

# Autologous Free Dermal Fat Graft

## Reconstruction of Facial Contour Defects

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**Objective:** To examine the use of autologous free dermal fat grafts (FDFGs) in the reconstruction of soft tissue facial contour defects, an 8-year, retrospective, computerized medical chart review was conducted for 21 patients who underwent reconstruction with FDFGs.

**Setting:** Section of Facial Plastic and Reconstructive Surgery, Department of Otolaryngology, Oregon Health Sciences University, Portland, or affiliated hospitals.

**Patients:** Twenty-one patients identified in the chart review were included in the retrospective evaluation. Follow-up periods ranged from 11 to 94 months. Five patients were unavailable for follow-up at the chart review, but all five had satisfactory results at their last evaluation.

**Design:** Soft-tissue augmentation was performed using autologous FDFGs harvested from the abdomen following in situ de-epithelialization with a high-speed dermabrader. Facial contour defects resulted from tumor extirpation, congenital deformity, trauma, or degenerative disease.

**Main Outcome Measures:** Outcome was considered satisfactory when the patient and the surgeon were pleased with the long-term results at the last evaluation.

**Results:** Complications, including graft resorption (five patients) and epithelial cyst formation (two patients), were observed in seven patients and resulted in an unsatisfactory outcome. The remaining 14 patients demonstrated satisfactory results as determined by the patient and the surgeon at the last evaluation.

**Conclusions:** Successful long-term augmentation of facial contour defects may be achieved with autologous FDFGs in an appropriate patient population. Careful patient selection and proper surgical technique are essential for satisfactory long-term results. Guidelines are provided for the augmentation of facial contour defects with autologous FDFGs.

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**C**ONSPICUOUS soft-tissue facial defects arise from various causes, including degenerative disease, extirpative surgery, congenital deformities, and soft-tissue trauma. Most patients find such contour defects aesthetically unacceptable and will frequently seek surgical restoration of premorbid cosmesis. Ideally, reconstruction of facial soft-tissue voids should employ filler materials that are biologically inert, predictably durable, inexpensive, readily available, and suitable for single stage implantation. In the face, secure tissue fixation and lasting flexibility are paramount because the implant material must withstand the constant demands of mimetic expression. Although the search for an ideal soft-tissue filler has produced a wide range of alloplastic materials,

few, if any, available materials are well suited for reconstruction of facial soft tissue defects. Most alloplastic materials have suboptimal texture, are expensive, are scarce, or are poorly tolerated by the host. Host tolerance is particularly problematic in the irradiated recipient tissue bed, and alloplastic materials are poorly suited for use in children because they fail to accommodate facial growth.

The first report describing the use of living autogenous materials for correction of facial soft-tissue defects came from Europe early in this century.<sup>1-3</sup> Lexer<sup>1</sup> reported the use of free dermis to repair nasal tip, alar, and auricular defects in 1914, while Eitner<sup>2</sup> successfully corrected a postsurgical malar depression with a free dermal graft in 1920. In 1931 the use of autogenous free dermal fat grafts (FDFGs) for correction of facial contour defects was first reported in the American literature by Fig. 4. His report detailed the successful repair of a depressed (anterior table)

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## PATIENTS AND METHODS

Using a computerized patient database, a retrospective medical chart review was conducted by one of us (T.A.C) to identify all patients undergoing autogenous FDFGs for correction of facial contour defects. A total of 21 patients (three males and 18 females), treated from 1983 through 1991 in the Section of Facial Plastic and Reconstructive Surgery, Department of Otolaryngology at Oregon Health Sciences University, were identified. Average age at time of surgery was 33 years (range 10-65 years). Reconstructions were performed for a variety of soft-tissue defects and origins. When FDFGs were used for the reconstruction of defects arising from tumor surgery or facial trauma, reconstruction was delayed for a minimum of 6 months. In patients suffering from hemifacial atrophy, reconstruction was not attempted until at least 1 year of inactive disease was documented.

