

## R E V I E W

# Techniques and strategies for hand rejuvenation: An up-to-date review

SILVIA SCEVOLA<sup>1</sup>, NICOLA LUIGI SOLDÀ<sup>2</sup>, ALDO ARPINO<sup>3</sup>, MARCO SALER<sup>1,4</sup>, ANGELA FAGA<sup>1</sup>, GIOVANNI NICOLETTI<sup>1,4,5,6</sup>

<sup>1</sup>Advanced Technologies for Regenerative Medicine and Inductive Surgery Research Center, University of Pavia, Pavia, Italy; <sup>2</sup>Aesthetic and Wellness Medicine Master's Degree Program, University of Pavia, Pavia, Italy; <sup>3</sup>Medical School, University of Turin, Turin, Italy; <sup>4</sup>Integrated Unit of Experimental Surgery, Advanced Microsurgery and Regenerative Medicine, University of Pavia, Pavia, Italy; <sup>5</sup>Department of Clinical, Surgical, Diagnostic and Pediatric Sciences, University of Pavia, Pavia, Italy; <sup>6</sup>Surgery Unit, Azienda Socio-Sanitaria Territoriale di Pavia, Pavia, Italy

## ABSTRACT

**Introduction:** Hands significantly contribute to an individual's aesthetic appearance and can be indicative of a person's age even more than their face. Despite their significant social and aesthetic impact, hands have traditionally received less attention in cosmetic treatments compared to the face and neck. In recent years, Aesthetic Medicine has shown growing interest in hand rejuvenation techniques.

**Objectives:** This review explores the literature reports on the main techniques employed in hand rejuvenation.

**Methods:** PubMed-indexed articles were searched using the keywords: "hand rejuvenation", "hand aging", "dermal filler", "chemical peel", "laser", "sclerotherapy", and "fat grafting" in different combinations. All references cited in the selected articles were examined to identify additional relevant sources. Only studies involving patients treated specifically for hand rejuvenation were included. Articles lacking objective outcome data or focusing on techniques without clinical validation were excluded.

**Results:** A total of 78 articles (14 reviews and 64 original articles) were retrieved, spanning from the year 2000 to 2025 and published in 21 countries. Twenty-two single treatments and seven combination protocols were identified.

**Conclusions:** Available evidence supports the safety and efficacy of both single and combined approaches for hand rejuvenation, emphasizing the need for individualized, anatomy-based treatment planning to optimize outcomes.

**Key words:** Hand rejuvenation, dermal filler, chemical peel, laser, sclerotherapy, fat grafting



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**Correspondence:** Giovanni Nicoletti / Department of Clinical, Surgical, Diagnostic and Paediatric Sciences, University of Pavia / Piazzale Golgi, 19 - 27100 Pavia, Italy / E-mail: giovanni.nicoletti@unipv.it

## Introduction

The hands significantly contribute to an individual's aesthetic appearance and can be indicative of a person's age even more than the face. Despite their significant social and aesthetic impact, hands have traditionally received less attention in cosmetic treatments compared to the face and neck. In recent years, however, aesthetic medicine has shown growing interest in hand rejuvenation techniques.

## Aim and objectives

This review aims to explore the literature reports on the main techniques employed in hand rejuvenation, within the field of Aesthetic Medicine.

