CHALLENGES, CONSIDERATIONS, AND STRATEGIES IN HAND REJUVENATION

Release Date: July 1, 2016
Termination Date: June 30, 2017
Estimated Time to Complete This CME Activity: 1 hour
Medium or Combination of Media Used: Written article
Method of Physical Participation: Journal article, Journal post-test, web-based post-test, and evaluation
Hardware/Software Requirements: High speed internet connection, any web browser

Statement of Need

Dermatologists need to increase recognition of the complex, multifactorial process of skin aging influenced by exogenous and endogenous factors presenting in volume loss, rhytides formation, pigmentary alterations, and vascular changes.

There is need for increased medical knowledge of the multidimensional process of aging in the hands. A need exists for expanded clinical knowledge of broad strategies for rejuvenating the aging hand including the use of soft tissue augmentation is essential when treating the cosmetic dermatology patient.

There is a gap in the understanding of hand anatomy, the unique characteristics of the hand epidermis and dermis as they relate to successful injection strategies with optimal outcomes.

Educational Objectives

This activity is a multi-specialty, evidence-based initiative designed to increase the knowledge and competence of dermatological practitioners by providing them with the simultaneous integration of knowledge, skills, and judgment from thought-leader testimonials, science-based research, and evidence-based data to address the difference between present patient outcomes and those considered achievable in the field of dermatology.

Upon completion of this CME activity, learners should be able to:

- Recognize the clinical impact of intrinsic and extrinsic factors of the normal aging process in male and female patients of all skin types.
- Recognize common manifestations of intrinsic and extrinsic aging of the hands.
- Define strategies for the successful rejuvenation of the aging hand.
- Differentiate commonly utilized injection techniques using dermal fillers in the planning of soft tissue augmentation of the aging hand.
- Identify essential hand anatomy and characteristics of aging skin of the hands as they relate to aesthetics.

Target Audience

This activity is intended for dermatologists, residents in dermatology, and physician assistants to have an increased understanding of relevant anatomy of the hand relative to the safe and efficacious use of injectable dermal fillers used for successful aesthetic rejuvenation of the aging hand. To this end, dermatology healthcare providers will have increased skill in recognizing anatomic variations present in their patients, in proper injection techniques and product use, and in pre-empting procedure complications and management of potential adverse events.

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The peer reviewers have disclosed no relationships with commercial interests.

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Challenges, Considerations, and Strategies in Hand Rejuvenation

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ABSTRACT

Hand rejuvenation is an increasingly requested procedure in dermatology. Dorsal hand augmentation with soft tissue filler is one aspect of hand rejuvenation. Calcium hydroxyapatite is FDA approved for this purpose, while at the present time other filler products are utilized but are considered off-label for dorsal hand augmentation. This article reviews the relevant anatomy, the general and filler-specific techniques commonly employed, and potential complications that may arise.

J Drugs Dermatol. 2016;15(7):809-815.

INTRODUCTION

An increasing number of patients are requesting rejuvenation of the aging hand. Despite the hands being one of the first areas to show signs of aging due to their high levels of exposure (especially to ultraviolet radiation) and significant amounts of wear and tear, the vast majority of aesthetic procedures have traditionally focused on the face with little attention paid to the hands. Treating just the face can lead to a discrepancy between a rejuvenated facial appearance and the aged appearance of the hands.[1]

Current methods of hand rejuvenation include autologous fat injection, sclerotherapy, intense pulsed light, laser therapies, chemical peels, and microdermabrasion.[2] Aside from cumulative extrinsic factors like ultraviolet radiation, microcirculation deficiency may also potentially play a role in intrinsic aging of the skin, a manifestation of diabetes mellitus and peripheral arterial occlusive disease.[3] Loss of volume is believed to occur specifically because as aging occurs, the skin loses its subcutaneous fat and muscles resulting in thinning skin.[4] Other than fat injections, these device-based treatments and other procedures (eg, light-based therapies or peels) do not address volume loss and focus on textural changes and dyschromia. Hand augmentation with soft tissue fillers represents an important and emerging tool in providing volume replacement.