## SURGICAL TECHNIQUES

Free dermal grafts were harvested using an elliptical excision centered around a preexisting abdominal scar. In the absence of preexisting abdominal scars, a low transverse (Pfannenstiel's) incision was chosen to hide the donor scar beneath the bikini line. Care was taken to design the ellipse in a length-to-width ratio of 3:1 to facilitate a tensionless closure with minimal donor-site distortion. In this series, the unavoidable volume loss following implantation was offset by leaving the graft 25% to 30% thicker than ultimately desired. However, FDFGs were limited to thicknesses of 1.5 cm or less to avoid excessive graft resorption. No over correction in linear dimension was performed because the dermal component resists contraction when sutured securely along its periphery. Extreme care was taken while handling the graft to avoid shearing of those vessels necessary for fat survival.

Graft harvest and recipient-site preparations were performed concurrently using separate surgical teams. Preoperative intravenous antibiotic prophylaxis was administered while the donor and recipient sites were prepared. To estimate FDFG size accurately, the facial contour defect was measured prior to injection with local anesthetic. Both sites were then injected for hemostasis with 1% lidocaine hydrochloride containing 1:200 000 epinephrine. Follow-

ing injection, the donor ellipse was sharply incised to the level of the deep dermis. In situ de-epithelialization of the entire skin paddle was achieved using a high-speed dermabrader equipped with a diamond fraise. Care was taken to dermabrade to the deep dermis to devitalize all epithelial elements. Following thorough de-epithelialization, the ellipse was sharply excised along with a uniform 1.5 cm thickness of attached subdermal fat. The resultant defect was then undermined peripherally and irrigated. Hemostasis was achieved using monopolar electrocautery, and a tight two-layered closure was performed. A sterile compression dressing was applied to the donor site and maintained for two days.

Preparation of the facial contour defect began with elevation of the overlying skin flaps and excision of the previous scar (when applicable). Face-lift flaps, typically employing previous incisions, were used for exposure of preauricular, posterior mandibular, and cervical defects. Malar defects were approached through either infraorbital or melolabial crease incisions, and chin implantation was accomplished through a submental approach. Skin flaps were elevated at least 1 cm beyond the boundaries of the soft-tissue defect to permit redraping of the surrounding skin. The plane of dissection was intentionally kept superficial to allow good contact of the FDFG with the recipient subdermal vascular plexus. Care was taken not to violate the capsule covering adjacent alloplastic materials during the flap elevation.

Meticulous hemostasis was achieved using electrocautery, and wound sterility was insured using copious warm saline solution irrigation. After tailoring the FDFG to conform to the existing soft-tissue defect and after tapering the edges, the FDFG was sutured securely along the entire periphery with multiple, deep 4-0 polydioxanone monofilament (Ethicon Inc, Somerville, NJ) sutures. The dermis was placed superficially to provide a large contact with the overlying subdermal plexus and to smooth the surface contour of the implant. The procedure was completed with a careful two-layered skin closure followed by placement of a conventional pressure dressing. Face-lifts (either unilateral or bilateral) were occasionally performed when accelerated facial aging occurred as a result of degenerative or denervating pathophysiology. Antibiotic prophylaxis was continued in all patients for 7 to 10 days postoperatively.

frontal sinus fracture using a FDFG harvested from the thigh and inserted by a posttrichial approach. Since this initial publication, numerous reports extolling the use of FDFGs for repair of facial contour defects have been published. Despite these reports, FDFGs have yet to achieve widespread clinical acceptance.

The advantages of FDFGs over alloplastic materials for long-term facial implantation stem from their inherent biologic properties. As autologous substances, FDFGs possess complete histocompatibility and so are free of foreign-body reactions. As living vascularized tissue, FDFGs remain supple, are relatively resistant to infection, and accommodate long-term facial growth. Free dermal free grafts may be harvested at the time of reconstruction with minimal morbidity, and are eas-

ily sculpted to fit most soft tissue defects. Potential complications, such as graft resorption or epithelial cyst formation, may be avoided by careful patient selection and meticulous surgical technique. The unavoidable morbidity of donor-site scarring can be minimized by harvesting FDFGs from preexisting abdominal scars or by hiding the donor scar beneath the bikini line.

To confirm the benefits of FDFGs for reconstruction of facial contour defects, a retrospective review was conducted of patients who underwent reconstruction with autologous FDFGs by one of us (T.A.C.) at Oregon Health Sciences University, Portland. The indications, surgical technique, long-term results, and associated complications are presented.

