

# Hand Rejuvenation: A Comprehensive Review of Fat Grafting

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Dermal atrophy, bulging reticular veins, and prominent bones and tendons are characteristic of the aging hand. Demand for cosmetic procedures to restore a youthful appearance to the dorsum of the hand has risen in recent years. A review of the literature reveals that of the many options for hand restoration, autologous fat grafting stands out as the most promising choice compared with many available alternative options such as microdermabrasion, peeling agents, and dermal fillers. This article details the surgical technique and relevant anatomy necessary for successful hand rejuvenation. Future advancements may rely on further study into adipose-derived stem cells. (*J Hand Surg Am.* 2016;41(5):639–644. Copyright © 2016 by the American Society for Surgery of the Hand. All rights reserved.)

**Key words** Hand rejuvenation, fat grafting, cosmetic, autologous.

## HAND AESTHETICS

The appearance of the hands is a telltale sign of a person's true age.<sup>1</sup> Studies have shown that people are able to roughly estimate a person's age solely by viewing their hands.<sup>2</sup> Other than the face and neck, the hands are the most visible part of the human body and often have high exposure to environmental factors such as ultraviolet light and common household chemicals, which may lead to accelerated aging.<sup>3–6</sup> Therefore, it is unsurprising that the popularity of procedures to restore a youthful appearance to the hands has increased by over 60% in the past decade.<sup>2,7–11</sup>

The challenge for surgeons is to reverse the effects of aging by restoring the smooth contour and fullness characteristic of a young hand. Extrinsic effects on the hand include dermatoheliosis, or photoaging, which leads to wrinkles and irregular pigmentation

such as solar lentigines, solar purpura, punctate hypopigmentation, actinic keratosis, seborrheic keratosis, and telangiectasia.<sup>6,12,13</sup> Aging also leads to intrinsic effects such as the gradual disappearance of subcutaneous fullness and tissue atrophy in the form of collagen depletion and dehydration.<sup>11,14,15</sup> This leads to dorsal skin wrinkling and greater visibility of the extensor tendons, and makes subcutaneous veins appear more blue and tortuous.<sup>3,16</sup>

Multiple options are available for physicians and patients to consider for addressing these factors, all of which have their own unique effects on the dorsal appearance of the hand. Ablative procedures using trichloroacetic acid or phenol skin peels improve the quality of the skin by inducing dermal thickening and can also lighten pigmentation changes.<sup>1,8,12,17,18</sup> Surgical hand lift excises redundant skin and wrinkles from the dorsal hand, wrist, and forearm.<sup>18–20</sup> Dermal fillers such as polymethylmethacrylate, calcium hydroxyapatite (Radiesse, Merz Aesthetics, Franksville, WI), hyaluronic acid, poly-L-lactic acid, collagen, and silicone create a fuller-looking hand by reducing skin laxity and wrinkling and by hiding prominent structures such as bones, tendons, and veins. Some achieve this through the induction of neocollagenesis.<sup>5,6,9,11,13,15–17,21,22</sup> Laser treatments such as Q-switched lasers, intense pulsed light, photodynamic therapy, ablative fractionated lasers, non-ablative fractionated lasers, non-ablative resurfacing lasers, radio frequency, and plasma skin

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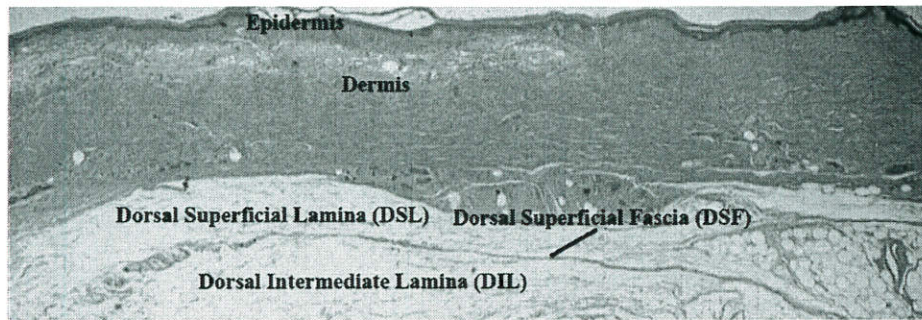
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**TABLE 1. Alternative Methods for Youthful Hands**