Volume restoration of the aging dorsal hands can provide a more youthful appearance, decrease skin laxity and wrinkling, and reduce the prominence of underlying structures such as veins, bones, and tendons.[5] The ideal filler for this purpose effectively adds bulk and volume, and is also durable enough to withstand repeated dynamic motion.[5] This review discusses the relevant anatomy, techniques for soft tissue augmentation, and potential complications of the procedure.

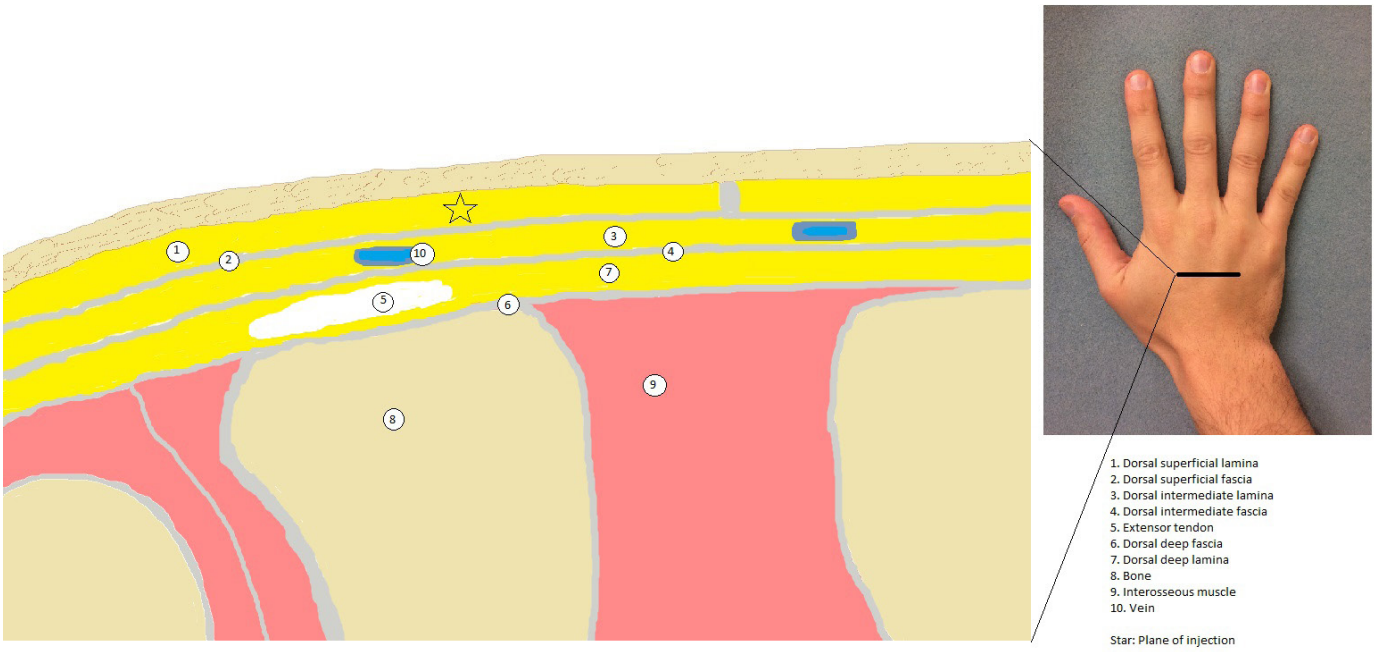
Anatomy

The skin and soft-tissue layers of the dorsal hand from most superficial to deep include the epidermis, dermis, two fascial planes intersecting fatty lamina, tendons, and finally, the deep fascia that covers the metacarpals and the interosseous muscles.[6,7] Histologic analysis of the dorsal hands reveals each of these three distinct fascial layers (Figure 1). The dorsal superficial fascia separates the superficial fatty lamina from the intermediate lamina, and the dorsal intermediate fascia separates the intermediate lamina from the deep lamina.[8] The thickness of the components of the dorsal hands can vary dramatically from patient to patient. The dorsum of the hand itself has a relatively thin dermis, which becomes more attenuated with the aging process. Lefebvre-Vilardebo et al examined ultrasound images of 14 healthy volunteers aged 25-72 and found the thickness of the dermis measured from 0.2 to 0.9 mm, the fascial plane from 0.3 to 2.2 mm, and the tendon layer from 0.7 to 1.7 mm. Overall the total thickness of all dorsal hand layers ranged from 2.2 to 4.6 mm.[6]

