Reversal of facial aging has been a quest of cosmetic surgeons throughout time. To further this goal, mechanisms of aging are continually under investigation. While various theories have been proposed, facial aging is likely a multifactorial phenomenon. Bone loss, muscle atrophy, and subcutaneous fat loss and/or redistribution have been suggested as the main variables in facial alteration due to aging.1-8 Recent reports on facial rejuvenation focus on replacement of facial volume loss, sometimes referred to as “the third dimension.” There is no consensus as to one universally applicable method of volume replacement. Current en vogue techniques include autologous fat grafting (facial fat rebalancing, liposculpture, fat autograft muscle injection), alloplastic implants, and injectable tissue fillers.9-11 Each method has advantages and disadvantages. Autologous fat is biocompatible with existing tissues, but there is no definitive evidence of fat longevity, and fat reabsorption can be asymmetric.10-12 Alloplastic implants are relatively permanent and allow for control of volume distribution, but require surgical placement with risks of infection, exposure, and inflammatory reaction. Further, alloplastic implants do not adapt to the continued progress of facial aging changes. Injectable tissue fillers require a minor procedure for placement, but duration of effect is variable and limited. It has been suggested that optimal facial rejuvenation requires a combination of surgical techniques and volumizing modalities.13

Aging changes of the superior sulcus require unique considerations for rejuvenation. The superior sulcus is in close proximity to the globe and orbital structures, and therefore modifications present challenges that are not encountered elsewhere on the face. Muscles of the eye and lid and their associated nerves pass in close proximity or directly within the superior sulcus. The superior sulcus is also the location of the lacrimal gland and the superior opthalmic vein. Disruption of these structures can result in a spectrum of complications, some with vision threatening side effects.

In the superior sulcus one must be wary of the method of material placement as well as the amount. For example, over aggressive fat grafting to the malar region may result in an undesirable cosmetic result. However, in the superior sulcus, this same complication can disrupt levator muscle function and result in a functional deficit from lid ptosis. These types of concerns have led to conservative endeavors for superior sulcus volume augmentation. Thus, few have reported on aesthetic procedures to address age-related periorbital volume disproportion.14-17

The literature is replete with reports of complications for injection of various filler materials.18-22 These compilations can range from localized necrosis to distal vascular occlusion. There are multiple reports of irreversible blindness from filler injections far distal to the globe.18,19 These

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complications occur due to the rich vascular anastamosis that exists in the facial region. In the face, this has been cited as the leading variable in numerous glabellar filler complications. The sulcus area has perhaps one of the richest arterial anastomotic systems involving the arcade vessels of the eyelid, as well as deeper orbital vessels. The likelihood of retrograde injection leading to blindness is far more anticipated in this proximal area then the numerous remote sites reported. The potential effects can be seen in steroid inactions placed into the eyelids for treatments of chronic granulomas resulting in retinal artery occlusion and irreversible blindness.

The nature of a “blind” injection in such a richly vascular area carries a much higher risk profile than that of an open surgical procedure where there is no chance of intravascular injection of synthetic or autologous filler material or inadvertent penetration of the globe. While the reported incidence is low, as stated by one author, “The published reports in the medical literature are made by experienced aesthetic surgeons and thus the actual incidence may be even higher.”

Secondly, the open nature allows for more accurate placement of graft material than blind techniques. Based on these reduced risks of complications and the robust survival rate of dermis fat grafting (DFG), it is our preferred method for providing the optimal cosmetic result with the lowest morbidity.

Dermis fat grafting to the orbit was first described in the early 1900s and is still commonly used to correct enophthalmos. Until recently, no authors have described DFG for senescent changes of the orbital tissues, specifically those comprising the superior sulcus. The technique described by Maniglia requires periosteal dissection, orbital septum disruption, and transposition of orbital fat. The dissection plane described exposes the lacrimal gland and/or the superior orbital nerve to potential injury. Transposition of fat from the orbit, effectively reducing orbital volume, carries the potential complication of creating anophthalmos. Further, improper manipulation or closure of the orbital septum in this area can lead to lid retraction. These risks may effectively limit this procedure to surgeons intimately familiar with the anatomy of this region and patients with an over-abundance of orbital fat.

We describe a technique of placement of a contoured dermis fat graft to the hollowed orbital superior sulcus. The volumization material was chosen for its biocompatibility, potential for long-term stability, readily available nature, and ability to be easily shaped at the time of surgery. This method allows us to achieve more predictable and stable results versus other modes of sulcus volume augmentation.

**SURGICAL TECHNIQUE**

The procedure can be performed under local anesthesia with sedation, if the surgeon plans on combinant procedures requiring patient cooperation, or general anesthesia. Approximately 4 cc of local anesthetic consisting of 0.75% marcaine mixed 50/50 with 2% lidocaine with 1:100,000 epinephrine and 10 units of hyaluronidase in a 10 cc syringe was injected into the superior sulcus. An appropriate amount of local was also injected into the graph harvest site. Preoperatively, the patients were given a choice of graft harvest site: inframammary fold of the breast, abdomen (just superior to the iliac crest), or thigh. For all of the study patients receiving a unilateral dermis fat graft, no other surgical procedures were performed concurrently on the contralateral control side.