Between 1983 and 1991, 26 FDFGs were used for reconstruction in 21 patients with facial contour defects. Soft-issue facial defects arose from a variety of origins, including postsurgical (nine patients), traumatic (six patients), congenital (one patient), and degenerative disorders (five patients). Postsurgical contour defects developed in patients with squamous cell carcinoma, eosinophilic granuloma, cystic hygroma, cavernous hemangioma, rhabdomyosarcoma, invasive blue cellular nevus, and pleomorphic adenoma. Degenerative and congenital soft-tissue defects included hemifacial atrophy, polio-induced muscle wasting, Bell's palsy, Crouzon's disease, and steroid-induced fat necrosis. Traumatic causes included a childhood burn injury and various blunt and penetrating injuries. Two patients received external beam radiotherapy prior to FDFG placement, and nine had preexisting alloplastic or autogenous skeletal implant material in the surgical site.

Preexisting implant materials included free iliac and calvarial bone grafts, reconstruction miniplates, Silastic implants, Dacron tray prostheses, and irradiated rib allografts. Free dermal fat grafts were placed in 26 separate sites throughout the head and neck area, including preauricular-cheek (nine patients), infraorbital-malar (seven patients), chin (three patients), posterior mandible (three patients), and temple (four patients). All facial contour defects were accommodated with FDFG thicknesses of 1.5 cm or less.

Whenever possible, FDFGs were harvested from existing abdominal wall scars. Eleven patients had preexisting abdominal scars suitable for FDFG harvest. In the remaining 10 patients without preexisting scars, a low transverse suprapubic donor site was employed. No patients suffered donor site complications or voiced dissatisfaction with the donor scar.

Since reconstruction, five patients have been unavailable for follow-up. None of these five patients noted complications at their last clinic evaluation. Of the remaining 16 patients, follow-up averaged 34 months (range, 11 to 94 months). Surgical repair of facial contour defects was considered successful if the patient and the surgeon were pleased with the result at the last follow-up visit. During the follow-up period, complications were observed in seven patients (33%). Two patients experienced epithelial cyst formation and five experienced varying degrees of graft resorption.

One patient experienced recurrent infections, which eventually led to preauricular fistula formation 3 years after implantation. Surgical exploration of the fistula revealed a hair-bearing, epithelialized cavity containing keratinous debris (Figure 1). Following excision of the cyst the patient remained asymptomatic. A second patient experienced recurrent abscess formation from an hair-bearing, epithelialized subcutaneous cyst (without fistula). Surgical excision provided symptomatic relief.

Five patients experienced varying degrees of graft resorption. One patient underwent implantation of a postsurgical malar defect produced 12 years earlier from resection of a facial rhabdomyosarcoma. Three years after implantation, mild-to-moderate resorption was noted. Despite partial resorption, the patient remained pleased with her cosmetic improvement. A second patient treated with hemimandibulectomy, bilateral radical neck dissections, and external beam radiotherapy



**Figure 1.** Cotton swabs inserted into well-epithelialized, fistulous tract contained within excised free dermal fat graft.

for mandibular squamous cell carcinoma experienced severe FDFG resorption. The FDFG resorption eventually led to skin breakdown and exposure of the underlying Dacron tray mandibular prosthesis. Dacron tray prosthesis removal and ultimately a trapezius myocutaneous pedicle flap was necessary for satisfactory soft-tissue coverage. A third patient treated with Dacron tray prosthetic reconstruction and postoperative external beam radiotherapy following composite resection for squamous cell carcinoma of the oropharynx also underwent FDFG placement over the Dacron tray prosthesis. Six-year follow-up revealed notable FDFG resorption but continued soft-tissue coverage of the Dacron tray prosthesis (Figure 2). A fourth patient also underwent FDFG placement over a Dacron tray prosthesis placed following excision of an eosinophilic granuloma. Despite the absence of radiotherapy, the patient also experienced subtotal resorption. The final patient experienced moderate FDFG resorption placed to repair a traumatic malar defect. A second FDFG was placed 17 months later with satisfactory results after 3 months of follow-up.