The venous system of the dorsal hand is an interconnected network that can be found within different levels of the fascial layers.[6] However, veins are found to be in highest concentration, along with residing sensory nerves, in the dorsal intermediate lamina.[8] By contrast, the dorsal superficial lamina has no distinct structures traveling within the plane.[8]

Treatment success after cosmetic procedures can be measured subjectively in several specific regions with patient satisfaction questionnaires. Objective success for hand rejuvenation can be measured using the Merz Hand Grading Scale (MHGS). The MHGS is a 5-point scale used to grade appearance of the dorsum of the hand (Table 1).[9] This tool has been validated for

FIGURE 1. Cross-sectional anatomy of the dorsal hand. The area indicated by the star is the plane at which soft tissue filler should be injected. Adapted from Lefebvre-Vilardebo et al. Hand: Clinical Anatomy and Regional Approaches with Injectable Fillers. *Plast Reconstr Surg.* 136(5).



both photographic and live assessments when compared to the Global Aesthetic Improvement Scale (GAIS).[10]

Technique

Pre-procedure evaluation of dorsal hand augmentation often includes an assessment of how much volume loss has occurred, and a plan in terms of anticipated volume of filler, as well as what specific filler, is anticipated to be used. As stated, calcium hydroxyapatite (Radiesse) is currently the only agent that is FDA approved for the purpose of dorsal hand augmentation, but other filler agents have been and continue to be used "off-label" for this specific purpose.

Prior to performing the augmentation, aesthetic physicians will often get a detailed list of current medications, inquire as to a history of medical problems and history of bleeding abnormalities, as well as find out what type of work or hobbies the patient may frequently perform that may utilize the hands (such as lots of keyboard activity or playing the piano), as some degree of swelling usually does occur.[11] Anti-coagulant medications such as aspirin, NSAIDs like ibuprofen, and vitamins and herbals that are known to affect the coagulation pathways are often discontinued 5-7 days before treatment to minimize bruising[12] but the authors do not discontinue prescription anticoagulants or even aspirin if the patient specifically has a personal history of a heart attack, stroke, blood clot, or atrial fibrillation.

Various augmentation agents have been reported to decrease the appearance of aging in the dorsal hands. We will discuss techniques for autologous fat grafting, hyaluronic acid (HA), poly-L-lactic acid (PLLA), and also the mentioned agent that has specific FDA indication for this purpose at this point, calcium hydroxyapatite (CaHA). See Table 2 for an overview of these fillers.

Irrespective of the agent or filler, the general technique for injecting into the dorsal hand is often similar. Many physicians have the patient use a topical anesthetic for 30-40 minutes (sometimes under occlusion) prior to initiating the procedure. Placing the patient in Trendelenburg position can reduce vein pressure and thus potentially decrease bleeding, which can be helpful in trying to minimize bruising and swelling. A very clean technique should be used and consists of the patient washing their hands with soap and water followed by the injector then cleansing the treatment area diligently with an antiseptic. One

TABLE 1.

The Merz Hand Grading Scale[9]	
Score	**Description**
0	No loss of fatty tissue
1	Mild loss of fatty tissue; slight visibility of veins
2	Moderate loss of fatty tissue; mild visibility of veins and tendons
3	Severe loss of fatty tissue; moderate visibility of veins and tendons
4	Very severe loss of fatty tissue; marked visibility of veins and tendons

TABLE 2.

Soft Tissue Fillers Used for Dorsal Hand Augmentation		
Filler	**Advantages**	**Disadvantages**
Calcium Hydroxyapatite	FDA-approved	Not reversible like Hyaluronic Acid
Hyaluronic Acid	Can be corrected with hyaluronidase	If injected too superficially, may risk blue appearance secondary to Tyndall effect
Poly-L-Lactic Acid	Clear-cut biostimulatory mechanism has been shown	Usually requires multiple injection sessions. Can cause nodule formation
Autologous Fat	No rejection risk	Cumbersome as material needs to be harvested from the patient. Unpredictable results

of the authors (JLC) preps the skin with two passes of isopropyl alcohol followed by two passes with Chlorhexidine scrub.