An eyelid incision was made with a #15 Bard-Parker blade at the position of the desired lid crease. The orbicularis was opened with monopolar cutting cautery using a Colorado cautery tip (Stryker, Kalamazoo, MI). Scissors were used to open the orbital septum, and the landmark of the preaponeurotic fat was identified (Figure 1). The

![Figure 1.](https://academic.oup.com/asj/article-abstract/35/7/892/2589223)

(A) Following a standard upper blepharoplasty incision, the orbital septum of this 46-year-old woman has been incised and the arrows indicate the border of the preaponeurotic fat. (B) Illustration from the sagittal view.
capsules of the preaponeurotic and nasal fat pads were then opened. Deliberate dissection was performed to delineate and expose the anterior capsule of the fat pads (Figure 2). The horizontal length of the eyelid incision was measured with a ruler. A corresponding length was then marked at the dermis/fat donor site. The dimensions of the graft are typically 25 to 29 millimeters in width and 7 to 10 millimeters in height (Figure 3). These dimensions represent an approximate 20%-30% oversizing of the graft to account for postoperative atrophy. It should be noted that the percentage of graft atrophy appears to vary from surgeon to surgeon and should be adjusted accordingly.

After incising the ellipse of skin with a #15 blade, the epithelium was removed from the dermis with a Wescott scissors (Storz, El Segundo, CA). The curved Metzenbaum scissors were then used to harvest the ellipse of dermis with 7 to 10 millimeters of underlying fat. Monopolar cautery was utilized for hemostasis, and the harvest site wound was closed in a layered fashion. Deep sutures consisting of 4-0 polygalactin in the fat/fascial layer were followed by a subcutaneous layer of 6-0 polygalactin, and then 6-0 plain gut to close the skin. A Tegaderm dressing (3M, St. Paul, MN) over a strip of Telfa gauze (Covidien, Mansfield, MA) was used to cover the harvest site wound.

The nature of the volume defect in the sulcus was considered, and the dermis fat graft was shaped to correspond to the contours of the defect. The dermis fat graft was placed in the eyelid with the dermis facing anteriorly and the fat in apposition to the exposed preaponeurotic fat pads. Using 6-0 polygalactin on a P-1 needle, the superior 180 degrees of the dermis border was anchored in place to the superior edge preaponeurotic fat capsule (Figure 4). The inferior 180 degrees of the dermis fat graft were not sutured (Figure 5A). The graft was again trimmed and adjusted to fit the available space. The upper lid skin and orbicularis were draped over the dermis fat graft to assess volume. Initial overcorrection of the superior sulcus defect by 20% to 30% is the goal at the time of surgery.

Eyelid crease reformation sutures of 6-0 polygalactin were placed from the orbicularis muscle at the inferior border of the eyelid crease incision to the anterior surface of the levator aponeurosis at 2 to 3 mm intervals. The eyelid crease skin incision was closed with simple interrupted sutures of 6-0 plain gut (Figure 5B). Ophthalmic antibiotic ointment was then placed on the incisions and in the eye. A video demonstrating the surgical technique may be viewed at www.aestheticsurgeryjournal.com.

Postoperatively, the patients were instructed to limit strenuous physical activity for one week. An oral antibiotic and ophthalmic topical antibiotic ointment were prescribed for 1 week. Follow-up was scheduled for 1 week, 1 month, and 6 months. Additional visits were scheduled if it was felt to be necessary.

**EXPERIENCE**

We have followed six patients (5 female, 1 male) long-term (5 unilateral, 1 bilateral) who underwent dermis fat grafting to the superior sulcus for cosmetic concerns. The patients ranged in age from 46 to 81 years, with a mean age of 63 years (standard deviation, 14 years). Patient follow-up ranged from 44.3 to 54.5 months, with a mean follow-up period of 50.6 months (standard deviation, 4.2 months).

Preoperatively, the patients chose the site for harvesting of the dermis fat graft. One chose the inframammary fold of the breast, 4 chose the abdomen just superior to the iliac crest, and 1 chose the thigh. Four of seven eyes had combinator ptosis surgery (57%) and four of had combinator blepharoplasty (57%). Overall, two of seven eyes had
combined ptosis surgery and blepharoplasty at the time of DFG placement (29%).

Preoperative superior sulcus depth improved in all patients. In patients that had unilateral augmentation, we were able to achieve near identical symmetry in sulcus depth to the non-operative eye. Comparing pre and postoperative eyelid position, all patients achieved postoperative symmetry within 0.5 mm. This was true for patients that had combined ptosis surgery and those only receiving DFG augmentation.