Alternative	Disadvantages			
Ablative procedures	Trichloroacetic acid skin peel <sup>1,8,12,18</sup> Phenol skin peel <sup>17,18</sup>	Epidermis and basal membrane injury leading to fibrosis of papillary dermis and dyspigmentation Epidermis and basal membrane injury leading to fibrosis of papillary dermis and dyspigmentation. Hypertrophic scars may also form		
	Skin tightening	Hand lift <sup>18-20</sup> Injury to superficial branch of radial nerve and dorsal branch of ulnar nerve, wound dehiscence, and decreased range of motion of wrist. Significant damage to epidermis and basal membrane leading to postinflammatory skin hyperpigmentation		
Dermal filler	Polymethylmethacrylate <sup>9</sup> Calcium hydroxyapatite (Radiesse) <sup>9,13,21</sup> Hyaluronic acid <sup>6,9,11,13,15</sup> Poly-L-lactic acid <sup>9,13,16</sup> Collagen <sup>5,6,22</sup> Silicone <sup>17</sup>	Contour deformity, sensory dysfunction, inflammatory symptoms, stiffness Contour deformity, inflammatory symptoms, stiffness. Transitory erythema, pruritus, ecchymosis, and edema that can last up to 2 wk Contour deformity, inflammatory symptoms, skin induration Contour deformity, inflammatory symptoms, subcutaneous nodules Nodule formation resolved by 6 mo, allergic reaction to bovine collagen Migration leading to subdermal mounds, yellowing of silicone		
	Laser	Q-switched laser <sup>8,13</sup> Intense pulsed light <sup>8,13</sup> Photodynamic therapy <sup>13</sup> Ablative fractionated lasers <sup>8,13</sup> Non-ablative resurfacing lasers <sup>8,13</sup> Non-ablative fractionated lasers <sup>13</sup> Radio frequency <sup>8</sup> Plasma skin regeneration <sup>23</sup>	Erythema, hypopigmentation, hyperpigmentation, scarring, textural change, crusting, bleeding, bullae formation No significant side effects observed Pruritus, erosions, erythema, edema, pain, scaling, crusting Risk of infection, dyschromia, scarring. Healing is slow and prone to complications Requires multiple treatments Erosions, herpetic reactivation, secondary bacterial impetiginization, edema, acneiform eruptions Has not been studied for cosmetic benefits Erythema, edema, desquamation	
		Vein therapy	Sclerotherapy <sup>13</sup> Endovenous laser ablation <sup>13</sup> Phlebectomy <sup>12,17</sup>	Pain, ecchymosis, various degrees of edema, coagulum of treated veins Skin burn and hand swelling Bruising and edema are variable and will be slowly resorbed
			Cosmetics & Accessories	Jewelry <sup>12</sup> Makeup <sup>12</sup>
		Dermocosmetics		Antioxidants <sup>8,12</sup> Growth factors <sup>12</sup>
			Other	Percutaneous collagen induction <sup>18,24</sup> Dermabrasion <sup>17</sup>

regeneration provide a variety of visible effects including epidermal whitening, removal of visible lesions, improved skin texture, reduced noticeable wrinkling, and dermal remodeling.<sup>8,13,23</sup> Prominent veins can be treated by sclerotherapy, endovenous laser ablation, and phlebectomy.<sup>12,13,17</sup> Percutaneous

collagen induction and dermabrasion are mechanical techniques that invoke epidermal thickening and elastin deposition.<sup>17,18,24</sup> Finally, accessories, cosmetics and dermocosmetics such as jewelry, makeup and antioxidants respectively, in addition to growth factors are a common choice for patients wanting to



**FIGURE 1:** Histologic slide demonstrating dorsal superficial lamina (DSL), dorsal superficial fascia (DSF), and dorsal intermediate lamina (DIL). (Reprinted with permission from Bidic et al.<sup>26</sup>)



**FIGURE 2:** Duplex ultrasound image demonstrating sagittal section of hand, showing the veins in the dorsal intermediate lamina (DIL). DSL, dorsal superficial lamina; DSF, dorsal superficial fascia; DIF, dorsal intermediate fascia; DDF, dorsal deep fascia; DDL, dorsal deep lamina. (Reprinted with permission from Bidic et al.<sup>26</sup>)

restore a youthful look to their hands.<sup>8,12</sup> All of these choices come with their own complications (Table 1).