The boundaries of the area treated are usually the fifth metacarpal laterally, the second metacarpal medially, and the dorsal wrist crease proximally.[5] Filler agents have typically been injected with a 27-30 gauge ½ inch needle into the subdermal and subfascial plane, but superficial (dorsal) to the deep fascia.[10,13] The thumb and the forefinger of the non-injecting hand are used to lift the skin over the dorsal aspect of the hand being treated.[5] This type of skin tenting can be used to separate the superficial fascial layers from the deep lamina, which contains vascular and tendinous structures. The patient's hand should be held loosely in a resting position as the filler is injected subcutaneously at an oblique angle adjacent to the dorsal veins of the hand.[2] Some injectors now prefer to use a 25 gauge 1.5 inch cannula to inject filler into the dorsal hand, making the initial entrance nick into the skin with an 18-22 gauge needle. Whether using a needle or cannula, a distal approach (more common) or proximal approach may be employed in order to place the filler volume in the appropriate places alongside tendons and veins. Distinct differences and volumes for each filler are discussed below.

The most commonly used technique is with a needle. However, some providers are more comfortable using a cannula. With a cannula, usually there are less entrance sites (often 2-3 total) that can be used for the cannula to be fanned-out in order to access areas of volume depletion. Especially when using a cannula, tenting the skin can help provide an easier passage to reach areas of volume loss.[14] In 2012, a double-blinded, randomized controlled trial compared a metallic cannula to a standard needle for soft tissue augmentation of the nasolabial folds. The authors reported less pain, edema, bruising, and redness with a metallic cannula.[15]

Performing gentle hand massage after injection (usually with the hand in complete flexion) is quite common. Chlorhexidine prep, ultrasound gel, vitamin K cream, or a mild lotion can be used to massage out visible lumps or bumps in a smooth fashion.[14] Patients often ice the treated area in the office for at least 10 minutes. Some physicians then prefer for the treated areas to be bandaged with a compression, non-stick wrap, and patients are sometimes even instructed to sit on their hands immediately post procedure in an effort to try to minimize swelling. Patients are usually recommended to avoid workouts for a day or two and also elevate their hands above the level of their heart several times that day for at least 15-20 minutes, also in an effort to try to minimize swelling.

In general, no massage by the patient is required or encouraged unless specified for the particular filler below.[5] Patients may return to normal activities as soon as they are comfortable. Mild swelling and bruising may be expected and can often last about 1 to 2 weeks. Some physicians prefer that some patients (especially those less known to the practice from a history of other procedures) be seen 14 days after initial injection for follow-up, and to reassess. More augmentation can occur at this re-check visit if needed or desired.[13]

