Pocket Grafting with Dermal Grafts: Autologous Collagen Implants for Permanent Correction of Cutaneous Depressions

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The objective of this study was to develop the rationale, operative results, and methods obtained from dermal grafting and to compare them with existing methods of soft-tissue augmentation. Techniques for delivery of autologous collagen for permanent correction of cutaneous depressions are described, evaluated, and discussed in detail, including an illustration and discussion of results obtained from correction of broad undulating acne scars and deep rhytides. The method of dermal grafting under study is then compared with existing procedures for soft-tissue augmentation. Pocket grafting with dermal grafts was found to be a promising technique for correction of certain facial defects.

Effectively, permanent therapy of broad, deep cutaneous depressions has continually posed a dilemma for surgeons treating facial soft-tissue defects. All previously used treatments have proven to carry some, or all, of the following shortcomings: allergic reaction or irritation, rejection or eventual reabsorption, inaccurate placement, high cost, time-consuming methods, lack of ready availability, and failure to achieve permanent correction. In contrast, an ideal filler substance would have none of these faults. A method of autologous solid-tissue implant grafting, employing permanent retroauricular dermal grafts (consisting of deep dermis and fibrous fat) placed into precise "pockets" created beneath deep wrinkles and broad, undulating acne scars, can overcome some or all of these shortcomings.

Dermal pocket grafting offers a promising means of permanently correcting broad, undulating acne scars and deep facial rhytides via autologous solid-tissue implantation. Deeper, smaller-diameter, or pitted acne scars can be treated by punch grafting, punch elevation, or dermabrasion, but broad undulating scars do not respond well to these methods. Fine facial rhytides, or "crows feet," respond well to dermabrasion, many types of chemical peeling, and bovine collagen implant, but wider, deeper rhytides, such as nasolabial or glabellar creases, are incompletely corrected by these modalities.

Rationale

"Dermal grafts" or "derma-fat grafts" have been in use for at least 57 years.1 In the past, surgeons have focused on their use in ophthalmology and correction of defects in other organ systems. Previous problems encountered with these grafts include persistence of the epithelium, cyst formation, and unpredictable behavior.2-3 Fournier has utilized solid bits of dermis and fat, obtained from face-lifts, brow-lifts, or blepharoplasty, for implantation into facial rhytides.4

Solid-tissue grafts have also been successfully employed by other facial surgical specialists in surgery of the larynx for many years.5,6 Neurosurgeons have used solid fat grafts for protective packing around the spinal cord,7 and ophthalmologists have utilized similar grafts for operative treatment of orbital "blow-out" fractures or for use following enucleation.8-10 Ear cartilage grafts are often employed in dermatologic surgery for correction of nasal cartilage defects.11 Finally, bone grafts are routinely used by orthopedic surgeons in a large variety of operative maneuvers.

Patient Selection, Materials, Methods, and Techniques

It is important to properly select patients for this procedure. Acne scars to be corrected should be soft and pliable, at least 4-5 mm across, and without underlying fibrosis. Rhytides should be at least 2-3 mm across, prominent, and capable of accepting undermining. In some instances, the patient may need to be willing to accept a subsequent dermabrasion in the event that other types of acne scars or defects are present.

The patient is first photographed in the sitting position; the wide scars and/or facial furrows are then outlined and marked in tangential light with gentian violet. Preoperative sedation may be obtained with oral diazepam, oral Percocet® (Du Pont) (oxycodone hydrochloride), and/or intramuscular Toradol® (Syntex) (ketorolac tromethamine). The patient is fully monitored, and the surgery is

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performed with sterile technique. Local anesthesia for the recipient and donor sites may be obtained with 1% xylocaine with epinephrine 1:100 000 mixed 50:50 with 0.5% Marcaine®. Tumescent anesthesia may be obtained with 0.1% xylocaine with epinephrine 1:1 000 000 (Figure 1). Preoperative and postoperative cephalosporins are employed to prevent infection; oral corticosteroids help diminish postoperative swelling.