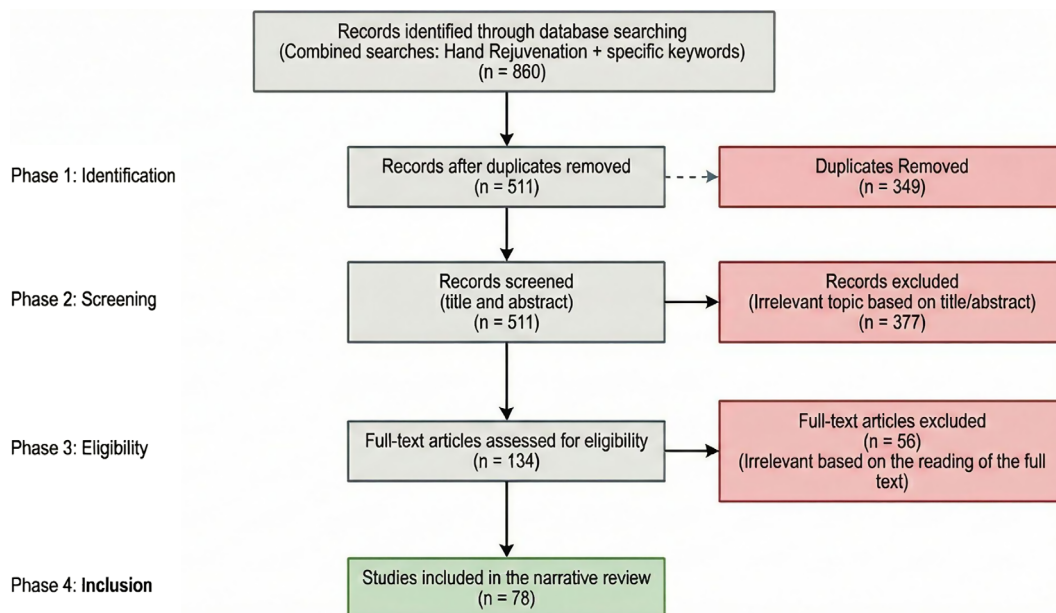
## Materials and methods

This review was conducted as a narrative literature review with a structured search strategy. We searched for PubMed-indexed articles published within the

time frame of January 2000 to January 2025. The search strategy employed the keywords “hand rejuvenation”, “hand aging”, “dermal filler”, “chemical peel”, “laser”, “sclerotherapy”, and “fat grafting” in different combinations. All references cited in the selected articles were subsequently examined to identify additional relevant sources.

The selection process was guided by specific inclusion and exclusion criteria. Inclusion criteria encompassed: (1) original articles (including randomized controlled trials, prospective, and retrospective studies) and reviews; (2) studies involving patients treated specifically for hand rejuvenation; (3) articles reporting objective outcome data. Exclusion criteria were: (1) articles focusing on techniques without clinical validation; (2) studies lacking objective outcome measures; (3) duplicate publications.

The initial search yielded a broad set of records which were screened by title and abstract. Full-text versions of potentially eligible studies were then retrieved and assessed for final inclusion. A total of 78 articles (14 reviews and 64 original articles) meeting these criteria were selected for this review (Figure 1).



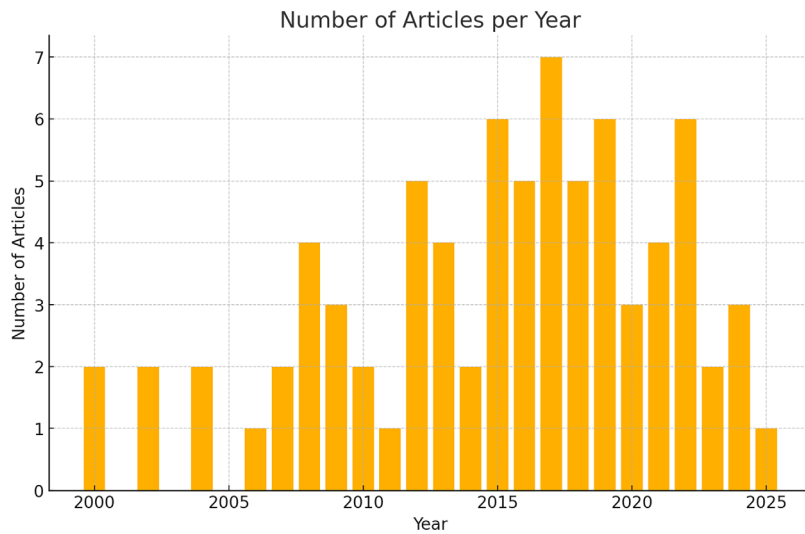
**Figure 1.** PRISMA flow diagram illustrating the literature search, screening, and selection process used to identify the 78 articles included in this review.