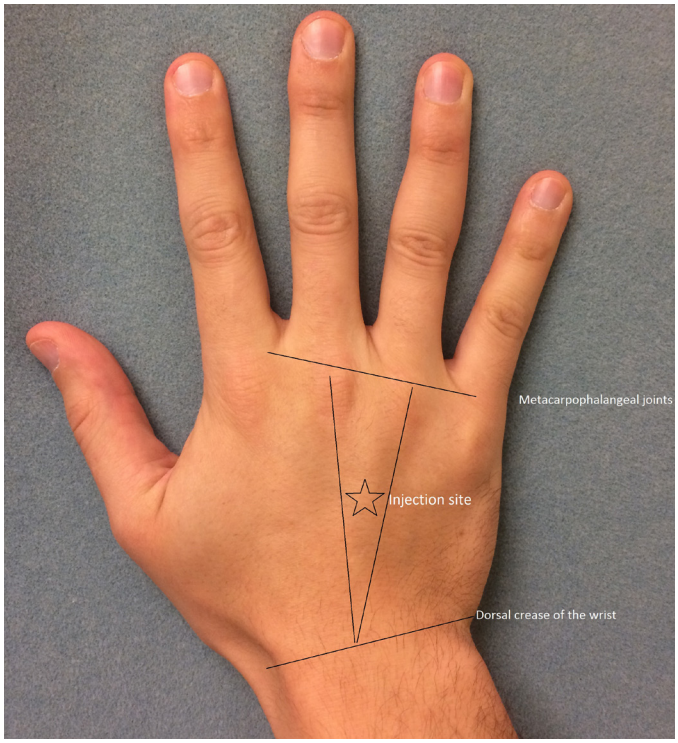
Autologous Fat Grafting

Autologous fat transfer has been used for a variety of reasons since 1889.[16] In the late 1980s, autologous fat grafts showed promise as a means of rejuvenation by restoring a youthful fullness to the dorsum of the hand.[17] Autologous fat treatment involves aspiration and harvesting of fat from a donor site and injection into the treated area through small incisions or 18-gauge needle holes with a micro cannula.[12] In 2002, Coleman described his technique of delivering fat in a structured fashion with many minuscule tunnels, thus advancing our knowledge of dorsal hand injection.[18] Additionally, reported complications of fat grafting, including infection, cyst formation, temporary dysesthesia, and significant edema, provided a benchmark of comparison for soft tissue fillers.[17] While autologous fat grafting is the earliest described technique for hand augmentation, it is more invasive (especially with the need for sites of harvesting) and time-consuming and has somewhat unpredictable results.[19] While it is still performed and popular in some aesthetic practices today, the scope of this article will focus on soft tissue fillers.

Hyaluronic Acid

Hyaluronic acid products are commonly used off-label to restore lost dorsal hand volume. Examples of HA fillers include

FIGURE 2. Injection site for pauci-bolus technique (indicated by the star).



Restylane, Belotero, and Juvederm.[12] *Streptococcus* species of bacteria generate HA. All three of these families of HA products available for use in the US are approved for facial soft tissue augmentation specific indications and not for hand rejuvenation. It is known that HA, in general, binds and retains water and can thereby increase turgor and tissue volume. HA is also thought to stimulate collagen production.[20,21] Although hyaluronic acid is biodegradable, crosslinking of HA improves its durability. A distinct advantage of HA is that imperfections or undesired product can usually be reversed in the short term using hyaluronidase enzyme.[19] There are two commercially available formulations of hyaluronidase, including Vitrase (ovine derived and requires skin testing) and Hylenex (human derived and does not require any skin testing).

Man et al compared HA versus human collagen. While this human collagen (Cosmoplast), which is no longer available,[19] was better tolerated overall with regards to adverse effects, patient satisfaction was higher with hyaluronic acid. Additionally, blinded independent board-certified investigators found the results of hyaluronic acid to be superior to human collagen injections.[2]

Brandt et al evaluated small gel particle HA in a prospective open-label study of 16 patients in the dorsal hand. Two weeks after treatment, vascular, tendon, bony prominence, and skin turgor were improved by 60.9%, 65.2%, 73.7%, and 26.3%, respectively. Substantial or complete global aesthetic improvement was rated in 75% of patients by investigators and in 56% by patient self-report; 81% of patients were satisfied or very satisfied.[19] In this study, the authors describe a threading technique using 2-4 ml of filler into the proximal hand and subsequently massaging distally using an anti-bruising cream, with subsequent melting ice application.[19]

Dallara described 99 patients in Europe who received combined HA (Juvederm Ultra 3 and Juvederm Hydrate) treatment. The mean volume injected was 1.02 ml of the former HA per hand at day 0 (minimum = 0.8 ml and maximum = 1.6 ml) and 0.91 ml of the latter HA per side at day 15 (minimum = 0.5 ml and maximum = 1 ml). The mean grade at baseline, according to the hand grading scale (named the Carruthers Aging Hand Scale in the study), was 3.18 (3.20 for the left hand and 3.16 for the right hand). This decreased at day 15 to 1.97 (1.96 and 1.99 for left and right hands, respectively) and at day 30 the mean score was 1.73 (1.71 for the left hand and 1.74 for the right hand).[1]