The remaining 14 patients with FDFGs (66%) experienced satisfactory cosmetic improvement without complication, as determined by the patient and the physician, as determined at their last follow-up visit (Figure 3 and Figure 4). All intentional volume over corrections gradually diminished to acceptable proportions. Two postparotidectomy patients noted diminished gustatory sweating (Frey's syndrome) following FDFG placement, and neither developed facial nerve injury despite the elevation of postparotidectomy face-lift flaps. No complications of FDFG placement were observed in conjunction with preexisting alloplastic or autogenous graft materials, although one patient suffered exposure of his Dacron tray prosthesis as described earlier.

#### COMMENT

Although FDFGs have been used successfully for reconstruction of facial contour defects for almost a century, they have failed to gain widespread clinical acceptance. This lack of popularity persists despite numerous advantages of FDFGs over available alloplastic implant materials. Two misconceptions may explain the reluctance to use FDFGs for reconstruction



**Figure 2.** Top, preimplantation frontal and oblique views following hemimandibulectomy and external beam radiotherapy for squamous cell carcinoma. Center, Postimplantation frontal and oblique views 2 months after reconstruction with a mandibular Dacron tray and large free dermal fat graft. Overcorrection with free dermal fat graft is apparent. Bottom, Postimplantation frontal and oblique views 6 years following reconstruction. Notable free dermal fat graft resorption is evident, but buccal fullness and soft-tissue coverage of the Dacron tray remains improved.

of facial contour defects. The first misconception is the unsupported notion that FDFGs place the patient at high risk for epithelial cyst formation secondary to retained epithelial elements, which may have originated from experiments in which buried whole skin frequently led to epithelial cyst formation.<sup>5</sup> The second misconception is the fear of complete FDFG resorption, which may have been perpetuated by the comparatively poor performance of free fat grafts, the use of excessively large FDFGs, and the failure of most FDFG studies to provide

long-term follow-up.

The propensity of FDFGs to form discrete epithelial lined cysts from epithelial structures retained within the dermis has been evaluated extensively in animal and human experiments. Sawhney et al<sup>6</sup> performed multiple FDFGs in pigs to evaluate the fate of various graft constituents during a 1- to 8-week postoperative period. Although histologic examination of the deep dermal layer revealed preservation of sweat glands, collagen, elastic tissue and nerve bundles, hair follicles and sebaceous glands degenerated into microcysts; and after 8 weeks "showed no tendency to cyst formation." In a similar study, Swenson<sup>7</sup> evaluated the fate of canine free dermal grafts from 7 to 152 days after implantation. Histologic evaluation revealed degeneration of epithelial remnants (microcysts) with eventual transformation of the implanted dermis into well vascularized fibrous tissue indistinguishable from host tissue. Five clinical cases of herniorrhaphy using FDFGs were also presented without evidence of cyst formation after follow-up periods of 6 months to 3 years. In 1937, Peer and Paddock<sup>3</sup> evaluated human FDFGs harvested from the abdomen and implanted subcutaneously into the thorax. Free dermal fat grafts were harvested at intervals of 1 week to 1 year after implantation and examined histologically. After 1 year of implantation, human FDFGs were free of epidermal epithelium, sebaceous glands, and hair follicles. Microcysts filled with horny material were observed throughout the latter stages of implantation, but these small cysts were not observed to increase in size and probably represented the by-products of epithelial degeneration.

In 1960, Thompson<sup>8</sup> published a clinical and histologic evaluation of free dermal grafts used for repair of facial contour defects. Biopsy specimens were obtained from healthy volunteers at various intervals ranging from 1 week to 5 years after implantation. Biopsy specimens of longterm dermal grafts showed "no trace of former epidermoid cysts, hair follicles, or sebaceous glands." Thompson concluded that although epidermoid cyst formation was common on a microscopic scale, the cysts seemed to be replaced by host fibrous tissue. His clinical evaluation of 43 dermal grafts implanted in 33 patients (with at least 1.5 years of follow-up in 85% of patients) revealed no clinical evidence of cyst formation, and his review of the literature also failed to reveal complications stemming from buried epithelial elements.