After reviewing the literature on hand rejuvenation from the past 20 years, we have concluded that autologous fat grafting not only stands out as a superior choice but should be accepted as the standard approach for patients requesting younger-looking hands. Fat grafting to the dorsum of the hands dates back to the 1980s and has since evolved to become a reliable and safe intervention.<sup>3,25</sup>

### RELEVANT ANATOMY

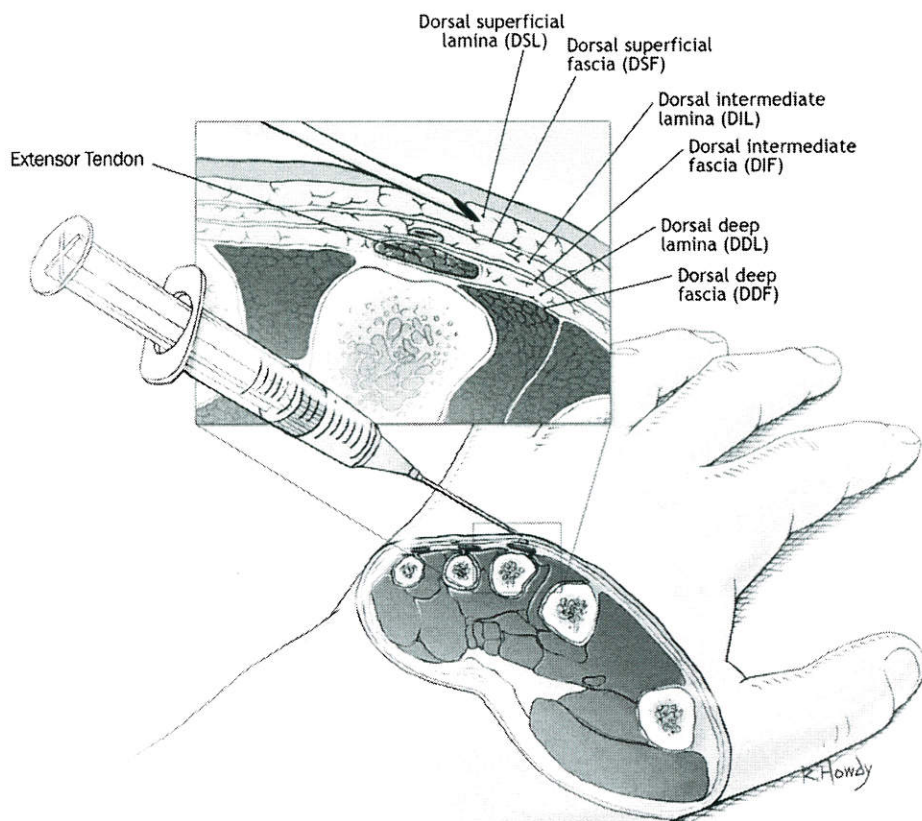
Bidic et al<sup>26</sup> investigated the dorsal hand anatomy relevant to the injection of cosmetic dermal fillers. Their studies of cadaver hands used histologic analysis (Figure 1), duplex ultrasound imaging to explore lamination in the dorsal skin (Figure 2), and lead oxide injection to examine the vascularity of perforating septa. They discovered that in the dorsal subcutaneous tissue there are three distinct fatty-areolar laminae, each separated by a facial layer. The dorsal veins and sensory nerves reside in the middle layer whereas the extensor tendons reside in the deepest stratum. The most superficial lamina contains no anatomic structures. They

concluded that theoretically, fat grafts could be injected into this layer without jeopardizing dorsal veins, sensory nerves, or extensor tendons (Figure 3).

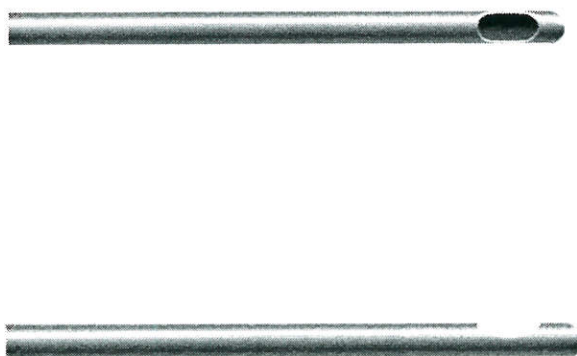
### METHODS FOR FAT GRAFTING

Although many treatment approaches have proven successful in various aspects of hand rejuvenation, none offer the complete restorative capacity of autologous fat grafting. First reported by Zuk et al<sup>27</sup> in 2001, multipotent stem cells found within adult adipose tissue have been used as primary or adjunctive treatment for many cosmetic procedures.<sup>28,29</sup> Harvested adipose tissue is autologous, completely biocompatible, and available in sufficient quantities; it naturally integrates into the host tissues, is removable if necessary, and is potentially permanent.<sup>30</sup> Fat reestablishes the fullness of a youthful hand by addressing the dorsal skeletonization that is the main effect of aging.<sup>8</sup>