Poly-L-Lactic Acid

PLLA (Sculptra) is a synthetic, biocompatible, biodegradable filler associated with a low risk of allergic reaction.[22] It is thought to stimulate the production of collagen in areas of volume loss.[12] The use of injectable PLLA for dorsal hand augmentation has not been evaluated or approved by the US Food Drug Administration and is considered off-label.[23] Redaelli described 27 patients with an average age of 65.9 years who were treated with PLLA for augmentation of the dorsal hands.[22] His study found a measurable decrease in vein tortuosity and extensor tendon visibility. For the evaluation of the results, a patient's satisfaction score (PSS) and a physician's satisfaction score (PhSS) was calculated from the second to the last treatment session (minimum 3, maximum 6, average 4.03 sessions per patient). A definitive (composite) graduated score (DGS) was then calculated for each patient. The DGS was the average of the PSS and PhSS (scores from 1 to 10). The PSS relevant to hands ranged from 4 to 9 (two patients scored 4 and two patients scored 9) averaging 6.59. The PhSS ranged from 4 (three patients) to 9 (two patients), averaging 6.4. In 6 patients (22.2%), the DGS was less than 5, in 14 patients (51.8%), it was 6 to 7, and in 7 patients (25.9%), it was greater than 8.[22]

PLLA can be reconstituted with bacteriostatic water with or without lidocaine 1%.[22,23] This reconstitution is recommended to stand for at least several hours, but usually a minimum of overnight is preferred by most injectors and, specifically, a higher-volume reconstitution (with 7-10 cc's) is preferred by most.[17] Injections of reconstituted PLLA are most frequently performed with a 25-27 gauge needle at an angle of 30-40 degrees into the deep dermis. Some physicians advocate aspirating back on the syringe to try to ensure that the needle (or cannula) is not in a vessel. Placement of subcutaneous aliquots of 0.1-0.2 ml per site is commonplace. Use of

approximately one bottle of reconstiututed PLLA each session into the intermetacarpal space using a threading or retrograde fanning technique has been described.[17]

Applying a moisturizing cream and then diligent massage to try to ensure even distribution is believed to be particularly important when specifically using PLLA. Instructing the patient as well to massage the injected areas of each hand for 5 minutes, 5 times a day, for 5 days is often employed after PLLA injections to try to avoid product clumping and promote a natural-looking correction. This technique helps minimize the chance of nodule formation.[17-23]

Calcium Hydroxyapatite

CaHA was approved by the FDA in June 2015 for soft tissue augmentation of the dorsal hands[12,24] after obtaining original FDA approval for facial augmentation in 2006. This product consists of CaHA microspheres (25-45 µm) suspended in a gel composed of water, glycerin, and sodium carboxymethlycellulose, in a 30% microspheres to 70% carrier gel composition. CaHA is the inorganic component of bone and teeth, and is inert, biocompatible as well as non-antigenic.[4] CaHA is considered to be non-permanent filler.

Before treatment, 0.2 to 0.3 mL of 1% or 2% lidocaine HCL is frequently mixed with each 1.5 ml syringe of CaHA. To achieve this, use a Luer-Lok-to-Luer-Lok connector and a 1 ml syringe with Luer-Lok. To avoid clogging, introduce CaHA into the syringe containing the anesthetic first. Then push the newly combined CaHA and lidocaine back and forth from syringe to syringe until it becomes a homogeneous mixture.[5]

The filler can be injected into the hand using a multi-bolus technique (0.2 to 0.5 ml per injection) evenly distributed on the dorsal hand.[10] Alternatively, CaHA can also be injected using a pauci-bolus technique (0.5-1.4 ml per injection),[5] with one to two injections per hand between the first and fifth metacarpals using a 27-gauge needle. With the pauci-bolus technique, a single bolus can be injected midway between the dorsal crease of the wrist and the metacarpophalangeal joints[17] (Figure 2). It is recommended that not more than 3 ml per hand should be injected per visit.[10] Total volume injected should be at the discretion of the treating physician to achieve the optimal cosmetic result. Figure 3 and Figure 4 show examples of patients treated with CaHA. Figure 5 compares treated hands with non-treated hands. While a 27-gauge needle was used for the FDA study, some physicians prefer to use a cannula off-label for CaHA injections in the dorsal hand.