The low incidence of epithelial cyst formation following dermal graft or FDFG implantation is also supported by several other large clinical series. Peer<sup>9</sup> reported only one epithelial cyst formation after 90 grafting procedures, although no length of follow-up was provided. Schuessler and Steffanoff<sup>10</sup> reported a series of 80 patients who underwent repair of facial contour defects using free dermal autografts. Of these 80 patients, only one epithelial cyst developed; the length of follow-up was also not provided. Boering and Huffstadt<sup>11</sup> reported a series of 20 patients who underwent FDFG placement for repair of facial contour defects without epithelial cyst formation. Length of follow-up was provided for four patients at 4 months and at 1, 5, and 8 years. Conley and Clairmont<sup>12</sup> implanted 29 patients with 33 FDFGs and noted no epithelial cyst formation, but length of follow-up was not reported. Nosan et al<sup>13</sup> implanted 11 postparotidectomy patients without cyst formation, with follow-up extending to 4.5 years. Leaf and Zarem<sup>14</sup> published a small series of five patients who underwent repair



**Figure 3.** Top, Preoperative frontal and oblique views of facial contour defect resulting from excision of left cheek cavernous hemangioma. Bottom, Postoperative frontal and oblique views 8 years following free dermal fat graft implantation (through a direct approach) with complete elimination of the contour defect.

of facial contour defects using FDFGs; follow-up ranged from 15 months to 3 years, and no patient experienced epithelial cyst formation.

Although length of follow-up was not addressed in several series, the evidence suggests that the incidence of epithelial cyst formation is exceedingly low. Nevertheless, the method of de-epithelialization and the site of donor harvest may have a negative effect on the incidence of cyst formation. Our series reports an unusually high incidence of epithelial cyst formation (two of 21 patients). Both patients who had epithelial cyst formation had FDFGs harvested from the suprapubic abdomen. It is possible that these FDFGs may have inadvertently included coarse pubic hair, which is at greater risk for incomplete de-epithelialization (regardless of the technique chosen). However, in our series we had no difficulty in obtaining sufficient graft material from beneath the bikini line without violating hair-bearing skin.

The risk of epithelial cyst formation may also increase with poor de-epithelialization technique. It is no longer necessary to increase donor-site scarring by removing the epithelium with a split-thickness skin graft. In situ de-epithelialization (strictly limited to the excised tissue) may be satisfactorily achieved with either a high-speed dermabrader or a carbon dioxide laser. While both techniques are rapid and effective, the carbon dioxide laser adds considerably to the overall cost and leads to



**Figure 4.** Top, Preoperative frontal and oblique views of right facial contour defect resulting from hemifacial atrophy. Disease quiescence was documented for 2 years prior to free dermal fat graft implantation. Bottom, Postoperative frontal and oblique views 4 years following free dermal fat graft implantation to the right chin, and right cheek contour defect is evident. Implant texture and pliability are indistinguishable from contralateral face.

immediate and substantial graft shrinkage. Therefore, de-epithelialization using the high-speed dermabrader is preferred.

Unlike the risk of cyst formation, the risk of unexpected FDFG resorption is a far greater threat to a satisfactory long-term outcome. Although the fate of implanted FDFG adipose tissue is uncertain, it is widely acknowledged that, even in the ideal patient, some degree of permanent FDFG volume loss will occur within several weeks after implantation.

Objective quantitation of FDFG resorption is technically difficult. Many authors have subjectively classified the extent of resorption as slight, moderate, or severe, while others have neglected the topic entirely. Sawhney et al<sup>6</sup> measured graft loss in an experimental pig model at 33% after 8 weeks of implantation. Histologic examination of the implanted material revealed near total replacement of fat with host fibrous tissue. However, texture and pliability were preserved despite the dramatic tissue conversion. Conley and Clairmont<sup>12</sup> implanted 29 patients with FDFGs and reported 70% to 100% graft absorption of all implants. These results were not surprising, because large graft volumes (96 to 288 mL) and comparatively excessive graft thicknesses (up to 3 cm) were routinely employed. The authors concluded that FDFGs were of limited value in tissue augmentation, but were helpful in "creating smoothness and contour."<sup>12</sup> In contrast, numerous authors have reported the pleasing clinical results (with limited fat resorption) obtained with FDFG reconstruction of facial contour defects.<sup>8,11,13-15</sup> Additional reports have histologically documented fat preservation in humans as many as 8 years after implantation.<sup>9,11</sup>