**Results**

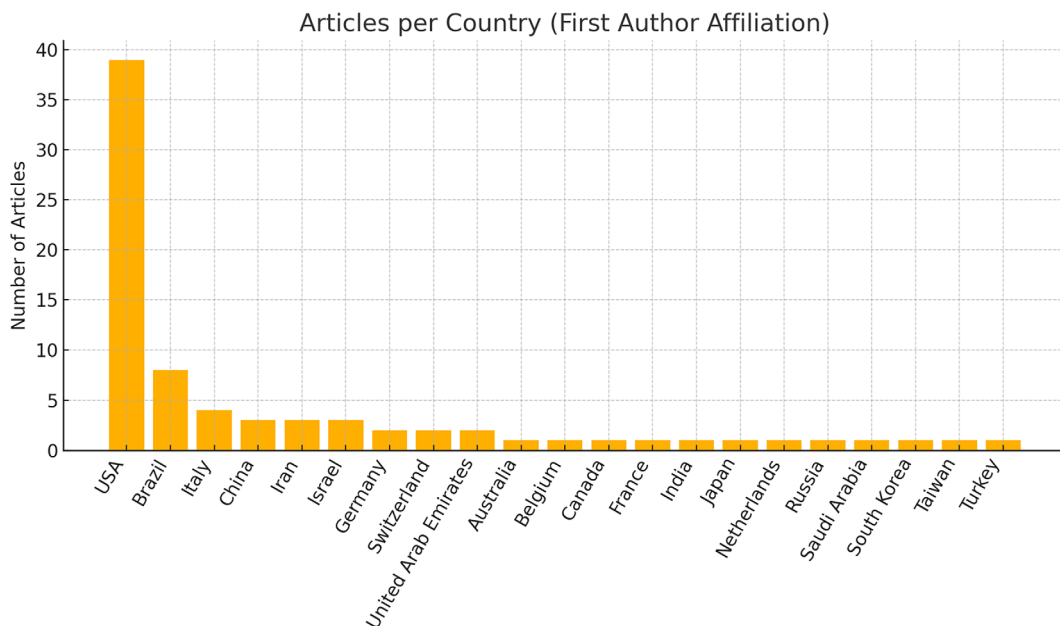
A total of 78 articles (14 reviews and 64 original articles) were retrieved, across the years 2000–2025 (Figure 2) published in 21 Countries (Figure 3).

A critical analysis of the retrieved literature reveals varying levels of evidence across the identified

modalities. Injectable treatments, specifically Calcium Hydroxylapatite (CaHA) and Hyaluronic Acid (HA), are supported by the most reliable data, including large multicenter randomized controlled trials (RCTs) that have led to specific regulatory approvals. In contrast, techniques such as autologous fat grafting and sclerotherapy rely predominantly



**Figure 2.** Distribution per year of retrieved articles on hand rejuvenation.



**Figure 3.** Distribution per country of publication of retrieved articles on hand rejuvenation.

on retrospective case series and observational studies with smaller sample sizes. Energy-based devices (lasers, IPL, RF) present an intermediate level of evidence, frequently evaluated through split-hand comparative trials and prospective pilot studies, though often lacking the extensive long-term follow-up data seen with injectable fillers.

The treatment modalities are reported in Table 1.

## Discussion

Most of the retrieved articles were published between 2015 and 2020.

Most of the articles were published in the USA.

Hand aging can be divided into three main aesthetically relevant processes:

1. The epidermis becomes thinner, presenting freckles and seborrheic keratosis.
2. In the dermis, the loss of collagen and elastin results in thinner skin, wrinkles, and skin

laxity. Capillary fragility, secondary to ultraviolet light damage, leads to telangiectasies and easy bruising.

3. Atrophy of subcutaneous fat, muscles, and bones, results in volume loss with increased visibility of veins, joints, deep intermetacarpal spaces, tendons and bones, giving the hands a skeletal appearance<sup>1,2</sup>.

According to the defect to be treated, different procedures are used as a single treatment or in combination, targeting the different anatomical layers.

## Topical agents

The use of sunscreen and other sun-protective behaviours is highly important.

Topical urea has a long history of use in dermatology and is one of the key components of the natural moisturizing factor (NMF) of the stratum corneum.

Vitamin C serum protects the skin from oxidative stress by sequentially donating electrons to neutralize