**OUTCOMES**

The results with respect to correction of volume deficiency, asymmetry of the superior sulcus, and maintenance of eyelid position were excellent. The majority of patients with unilateral sulcus deepening also showed involutional eyelid ptosis. Dermis fat grafting in isolation will not significantly improve eyelid position; however, in no instance did placement of a DFG increase or cause eyelid ptosis. There were no instances of graft failure, postoperative infection, or visual complications. One patient (bilateral DFG) had a bilateral blepharoplasty approximately 1 year postoperatively for patient perceived skin redundancy.

Recognizing the complicated interplay of the levator complex, the preaponeurotic fat, and the shape of the overlying skin, it is important to realize that altering any one of these features has consequences on the others. It would be difficult to encounter patients who needed only superior

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**Figure 4.** (A) The superior portion of the dermis fat graft is sutured to the superior edge of the preaponeurotic fat capsule, as demonstrated on this 46-year-old woman. The needle is shown passing through the fat capsule. (B) Illustration of the suturing from the sagittal view.

**Figure 5.** (A) The dermis fat graft has been sutured into place along the superior edge, as demonstrated on this 46-year-old woman. The forceps are shown grasping the free inferior edge of the graft. (B) Sagittal view illustrating the graft sutured in place with the overlying skin and orbicularis closed with simple interrupted gut sutures.
sulcus volume augmentation with no other alterations of the eyelid; thus the majority of the patients (83%) did have other combinant procedures. These other procedures need to be factored into the preoperative decision-making process for the patient with a hollow superior sulcus. Tightening the levator complex alone can slightly improve hollowing by bringing the preaponeurotic fat forward into the eyelid and compressing the lid tissue superiorly. Some degree of our improvement in the hollow sulcus may have been achieved by combinant ptosis repair and this must be factored into graft sizing.

Fifty-seven percent of eyes also had concurrent blepharoplasty. To some extent, one might think an excess of skin would be beneficial for replacing upper lid volume, but the resultant redundant tissues causes an undesirable contour of the lid. Instead of a smooth lid fold, excess skin creates superficial wrinkles or an elongated fold that hangs too low below the eyelid crease. This is sometimes improved by adding volume to fill in the skin, so we were conservative in skin removal at the time of DFG placement. In some of our early patients redundant skin persisted and was removed. Once the surgeon has performed sufficient cases to establish their graft resorption factor, appropriate skin can be removed at the time of graft placement.

There are certain features of the described technique that may aid in the reproducibility of the results. The DFGs were harvested to a measured size based on the intraoperative lid incision, but were harvested with surplus fat and then individually shaped to fit the defect in the eyelid. For example, some grafts may have had more tissue nasally, whereas some were thickest centrally. Based on previous reports of fat resorption and personal experience with fat grafting, the authors chose to oversize the volume by 20% to 30% at the time of surgery.31,35 With a relatively long-term follow-up (mean, 50.6 month) and good postoperative symmetry of the sulcus depth, this protocol appears to have predictive value for the amount of fill accomplished with the DFG (Figure 6 and Supplementary Figure 1).

The superior edge of the DFG dermis was anchored to the preaponeurotic fat or capsule of the fat in an attempt to best approximate the location of the missing or atrophic fat. The inferior edge was purposely left unattached so as not to inhibit the movement of the levator. Posterior anchoring of the inferior edge of the graft might limit upward excursion of the muscle and cause ptosis. Similarly, any attachment to or closure of the orbital septum is not advised.

**COST**

The obvious cost advantage to this procedure is the use of the patient’s native tissue, negating an expense for alloplastic implants or filler materials. There is no special instrumentation required, and any of the described forceps, scissors, and needle drivers can be substituted for the surgeon’s preference without altering the technique. Similarly, subcutaneous suture of similar absorption profiles and skin suture can be substituted to surgeon preference.

**CONCLUSION**

This technique shows promising results for correction of the hollow superior sulcus while maintaining eyelid position and function after surgery. The dermis fat graft is a readily available, has superior biocompatibility, and persists indefinitely after the initial phase of resorption. The technique described can be combined with additional procedures to correct eyelid asymmetry or skin redundancy without need for modification to achieve consistent and desired postoperative results. The safety profile of the procedure is superior to many of the alternatives, especially those incorporating closed augmentation. The longevity

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**Figure 6.** (A) Preoperative photograph of this 46-year-old woman with a history of past trauma to the left periocular area. The patient has a unilateral deepening of the left superior sulcus and eyelid ptosis. (B) Postoperative photograph of the patient obtained four years following dermis fat graft placement to the left superior sulcus and external levator advancement at the time of dermis fat graft surgery. No additional procedures were performed.
and stability of results are superior to those of injectable materials and comparable to those of alloplastic implants. It should be stressed that DFG placement alone will not improve eyelid ptosis or dermatochalasis, regardless of technique.

Supplementary Material

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