Complications

Patients often experience temporary swelling as well as occasional areas of bruising after treatment. Adverse events

FIGURE 3. 66-year-old woman prior to receiving CaHA (A) and after injection with 1.5 ml of CaHA (B).
Courtesy of Joel L. Cohen, MD, Greenwood Village, CO.

commonly reported after CaHA dorsal hand treatments include transient erythema, pruritus, as well as ecchymosis and edema that can last up to 2 weeks.[17] Difficulty performing activities with the hands has also been described (such as keyboarding or playing piano etc). Itching has been reported to improve with a high-potency topical corticosteroid.[24] The most frequently reported reaction to PLLA treatment is the formation of nodules.[25] Many practitioners have discontinued use of PLLA in the dorsal hands due to the risk of formation of nodules and the availability of other soft tissue augmentation agents.[24] Hyaluronic acid adverse events in general use, also include edema, hematoma, redness, and pain.[1] But, hyaluronic acid has the benefit of having a potential reversal agent (the enzyme hyaluronidase). If hyaluronic acid is injected too superficially, there is a risk of a blue discoloration of the skin. This blue discoloration is likely due to the Tyndall effect.[26] The Tyndall effect has yet to be reported in the hand with HA fillers, but a theoretical risk exists. Treatment includes extraction of the superficial hyaluronic acid with a small nick using a surgical blade or injection of hyaluronidase to help with dissolution. Potential complications of fat transfer to the hand include infection, cyst-formation, temporary dysesthesia, and marked edema.[27]

Specific studies focused on hand complications from soft tissue augmentation exist. One study retrospectively identified 15 patients injected with various agents over a 10-year period with complications secondary to soft tissue augmentation. Injected materials included PMMA microsphere filler, CaHA filler, HA filler, PLLA filler, and other medical fillers.[28] Complications mentioned in this study included contour deformity (12/15), sensory dysfunction (4/15), inflammatory signs including foreign body granuloma (8/15), and stiffness (4/15).[28] However, only 1/15 of these patients reported not being satisfied with the outcomes after soft tissue augmentation treatment for hand rejuvenation.

Park et al describe a method to try to minimize filler-related complications of the dorsal hand. This report recommended that all patients immediately begin applying ice to the area of injection, along with aggressive massage and hand elevation. At regular follow-up, if a complication has arisen such as a granuloma or evidence of infection, they began treatment with two-drug antibiotic therapy composed of a second-generation cephalosporin plus a third-generation macrolide. If there are still unsatisfactory results such as irregular contour, the course of treatment depended on the type of filler. For HA fillers, they initially started a trial of hyaluronidase injections – but went as far as surgical excision if there was no improvement. CaHA fillers were treated with surgical excision. With all other fillers, the authors attempted intra-lesional corticosteroid injections with subsequent surgical removal if there was no improvement. The authors emphasized that surgical excision was a last resort option for filler-related granulomas.[28] Improvement of various types of persistent filler-related nodules with intra-lesional injections has been reported, including utilizing 5-FU (50 mg/mL) as well as triamcinolone (up to 40 mg/mL).[29] We would emphasize repeating trials of non-surgical treatment options, until it is deemed definitively non-efficacious, before considering surgical excision.

Al-Qattan reported 3 cases of foreign body granuloma after use of PMMA suspended in bovine collagen for soft tissue augmentation of the dorsal hand.[30] The patients developed granulomas greater than 1 year after the hand augmentation procedures, and all responded to intralesional triamcinolone. Although the granulomatous reactions resolved, the authors noted subsequent hyper- and hypopigmentation. It is unclear if this was secondary to the granulomatous reaction or the injection of corticosteroids.

FIGURE 4. 73-year-old woman prior to receiving CaHA (A) in both dorsal hands (1.5 ml each) (B). This patient also was treated with dual-pulsed Q-switched Nd:YAG immediately prior to augmentation for pigment correction.
Courtesy of Joel L. Cohen, MD, Greenwood Village, CO

CONCLUSION

Hand augmentation with soft tissue filler, alone or in conjunction with other rejuvenating modalities, can have a significant impact on improving the appearance of the dorsal hands. The relevant anatomy includes three fatty laminae that are divided by fascial planes. The Merz Hand Grading Scale provides an objective measurement tool for assessing clinical improvement. Whether using a needle or a cannula, tenting the skin allows a plane of entry that may help in avoiding tendons and vasculature. Hyaluronic acid (HA), poly-L-lactic acid (PLLA), and calcium hydroxyapatite (CaHA) are the agents most commonly used for augmentation though CaHA is the only current FDA cleared for dorsal hand augmentation. Erythema, pruritus, ecchymosis, and edema are the most commonly encountered adverse effects.