**Table 1.** Single-treatment modalities and combination regimens for hand rejuvenation.

Unique single-treatment modalities (including also components of combo-treatments)	Unique combination regimens
<ol style="list-style-type: none"> <li>1. Calcium hydroxylapatite filler (Radiesse®)</li> <li>2. Hyaluronic acid filler</li> <li>3. Polycaprolactone-based collagen stimulator (Ellansé®)</li> <li>4. Poly-L-lactic acid filler</li> <li>5. Polymethylmethacrylate/collagen filler</li> <li>6. Human collagen filler</li> <li>7. Autologous fat grafting (structural &amp; micro-autologous)</li> <li>8. Ablative fractional CO<sub>2</sub> laser</li> <li>9. Non-ablative fractional laser (e.g. 1550/1927 nm dual-wavelength)</li> <li>10. Fractional Er:YAG laser</li> <li>11. Microneedle fractional radiofrequency</li> <li>12. Nd:YAG laser (incl. long-pulse)</li> <li>13. Pulsed-dye laser</li> <li>14. Intense pulsed light (IPL)</li> <li>15. Monopolar radiofrequency</li> <li>16. TriPollar® radiofrequency</li> <li>17. Photodynamic therapy (ALA-PDT and blue-light PDT)</li> <li>18. Photobiomodulation therapy</li> <li>19. Foam sclerotherapy</li> <li>20. Sclerotherapy</li> <li>21. Chemical peels (glycolic acid, TCA)</li> <li>22. Fractional photothermolysis</li> </ol>	<ol style="list-style-type: none"> <li>1. Nd:YAG laser + IPL</li> <li>2. 15% TCA peel + 3% glycolic-acid peel</li> <li>3. Bipolar/monopolar RF + optical energies (vs optical alone)</li> <li>4. Laser therapy + monopolar RF + IPL immediately after hyaluronic-acid filler</li> <li>5. Foam sclerotherapy + calcium-hydroxylapatite filler</li> <li>6. Diclofenac 3% gel → ALA-PDT</li> <li>7. Dorsal-vein foam sclerotherapy + CaHA filler injections</li> </ol>
Total distinct single treatments: 22	Total distinct combination protocols: 7

the free radicals and reduces melanogenesis by inhibiting tyrosinase activity. Its anti-inflammatory and antioxidant properties can reduce skin redness. Its ability to enhance collagen production can strengthen the walls of blood vessels.

Topical Retinoids stimulate epidermal renewal and dermal fibroblasts to produce collagen, elastin, and hyaluronic acid; they also reduce melanin transfer, thereby normalizing dyschromia<sup>1</sup>.

The daily topical application of 0.1% Rapamycin for 6–8 months, revealed a significant reduction in P16INK4A levels (a marker of senescence), an increase in dermal collagen VII, with clinical improvement of the thickness and tone in the treated areas<sup>3</sup>.

Sodium copper chlorophyllin (Cu-Chl) has demonstrated several therapeutic properties *in vitro*, including antioxidant, anti-inflammatory, and antibacterial effects, as well as inhibition of hyaluronidase<sup>1</sup>.

The topical application of very low concentrations (0.025–0.1%) of liposomal Cu-Chl in a formulation also containing urea 25% and a plant-derived lipid concentrate has shown improvements in photoaged hand skin, including fine lines/wrinkles, tactile roughness, uneven skin tone, and mottled pigmentation<sup>4</sup>.

## Chemical peels

Chemical peels have been used for epidermal rejuvenation for many years and remain a cost-effective option, particularly for addressing pigmentation changes of the hands, such as spots and solar freckles. They are also employed to improve skin texture, reduce superficial wrinkles, and enhance skin firmness<sup>1</sup>.

For the hands, superficial peels are recommended due to the limited presence of adnexal structures, in order to reduce the risk of scarring or pigmentary alterations<sup>5</sup>.

The most frequently used superficial peels for the hands include alpha-hydroxy acid such as glycolic acid, beta-hydroxy acids like salicylic acid, 10–25% trichloroacetic acid (TCA), or other agents such as 50% resorcinol. TCA peels above 30% are considered medium-depth, as they reach the papillary dermis<sup>5</sup>; these may be used as spot treatments for pigmented lesions with great caution and should only be performed by experienced practitioners.

Due to the thin epidermis of the hands, deep peels are generally avoided. However, some studies have described the use of layered 35–45% TCA gel over 70% glycolic acid gel, which improved skin texture, reduced wrinkles, and lightened pigmentary anomalies, including freckles, without adverse effects. Other studies on peels for hand rejuvenation include the use of Jessner's solution (containing salicylic acid, lactic acid, and retinol), applied in two or more layers, which successfully improved hand pigmentation<sup>5,6</sup>.

A recent prospective, evaluator-blinded, split-hand trial involving 20 patients with dorsal freckles demonstrated that three sessions of a combined chemical peel using 15% TCA and 3% glycolic acid, administered at four-week intervals, significantly improved the appearance of treated freckles compared to the control side, without relevant adverse events<sup>7</sup>.