For many years, dermatologic surgeons have employed simple undermining, without additional soft-tissue implants, as a means of permanently correcting acne scars. The rationale for this maneuver lies in the fact that undermining with a small blade or large needle leads to fibrin
production and creates granulation tissue, with both results serving to permanently augment facial acne scars.

A comparison of undermining alone versus dermal grafting alone has not yet been completed. However, the author believes that a “pretunneling” step will aid the procedure in two ways: by promoting initial augmentation of the acne scars, or rhytides, and by establishing a well-vascularized bed of granulation tissue to accept the grafts once they are inserted 1½–2 weeks after the undermining.

Therefore, initially the scars or rhytides are simply undermined with an 18-gauge Nokor® needle (Becton Dickinson, Cockeysville, MD) under local anesthesia in an attempt to stimulate granulation tissue and to achieve some initial correction. Ten to 14 days later the patient returns to the surgical suite for the dermal grafting operation, which uses similar preparation, anesthesia, and sterile technique. A commonly selected and convenient donor site is the crease behind one or both ears in an area devoid of appendages. Under local anesthesia, this area is dermabraded with a coarse diamond fraise down to the level of the deep dermis (Figures 2 and 3).

The remaining ellipse of dermal fibrous fat is then harvested with a scalpel down the level of the retroauricular fascia (Figures 4 and 5). Alternatively, for correction of smaller acne scars alone, 3-mm punches of dermal fibrous fat tissue are harvested in two parallel rows. The resulting “serrated island” and other strips or desired sizes of grafts are then harvested down to the level of the deep fascia (Figures 6 and 7). All grafts are placed in chilled sterile saline, sorted, graded, and trimmed to exactly fit the recipient defects (Figure 8). Smaller “julienne” strips of dermis may be custom dissected to fit the exact length and width of particular rhytides. Closure of the donor site with running horizontal mattress 4/0 PDS or 4/0 Vicryl results in a linear scar hidden in the postauricular crease (Figure 9). This scar tissue, incidentally, is an excellent source of tissue for subsequent grafting procedures.

Undermining is then performed under the desired recipient sites: broad, soft acne scars; glabellar, nasolabial, perioral, or mental creases; atrophic upper or lower lips; depressed surgical scars; areas of lipoatrophy; and other soft tissue defects. Many of these imperfections are, in a sense, like the tufting on a sofa: the defect is bound down by bands of fibrous tissue connected to deeper facial musculature or fascia. Acne scars are best lifted with tunnels created by a 16- or 18-gauge Nokor needle; larger and narrower rhytides are easily floated following tunneling with a Rhytisector (Byron, Tucson, AZ) (Figures 10–13). Although this tunneling or undermining creates a “pocket” that allows scars or wrinkles to temporarily elevate, they would likely soon reattach to the underlying fibrous
bands if no filler substance were inserted into the pocket. Thus, insertion of the dermal grafts serves two purposes: permanent elevation of the desired scars or wrinkles, and creation of a permanent "spacer" between the overlying skin and the underlying fibrous band or scar tissue.

The dermal grafts can be carefully maneuvered and inserted into their pockets by means of a fine diamond-tipped jeweler's forceps (Robbins Instruments, Chatham, NJ) until a slight overcorrection is perceived (Figure 14). Alternatively, during correction of long rhytides, a suture on a Keith needle may be employed to pull the graft through the defect, a technique similar to that used for solid malar implants. Once the graft has been properly positioned, the permanent suture is released and the superior aspect of the graft is secured with a buried degradable suture (Figures 15–18). The needle holes (graft insertion sites) may be closed with Steri strips or fine

Figure 6. Dermal grafts harvested from non-hair-bearing postauricular region.

Figure 7. Harvesting of 3-mm punches of dermal tissue for use in dermal grafting for smaller acne scars.

Figure 8. Dermal grafts, dissected to various customized sizes, ready for implantation.
Degradable suture, followed by a nonadherent dressing (Figure 19).

Immediate correction of the scars or rhytides is evident upon dressing-removal in 2–4 days; crusting and bruising nearly always resolves within 7 days. Patients are able to return to work generally within 4–7 days.