DISCLOSURES

Dr. Fathi reports no conflicts related to this paper. Dr. Cohen indicates that related to soft tissue augmentation agents, he has served as a consultant or clinical trial participant for Allergan, Merz, Galderma, and Suneva.

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1. What is the only filler currently (2016) FDA approved for rejuvenation of the dorsal hands:
   a. Calcium Hydroxyapatite
   b. Hyaluronic Acid
   c. Autologous Fat
   d. Poly-L-Lactic Acid

2. Which of the following is not a commonly reported side effect of soft tissue augmentation of the dorsal hand:
   a. Edema
   b. Ecchymoses
   c. Necrosis
   d. Pruritus
   e. Erythema

3. Which of the following has the advantage of having a potential reversing agent:
   a. Calcium Hydroxyapatite
   b. Poly-L-Lactic Acid
   c. Hyaluronic Acid
   d. Autologous Fat

4. Which of the following soft tissue fillers may cause bluish discoloration if injected superficially:
   a. Calcium Hydroxyapatite
   b. Poly-L-Lactic Acid
   c. Hyaluronic Acid
   d. Autologous Fat

5. Veins and sensory nerves of the hand are found to be in the highest concentration in the:
   a. Dorsal intermediate lamina
   b. Dorsal superficial fascia
   c. Interosseous muscles
   d. Dorsal deep lamina

6. Which of the following fillers would likely require multiple injection sessions:
   a. Hyaluronic Acid
   b. Calcium Hydroxyapatite
   c. Autologous fat
   d. Poly-L-Lactic Acid

7. A patient has moderate loss of fatty tissue of the dorsal hands with mild visibility of veins and tendons. Based on the Merz Hand Grading Scale, they would be given a score of:
   a. 1
   b. 2
   c. 3
   d. 4

8. A patient received Calcium hydroxyapatite for soft tissue augmentation of the dorsal hands. In what timeframe is it most typical for bruising to resolve:
   a. Within 2 days
   b. Within 2 weeks
   c. Within 2 months
   d. Likely permanent

9. With the pauci-bolus technique of dorsal hand augmentation, what is the preferred landmark of injection:
   a. Immediately distal to the dorsal crease of the wrist
   b. Immediately medial to first extensor tendon
   c. Midway between the dorsal crease of the wrist and the metacarpophalangeal joints
   d. Immediately proximal to the metacarpophalangeal joints

10. Based on the FDA approval pivotal trial, what is the recommended maximum amount of calcium hydroxyapatite that should be injected per visit per hand:

    a. 1 mL
    b. 3 mL
    c. 5 mL
    d. 10 mL

11. In the general aesthetic use of what product is it typically recommended that the patient massage diligently several times a day for the first 4-5 days after injection:

    a. Hyaluronic Acid
    b. Calcium Hydroxyapatite
    c. Autologous Fat
    d. Poly-L-Lactic Acid

12. Which filler is most associated with water binding and water retention -- thereby increasing skin turgor and tissue volume:

    a. Hyaluronic Acid
    b. Calcium Hydroxyapatite
    c. Autologous Fat
    d. Poly-L-Lactic Acid

13. What is a direct theoretical advantage of using a cannula instead of a needle for dorsal hand augmentation:

    a. Less entrance sites
    b. More even distribution
    c. Less risk of vessel puncture and tendon trauma
    d. Less pain
    e. All of the above

14. What position has been used to reduce vein pressure and thus potentially decrease bleeding when performing dorsal hand augmentation:

    a. Supine
    b. Reverse Trendelenberg
    c. Trendelenberg
    d. Seated

15. Anti-coagulant medications, such as aspirin, NSAIDs, and specific vitamins and herbals are often discontinued how many days before treatment to minimize bruising when performing dorsal hand augmentation:

    a. Not recommended to stop medication
    b. 1-3 days
    c. 5-10 days
    d. 3-4 weeks

Evaluation Form

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1 2 3 4 5

Enhanced my current knowledge base
1 2 3 4 5

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1 2 3 4 5

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1 2 3 4 5

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