## LASER and other light-based technologies

### INTENSE PULSED LIGHT (IPL)

Intense pulsed light devices employ a high-intensity, broad-spectrum light source (515–1200 nm) capable of targeting structures with varying absorption spectra, including vascular and pigmented cutaneous targets. Dermal heating induced by IPL has also been shown to stimulate type I and III collagen synthesis in the papillary and reticular dermis; IPL emits signals at multiple wavelengths to target the distinct absorption spectra of haemoglobin, deoxyhaemoglobin, and melanin, thereby allowing for the simultaneous treatment of vascular lesions (e.g., telangiectasies and erythema) and pigmented lesions (e.g., solar freckles and lentigines). Additionally, IPL provides a skin rejuvenation effect by improving texture<sup>8–10</sup>. The risk of oedema or blistering can be reduced by using a fluence 5–10% lower on the hands than that applied to the face<sup>4,6</sup>. A review focusing exclusively on dorsal hand rejuvenation classified IPL as a first-line procedure for the treatment of dyschromia and superficial photoaging<sup>11</sup>.

IPL can be combined with fractional or Q-switched lasers to optimize results. The combination of Nd:YAG 1064 nm and IPL demonstrated superior reductions in solar freckles and fine wrinkles compared to Nd:YAG alone<sup>1,12,13</sup>.

## Q-SWITCHED LASERS

Available Q-switched lasers include the ruby laser (694 nm), alexandrite laser (755 nm), frequency-doubled Nd:YAG laser (532 nm), and standard Nd:YAG laser (1064 nm).

A randomized controlled study comparing the efficacy of three different lasers to liquid Nitrogen treatment for solar freckles on the dorsal hands found that the non-ablative frequency-doubled QS Nd:YAG laser was the most effective compared to liquid nitrogen, the KTP laser, and the 532 nm diode laser<sup>14</sup>. Different controlled studies demonstrated that the QS ruby laser is significantly more effective in removing solar freckles from the dorsal hands compared to the ablative fractional CO<sub>2</sub> laser, with a more favourable safety profile<sup>15,16</sup>.

## NON-ABLATIVE FRACTIONAL LASERS

Non-ablative fractional lasers that have been studied for hand rejuvenation include the 1,927 nm thulium laser and the 1,550 nm erbium-doped glass laser (Fraxel), both primarily used to improve skin texture and appearance. Another device used in this context is the 1,320 nm neodymium-doped yttrium aluminum garnet (Nd:YAG) laser, which has been reported to achieve mild-to-moderate improvements in skin smoothness after six treatment sessions over a four-week period<sup>5</sup>.

The 1,927 nm thulium laser is typically preferred for targeting pigmentary abnormalities and, to a lesser extent, texture irregularities. It provides high precision in dermal penetration, visible improvements in pigmentation and photoaging, low erythema rates, and average recovery times of less than three days<sup>17</sup>.

The 1,550 nm fractional erbium glass laser is particularly effective for texture improvement. An average 6.7% increase in collagen fibers has been reported.<sup>15</sup> The most common adverse effect reported in hand rejuvenation procedures using this wavelength is persistent erythema.<sup>1</sup>

Three monthly treatment sessions with 1,064 nm Long-Pulsed Nd:YAG Laser on dorsal hand wrinkles demonstrated a 35% reduction in the wrinkles, with no reports of persistent erythema or serious complications<sup>18</sup>.

Significant improvements in reducing dorsal hand wrinkles were demonstrated by the combination of 1,320 nm Nd:YAG Laser with cryogenic cooling<sup>19</sup>.

A dual-wavelength protocol combining the 1,550 nm Fraxel® re:store laser followed by the 1,927 nm thulium laser, has been shown to optimize both energy fluence and microzone density, enhancing neocollagenesis and pigment correction without significantly increasing downtime<sup>20</sup>.

## ABLATIVE LASERS

Ablative lasers, such as the 10,600 nm CO<sub>2</sub> laser and the 2,940 nm Erbium:YAG laser are infrequently used on the dorsal hands due to the reduced presence of adnexal structures and an increased risk of delayed healing. Therefore, there is a limited body of literature specifically addressing the application of these laser types on dorsal hand skin. The retrieved articles report good or excellent results in the treatment of skin wrinkles, pigmentation and texture, with a few side effects<sup>11,21-24</sup>.

Despite these findings, the risk of infection, dyschromia, and scarring is elevated compared to non-ablative procedures, due to the low vascularity and scarcity of pilosebaceous units in this region. As such, the use of ablative lasers for this indication remains a topic of ongoing discussion.

## VASCULAR LASERS

The 595 nm pulsed dye laser (PDL) is highly effective for the treatment of telangiectasies and erythema on the dorsal hands with no significant complications<sup>1,25,26</sup>.