Figure 11. Initiation of undermining with 18-gauge Nokor needle.

Comparison with Other Autologous Implants

In order to critically evaluate the results obtained from dermal pocket grafting, it is essential to compare this method with the other procedures that have been previously employed for soft-tissue augmentation.

Injectable bovine collagen implant (Zyderm®, Zyplast®) (Collagen Corporation, Palo Alto, CA) has proven ineffective for treatment of larger cutaneous defects because of high cost, need for repeated injections of increasing volumes, and risk of allergic reaction. Silicone, previously utilized by practitioners on both coasts, has been banned by the U.S. Food and Drug Administration. Fibrel® (Mentor Corp., Goleta, CA) has not achieved widespread acceptance because of the low volume of material produced from each kit, irritant reactions after injection, and questions about long-term maintenance of correction. The implantation of other foreign substances (Silastic®, plastics, Goretex®, synthetic collagen threads, permanent sutures), is slowly achieving increased phy-
A. SCAR OR WRINKLE UNDERMINED WITH 
NOKOR NEEDLE 10-14 DAYS PRIOR 
TO GRAFTING

B. UNDERMINING STIMULATES FORMATION 
OF GRANULATION TISSUE AND NEW 
COLLAGEN, PROVIDING SLIGHT 
CORRECTION

C. SCAR OR WRINKLE AGAIN UNDERMINED 
ON DAY OF PROCEDURE TO CREATE A 
'POCKET'

D. DERMAL GRAFTS INSERTED INTO POCKET 
WITH JEWELER'S FORCEPS

E. SCAR OR WRINKLE FULLY CORRECTED

Figure 13. Pocket grafting with dermal grafts.

Figure 14. Insertion of dermal graft through needle hole with fine diamond-tipped jeweler's forceps.

Figure 15. Rhytidsector adjacent to nasolabial fold prior 
to undermining.

Comparison of Dermal 
Grafting with Fat Transplantation

Long-term correction of the target defects with autologous fat transplantation has been unpredictable at best 
and disappointing at worst. \(^{13-18}\) Dermal implantation of fat, and accurate location via syringe or gun injection, is 
quite difficult. Lack of survival of injected fat cells may be due, in large part, to the absence of a connective tissue 
stroma, causing the labile cells to perish before adequate nutrients can reach them. Recent studies conducted 
months after "lipocytic dermal augmentation" revealed vacuolar degeneration of the injected fat, which was re-
placed by foamy histiocytes, chronic inflammatory cells, and scar formation. \(^{19}\)

Comparison with 
"Autologous Collagen" Implantation

"Autologous collagen" has been obtained via centrifuga-
tion of autologous fat cells, decantation of the super-
natant and infranatant, and disruption by passing the 
material back and forth between two syringes through a 
special stopcock (Bernsco, Seattle, WA). \(^{20}\) Mail-order au-
tologous collagen has also been offered, entailing the pro-

sician acceptance, but poses the risk of future rejection 
or allergic reaction.
Figure 16. Undermining of nasolabial fold with Rhytisector creating a tunnel.

Figure 17. Dermal graft, attached to suture on a Keith needle, has nearly been pulled through the recently created tunnel.

Figure 18. Dermal graft has now been pulled completely through. This pull-through suture will be divided, and the graft will be anchored at the superior aspect with a finer degradable suture.

Figure 19. Dermal grafting needle holes are closed with steri-strips alone.
cessing of large amounts of a patient's excised skin for shipment back to the referring physician for reinjection. Possible disadvantages here include the need for relatively large amounts of excised skin, high cost, a distant processing lab, and the theoretical possibility of a mix-up of shipped specimens.

Similarly, "cryolipoinjection" involves plunging syringes of autologous fat into liquid nitrogen, disrupting the lipocytes. Once thawed, the syringes are centrifuged for a sufficient time and speed to produce three distinct layers: a serosanguinous infranatant, a clear yellow lipid supernatant, and a central whitish gray zone of autologous collagen (also containing, in all likelihood, cell fragments and elastic tissue). After decanting both liquid layers, the autologous collagen is fragmented by passing it between two syringes through a special stopcock as outlined above. This collagenous material is then injected into the desired defect through a 25- or 27-gauge needle.