Beginning in the late 1980s, autologous fat grafts showed promise as a means to restore dorsal hand contour.<sup>13</sup> Fournier, a pioneer of the procedure, was a proponent of injecting a large bolus of fat into the dorsum and then massaging it throughout the rest of the hand.<sup>3,13,31</sup> The result of this was unpredictable and the procedure was generally regarded as unreliable.<sup>3,13</sup> It



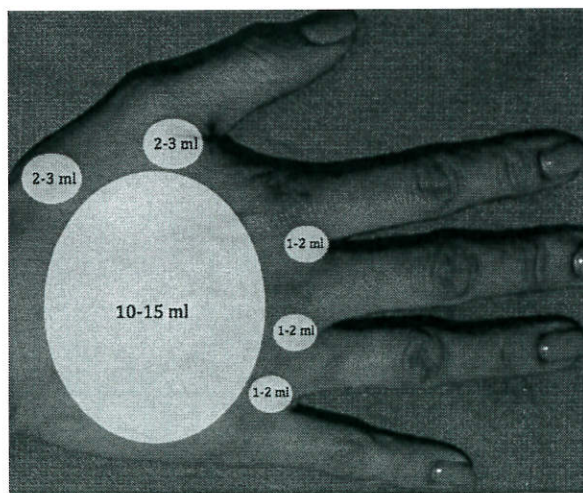
**FIGURE 3:** Different fascial layers and fatty laminae, with injection cannula placed within the dorsal superficial lamina. Abbreviations as in Figure 2. (Reprinted with permission from Bidic et al.<sup>26</sup>)



**FIGURE 4:** Front and side views of the tip of the blunt 17-gauge cannula used to place the fatty tissue. The 7- to 9-cm cannula is completely capped with a side opening located within 2 mm of the blunt tip. (Reprinted with permission from Aust et al.<sup>18</sup>)

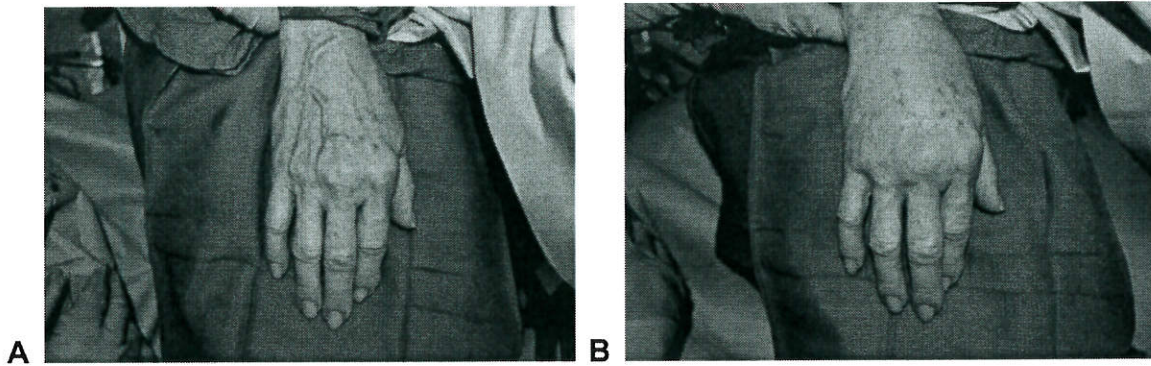
was not until 1992 that Coleman modified the technique to the form still used today, which has fewer complications and a high level of patient satisfaction.<sup>13</sup>

Fat may be harvested from a multitude of sites based on patient preference. Locations such as the abdomen, flank, thigh, or medial knees all yield dense bloodless fat.<sup>3,13,31</sup> The zone chosen should be marked while the patient is standing if this it is located in the trochanteric



**FIGURE 5:** Fat grafting to the dorsum of the hand. Stab incision are made and blunt cannulae are used to introduce small aliquots of fat for a total of 10 to 15 mL in the dorsum of the hand, 2 to 3 mL in the snuffbox, and 1 to 2 mL in each dorsal webpace. (Reprinted with permission from Bank et al.<sup>25</sup>)

region or hip, or with the patient supine if it is located in the lateral buttock or abdominal wall, because the morphology of these regions is modified by position.<sup>17</sup> A tumescent solution, usually lidocaine with



**FIGURE 6:** A Before and B after fat grafting to the dorsum of hand. Enough fat should be injected to give hands a puffy, slightly overfilled look.