Despite these encouraging findings, studies focusing exclusively on the dorsal hands remain limited. There is a need for randomized controlled trials with larger sample sizes to determine optimal treatment parameters (including fluence, density, and number of sessions) and to confirm the safety and efficacy profile of PDL in this specific anatomical area.

## LED THERAPY (LIGHT EMITTING DIODES)

Low-intensity light (630–850 nm) used for photobiomodulation (PBM): reduces inflammation,

promotes tissue repair, and improves skin hydration with no downtime.

Although most clinical PBM research focuses on facial skin, a hand-specific trial demonstrated that blue light LED can safely accelerate healing and tissue repair in digital skin lesions, suggesting potential applications for photo-aged hand skin<sup>27</sup>. To date, randomized controlled trials of LED therapy on healthy dorsal hand skin (e.g., for improving hydration, elasticity or collagen synthesis with red [630 nm] or near-infrared [830 nm] LEDs) are lacking; further studies are required to establish optimal wavelengths, energy densities, and treatment schedules for hand rejuvenation.

### PHOTODYNAMIC THERAPY

Photodynamic therapy (PDT) is clinically indicated for the treatment of actinic keratoses but has also demonstrated efficacy in skin rejuvenation. For this purpose, a single treatment session is generally recommended. Available light sources include specialized red and blue light, PDL, and IPL, all capable of activating protoporphyrin IX<sup>1,28-30</sup>.

Despite the favourable safety profile and the absence of significant downtime, optimal treatment parameters, such as the type of photosensitizer, incubation time, and light source, remain to be defined specifically for the dorsal hands, due to the thicker stratum corneum and the increased sensitivity of this area to pain and phototoxicity.

### RADIOFREQUENCY

Radiofrequency could be employed on the hands to reduce wrinkles and the appearance of prominent veins.

In a prospective study involving 16 subjects a 44% improvement in dorsal hand roughness was observed compared to baseline after three sessions of fractional microneedle radiofrequency at four-week intervals. Patients, treated under topical anaesthesia, experienced transient pain, erythema, and oedema, which resolved within three days<sup>31</sup>.

Treatment with a monopolar radiofrequency system (Pellevé S5 Wrinkle Treatment Generator), administered three times at two-week intervals, resulted in a 50% improvement from baseline and 39%

marked improvement, with no significant adverse effects reported<sup>32</sup>.

The combination of bipolar radiofrequency with IPL produced significantly good outcomes in pigmentation, skin laxity, and texture<sup>33</sup>.

Histological findings from patients treated with TriPollar radiofrequency showed a 49% increase in dermal thickness and focal thickening of collagen fibers<sup>34</sup>.

Despite these findings, controlled studies on the use of radiofrequency specifically on the dorsal hands remain limited. Further randomized trials and standardization of treatment protocols are required to establish optimal parameters and confirm long-term safety.

### DERMAL FILLERS

Dermal fillers have emerged as a cornerstone in the aesthetic restoration of age-related volume loss on the dorsum of the hands. By augmenting subcutaneous volume and stimulating dermal remodelling, injectable fillers not only camouflage prominent veins and tendons but also restore a more youthful contour and texture<sup>35</sup>. The most widely used agents include hyaluronic acid (HA) and calcium hydroxylapatite (CaHA), which provide immediate volume replacement and varying degrees of collagen biostimulation. Newer polycaprolactone (PCL)-based stimulators and Poly-L-lactic acid (PLLA) work predominantly by inducing collagen neosynthesis. Selection of the appropriate filler depends on the patient's skin quality, degree of atrophy, and desired duration of effect.

### CALCIUM HYDROXYAPATITE

Calcium hydroxylapatite consists of microspheres suspended in a carboxymethylcellulose gel carrier. The gel is resorbed within 2–3 months, while CaHA particles persist and stimulate collagen production. Its high viscosity and elasticity provide immediate volumetric correction, while its opacity yields a natural, matte appearance<sup>36,37</sup>. Radiesse® (Merz North America, Raleigh, NC, USA) is currently FDA-approved for dorsal hand volume loss. Appropriate placement techniques and dilutions are critical to optimize outcomes<sup>38-40</sup>. Clinical studies report that results may persist up to 12-24

months<sup>41</sup>. Adverse events, including swelling, bruising, or transient nodules, are generally mild and self-limiting<sup>42</sup>, and outcomes can be monitored using validated tools such as the Merz Hand Grading Scale<sup>43</sup>.