With all present forms of autologous-collagen injection, persistent long-lasting correction and full correction of the defect in question remain elusive goals. This may be due, in part, to the fact that fat only contains around 2% weight by volume of actual collagen (versus 3% weight by volume in Zyplast®), mostly in the form of collagen and fibrous septae. The injected material, then, seems to stimulate the body's immune and reparative responses to produce new fibrillar collagen bundles and microscopic dermal scars, which modify with time. Clinical augmentation, then, seems to occur via generation of newly synthesized host collagen rather than by persistence of the injected material.²¹
Figure 24. Correction, at 9-month interval, following one session of dermal grafting bilaterally.

Results and Complications of Pocket Grafting
A number of patients with both acne scars and deep rhytides have been followed for up to 3½ years. All patients treated to date with dermal grafting have achieved 40–70% correction with one procedure, with 50–100% correction after two pocket grafting procedures (Figures 20–30) persistent for at least 1 year. Some patients will request a subsequent dermabrasion to correct other related or unrelated cutaneous defects. Short-term complications include bruising, crusting at the insertion site, and mild edema. Secondary infection has not been seen. Scarring is obviated by the use of an 18-gauge Nokor needle to create the insertion site. To date, no permanent complications have been encountered, and no epidermal inclusion cysts have resulted from this maneuver.

Discussion
Why does this autologous-tissue graft survive so well? The answer most likely lies with the process of inoscu-

Figure 25. Female patient with prominent nasolabial folds and perioral folds.

Figure 26. Patient at 11-month follow-up revealing persistence of dermal grafts and absence of perioral creases or nasolabial folds. (This is the same patient depicted in Figures 14–17.)

Figure 27. Male patient with depressed undulating acne scars recurrent after injection with bovine collagen.
Scars are carefully marked in tangential light prior to dermal grafting.

Figure 28.

In this manner, dermal pocket grafts are similar to a standard full-thickness skin graft or a composite skin-cartilage graft. In contrast, as previously mentioned, this anastomosis is difficult or impossible to achieve with injected liquid fat, resulting in the death of many or all of the injected cells.

This method of autologous tissue delivery offers a number of significant advantages for the correction of soft-tissue defects. Dermal grafts possess many of the qualities of the ideal filler substance: they are readily available in abundant supply, are not rejected, maintain permanent correction of the desired defect, and can be accurately tailored and meticulously inserted to exactly fit a variety of cutaneous defects. Their only apparent drawback is the length of the surgical procedure, resulting in a cosmetic surgical cost to the patient.

In the future, pocket grafting may prove to be effective for therapy of “cellulite” dimples (skin depressions in fatty body areas caused by downward traction of fibrous bands). Cellulite is improved little, if at all, by tumescent liposuction. However, these defects may possibly be elevated by undermining and subsequently could be permanently corrected by means of soft-tissue grafts inserted through an adjacent needle hole. Further study and long-term follow-up in this area is required.

Additional areas for further clinical research include: an analysis of preoperative and postoperative skin biopsies to determine long-term persistence of the grafts; experience with grafts from other sources (including the palate, thick dermis of the upper back, quiescent surgical scars, and fibrous capsules from tissue expanders); use on other body areas or for other types of defects or diseases; and combination with other surgical procedures. Preoperative and postoperative biopsies have not been performed due to the facial location in private patients, the difficulty in proving an increased thickness to the dermis, and the probability that a histologic section would likely reveal only a scar with increased collagen bundles and fibrosis. However, should an appropriate histologic marker be discovered, perhaps tissue biopsy could be employed to further evaluate this technique. It is clear, however, that dermal pocket grafting offers a promising new modality for permanent correction of cutaneous defects by means of autologous tissue implants.

Figure 29. Result at 2-year interval following two dermal grafting procedures.

Figure 30. Follow-up at 2 years and 9 months, after subsequent dermabrasion, reveals excellent result with settling of dermal grafts and smoothing of smaller facial depressions.
References


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