epinephrine, is injected into the harvest site 15 minutes before the collection.<sup>1,8,13,25</sup> A 10-mL tulip syringe with a 2- to 3-mm cannula is then used to harvest 15 to 40 mL of fat per hand. This is allowed to separate into supranatant fat and infranatant fluid within the syringe.<sup>1,3,8,13,17</sup> After the fluid is poured off, the supranatant fat is combined with a second decanted syringe.<sup>3,13,17</sup> The full 10-mL syringes are centrifuged at 3,000 to 3,600 revolutions per minute for 3 minutes to concentrate the fat further.<sup>3,8,13</sup> Centrifuged fat is preferred because it has better overall longevity owing to an increased concentration of adipose cells, which leads to longer survival and slower resorption of the injected volume.<sup>13,32</sup>

The hand is prepared and draped in a sterile fashion and is anesthetized with lidocaine at either the injection sites or dorsal wrist crease, followed by massage to disseminate the local anesthetic solution throughout the dorsum of the hand.<sup>1,13,17</sup> The graft is performed using a 1- to 3-mL syringe with a 1-mL blunt cannula through a stab incision made with an number 11 blade or 18-gauge needle.<sup>3,7,8,13,25</sup> Sharp needles were abandoned for blunt cannulae (Fig. 4) to reduce the risk of dorsal vein perforation.<sup>3</sup> Sommer and Sattler<sup>33</sup> reviewed various approaches and success rates and concluded that good results have been reported regardless of technique as long as small volumes are used. Carpeneda<sup>32</sup> was the first of many to note that in histologic study, the diameter of a parcel of injected fat must be 3 mm or less for neovascularization to occur.<sup>8</sup> The fat is injected in a retrograde fashion with 0.3 mL or smaller aliquots as the cannula is withdrawn.<sup>3,8,13</sup> Coleman<sup>3</sup> and Fabi and Goldman<sup>13</sup> advocated a technique that involves many small tunnels to maximize surface area contact between the fat and recipient tissues. This encourages nutrition, respiration, stability, integration, and uniformity of the grafted fat.<sup>3,13</sup> Studies have demonstrated that 60% of grafted fat cells that are more

than 1 mm from a source of respiration and nutrition will die.<sup>13,34</sup> An example of fat allocation is diagrammed in Figure 5, which involves dispersing the fat in a fanning ray pattern.<sup>25</sup> Between 10 and 30 mL of fat should be injected to give the hand a puffy, slightly overfilled look (Fig. 6).<sup>1,13,17,25</sup> A small volume of fat tissue should also be injected at the base of each finger, because failing to do so will be noticeable.<sup>17</sup> Incisions are closed with either absorbable suture or Octylseal (Medline Industries, Mundelein, IL) and Steri-Strips (3M Nexcare, St. Paul, MN).<sup>25</sup> Hands should be elevated for the first 24 hours and a soft dressing should be used postoperatively for 5 days.<sup>1,8,13,25</sup> Authors disagree on whether the hands should be massaged during the first postoperative week.<sup>1,3</sup> Patients should be warned that edema and ecchymosis will be apparent for 1 to 2 weeks.<sup>8,13</sup> Antibiotics should be prescribed for 10 days, beginning the evening before the surgery.<sup>8,13</sup>

## COMPLICATIONS

With use of the most up-to-date techniques, autologous fat grafting is associated with few complications. Reported complications include cellulitis at the fat harvest donor site, transient digital numbness,<sup>25</sup> infections at both hand and harvest sites,<sup>8</sup> cyst formation<sup>8,17</sup> in 10% of patients, temporary dysesthesia,<sup>8</sup> fat necrosis,<sup>8,35</sup> and reabsorption of the grafted fat,<sup>1,17</sup> which is the most common complication. As many as 24% of patients required repeat fat injection in one study.<sup>1</sup> A second study indicated that 10% of patients require reinjection to achieve long-lasting results.<sup>17</sup>

## FUTURE OF FAT GRAFTING

Future advancements in fat grafting to the dorsum of the hand may rely on continuing research into adipose-derived stem cells (ASC) and their use in the grafting process. The density of stem cell reserves varies as a

function of the location and type of adipose tissue.<sup>28,29</sup> Several articles have stated that in white adipose tissue, ASC yields are greatest in subcutaneous depots compared with visceral fat, with the highest concentrations in arm adipose tissue depots, and that the greatest plasticity is in ASCs isolated from inguinal adipose tissue depots.<sup>28,29,36</sup> This information may provide insight into the most effective harvesting site for autologous fat grafting procedures.

Recent studies<sup>37</sup> have confirmed that patients are concerned not only about hand function but also about hand cosmesis, particularly when it comes to reversing the effects of aging by restoring smooth contours and fullness. Volume restoration in the hand improves hand cosmesis; in the future, pending further study, ASCs may have a role in hand rejuvenation.

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