## HYALURONIC ACID

Hyaluronic acid effectively restores volume and skin quality through hydration and fibroblast-mediated collagen synthesis<sup>11, 44-49</sup>. Various HA fillers are available, differing in concentration, cross-linking, and viscosity<sup>1</sup>. Restylane Lyft® (Galderma Laboratories, Fort Worth, TX, USA) received FDA approval in 2018 for age-related volume loss in the dorsal hands<sup>47</sup>. Cannula injection is generally preferred to minimize bruising and intravascular risks<sup>50</sup>. Compared to CaHA, HA carries a potential risk of the Tyndall effect if injected too superficially, but remains a versatile option with effects lasting 6 to 18 months<sup>47</sup>.

## POLYLACTIC ACID

Poly-L-lactic acid is a biostimulatory filler that induces neocollagenesis<sup>1,51</sup>. Unlike HA and CaHA, PLLA does not provide immediate volumizing effects; visible results develop over 4–6 weeks, typically requiring 2–3 sessions. Sculptra® (Galderma Laboratories, Bridgewater, NJ, USA) is the primary FDA-approved PLLA product. Proper reconstitution and post-injection massage (the “5-5-5 rule”) are recommended to ensure even distribution<sup>52-54</sup>. Results typically last between 1 and 3 years, with side effects mainly limited to transient bruising or the occasional formation of nodules<sup>53,55</sup>.

## POLYCAPROLACTONE

Polycaprolactone-based fillers (e.g., Ellansé®) consist of microspheres in a carboxymethylcellulose gel carrier. The carrier provides immediate volume and is resorbed within weeks, while PCL stimulates type I and III collagen deposition, offering durability of 18–24 months<sup>56</sup>. High patient satisfaction has been reported<sup>57</sup>. Expert consensus recommends subdermal injection using a cannula to minimize vascular injury, though larger studies are needed to confirm long-term safety profiles in the hand<sup>58</sup>.

## COLLAGEN

Collagen fillers provide immediate soft-tissue augmentation. While historically derived from bovine sources, modern formulations utilize human-recombinant or non-animal-stabilized collagen to minimize immunogenicity and eliminate the need for pre-screening skin tests<sup>59</sup>. Upon injection, the matrix acts as a temporary scaffold for host fibroblasts before being resorbed<sup>60</sup>. However, the clinical effect typically wanes within 3–6 months, leading to a general preference for HA fillers regarding longevity<sup>59</sup>. To extend durability, collagen has also been successfully employed as a carrier for polymethylmethacrylate (PMMA) microspheres (e.g., Bellafill®), yielding satisfactory long-term results<sup>61</sup>.

## AUTOLOGOUS FAT GRAFTING

Adipose tissue has been shown to be a source of adipose-derived stem cells (ADSCs). In addition to providing volume to the injected area, fat grafts may help improve aged and atrophic skin.

In the 1980s, fat augmentation of the dorsal hand was first described by injecting a large bolus of fat, followed by manual redistribution using digital massage<sup>62</sup>. The procedure was largely considered unpredictable and unreliable due to the risk of infections, the formation of nodulations, the uneven distribution of adipose tissue, the necrosis of areas not subjected to neovascularization and engraftment.

In 1992, a modified technique was proposed that involved fewer complications and greater patient satisfaction. This technique is still used today and involves harvesting small pieces of adipose tissue, removing non-viable components, and using a cannula to inject small pieces of fat in thin layers to maximize contact between the surface of the transplanted fat and the surrounding recipient tissue<sup>63</sup>.

This approach promotes the integration and long-term survival of the transplanted fat, with the general goal of restoring a full and youthful appearance to the atrophic subcutaneous tissue of the aged hand. The duration of results is extremely variable, from as little as 4 months to 3 years. Over the years, autologous fat grafting techniques have been refined using

increasingly smaller and more homogeneous sizes of adipose tissue to increase grafting possibilities without adipose tissue necrosis, as occurred in the past with high volumes and large fat particles<sup>64-67</sup>. Adipose tissue cells from the lower abdomen and inner thigh demonstrated a higher concentration of ADSCs and could therefore serve as ideal donor sites<sup>68</sup>.