Several factors may account for the variability in loss of implanted graft volume. These factors include fat resorption from excessive graft thickness, traumatic graft handling, hematoma,

wound infection, inadequate immobilization, or poor vascularity of the recipient tissue.<sup>12-14</sup> While the precise sequence of FDFG revascularization is uncertain, inclusion of the attached dermis to the transplanted fat without dermis are associated with considerably higher resorption rates of up to 66%<sup>16</sup>

The observation by Starks<sup>17</sup> that FDFGs greater than 1.0-cm thickness result in excessive absorption<sup>17</sup> is consistent with our clinical experience. Grafts greater than 1 to 1.5 cm in thickness appear to exceed the limits of revascularization derived from contact of the grafted dermis with the subdermal plexus of the overlying recipient skin flap. Fortunately, most facial contour defects do not require graft thicknesses greater than 1.5 cm.

Owing to the inevitable volume loss of implanted FDFGs, many authors have recommended initial overcorrection to compensate for anticipated graft shrinkage. While the exact overcorrection is seldom quantitated, published estimates range from 10% to 40%.<sup>13-15</sup> In the patient without complications, we have found FDFGs to resorb predictably by 25% to 30% when the subdermal fat is limited to thicknesses of 1.5 cm or less.

In this series, five patients experienced unexpected graft resorption despite the absence of traumatic tissue handling, excessive graft thickness, or wound complications. However, all of these patients had one or more causes of cutaneous vascular compromise, including traumatic scarring, multiple prior surgical procedures, or high dose radiotherapy, each of which has been previously implicated in excessive graft resorption.<sup>12,13</sup> Although precise graft volume was not measured in this series, a clear trend toward excessive FDFG resorption was noted with larger grafts. This trend occurred despite limiting FDFG thickness to 1.5 cm or less. The susceptibility of larger grafts to excessive resorption may have resulted from the additional risk factors typical of patients requiring greater degrees of augmentation. Moreover, the extensive undermining necessary to accommodate larger FDFGs and the additional tension produced by added bulk also contribute to vascular compromise of the overlying skin flap. All FDFGs placed directly over Dacron tray mandibular prostheses experienced notable degrees of fat resorption. While these FDFGs tended to be comparatively large and each of the patients experienced notable preoperative scarring, the lack of underlying vascular support may have also contributed to the excessive resorption encountered in these patients.

In addition to the correction of facial contour defects, FDFGs may also be useful in the treatment of post parotidectomy gustatory sweating (Frey's syndrome). Nosan et al<sup>13</sup> used FDFGs to primarily reconstruct, parotidectomy defects in 11 patients, and noted no evidence of postoperative Frey's syndrome. In this series, two patients experienced a significant reduction in gustatory sweating following FDFG implantation of post parotidectomy defects. The improvement persisted through their last follow-up visits at 24 and 48 months. When implanting postparotidectomy defects, reconstruction should be delayed for a minimum of 6 months (or longer for malignant histology) to avoid obscuring local recurrence. To date we have experienced no facial nerve injuries despite delayed implantation.

Free dermal fat grafts provide a lasting, reliable, and effective source of autogenous implant material for repair of facial contour defects when used appropriately in selected patients. Although FDFGs require a donor incision, morbidity can be

reduced to acceptable levels through the use of existing abdominal scars or suprapubic donor sites. Free dermal fat grafts seem to have more predictable shrinkage characteristics when the recipient vascular supply is robust and when graft size and thickness are limited. In the absence of preexisting vascular compromise, overcorrection of the defect by 25% to 30% typically provides lasting, satisfactory cosmetic results. For patients with large volume defects or with preexisting vascular compromise, microvascular free grafts may be necessary to insure adequate bulk because excessive overcorrection is likely to result only in additional graft resorption. Although experimental evidence suggests that the FDFG adipose tissue is at least partially replaced by host fibrous tissue, the supple texture and pliability of the graft is clinically preserved for years after implantation. In this series FDFGs were also used safely in conjunction with alloplastic implant materials. The risk of epithelial cyst formation seems to be acceptably low, particularly when de-epithelialization is performed meticulously and grafts are harvested from non-hair-bearing tissue.

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