The insertion sites typically include four rotation points at the central base of the interdigital spaces, 2 cm from the edge on the dorsal surface of the hand<sup>67</sup>. A 16 G blunt cannula is used to deliver the fat. The volume delivered is carefully grafted into the dorsal part of the hand in three layers: the deep dorsal lamina (deep layer), above the deep dorsal fascia and below the intermediate dorsal fascia; the intermediate dorsal lamina (middle layer), between the intermediate dorsal fascia and the superficial dorsal fascia; and the superficial dorsal lamina (superficial layer), between the superficial dorsal fascia and the skin<sup>67,69</sup>.

The key technical principles are a low-pressure injection, small aliquots, and a uniform distribution across multiple planes<sup>70</sup>.

Currently, autologous fat transfer is considered a safe and effective technique, with minor side effects (oedema, ecchymosis, transient dysesthesia, cysts or irregularities, rare infections) that usually resolve spontaneously<sup>64-66,71,72</sup>.

## SCLEROTHERAPY

Fat loss over time may lead to the visibility of veins. Often, only the increase in soft tissue can significantly improve the appearance of prominent veins by concealing them under the newly placed volume. In some patients, however, the prominence persists despite filler injections, and sclerotherapy or endovenous laser treatments may represent an alternative option. Some physicians believe that the treatment of the dorsal hand veins may impair the drainage of refluxed blood, leading to permanent swelling, and therefore do not recommend hand sclerotherapy or endovenous ablation<sup>1</sup>.

The literature describing the use of sclerotherapy in the treatment of dorsal hand veins is limited. Most of the studies report on the use of 0.25% to 3% sodium tetradecyl sulfate (STS) foam. Safe, effective,

and long-term results were achieved with the lowest concentration<sup>73,74</sup>.

Alternatively, the use of 1% polidocanol foam is suggested<sup>75</sup>.

The most common complications in the use of sclerotherapy for dorsal hand veins are hematoma formation, clotting, stiffening of venous vessel walls, and persistent oedema. Clot formation can be treated with drainage, with most patients experiencing complete resolution within 2 months. Telangiectasies, ulceration, hyperpigmentation, erythema, urticaria, and allergic reactions have been reported, too<sup>1,73</sup>.

Some physicians recommend compression gloves for 1–2 weeks after treatment, despite presenting questionable results<sup>74</sup>.

In conclusion, sclerotherapy, especially in the form of low-concentration foam, might represent a safe and effective option for the treatment of reticular veins on the dorsal hands, with excellent long-term satisfaction and a profile of transient and generally mild adverse events.

## COMBINED TREATMENTS

Combined rejuvenation procedures performed in multiple sessions, or even within a single session, are becoming increasingly popular among patients and healthcare providers; however, official guidelines regarding combined therapies for hand rejuvenation have not yet been established<sup>5</sup>.

To reduce hyperpigmentation, sequential use of IPL + chemical peels, IPL + Q-switched laser, or IPL + ablative fractional laser over multiple sessions may be employed. For collagen loss, the combinations of non-ablative fractional lasers, IPL, and injectable treatments with PLLA may be used; for volume loss, ablative fractional lasers + fillers (HA and/or CaHA); in mixed cases of hyperpigmentation and volumetric atrophy, injections of PLLA or HA or CaHA followed immediately by chemical peels, even within the same session, are recommended<sup>5</sup>.

The combination of IPL 515–1,200 nm and Nd:YAG 1,064 nm improves pigmentation, fine lines, coarse wrinkles, and tone<sup>13</sup>.

Foam sclerotherapy with 0.5% STS combined with subdermal injection of CaHA ensures persistent improvement of both veins and skin atrophy<sup>73,76</sup>.

The use of a premixed hybrid filler composed of CaHA and HA for dorsal hand rejuvenation, demonstrates significant improvements in hydration, elasticity, and skin thickness<sup>77</sup>.

It is recommended to perform the superficial treatments (laser, radiofrequency, IPL, peels) first, and then to proceed with filler injections, to minimize the theoretical risk of inflammation or premature material degradation<sup>78</sup>.

Despite the promising outcomes reported, the current landscape of hand rejuvenation research highlights several unmet clinical needs and limitations. A significant portion of the existing literature, particularly regarding energy-based devices and fat grafting, relies on small-scale, retrospective studies lacking long-term follow-ups. This lack of high-level evidence hampers the development of standardized protocols concerning optimal parameters, treatment intervals, and safety guidelines for combination therapies. Additionally, the objective assessment of results remains a challenge; while the Merz Hand Grading Scale is frequently employed for volumetric evaluation, there is a notable absence of a universally validated, comprehensive scoring system that simultaneously accounts for skin quality, pigmentation, and vascular visibility. Future research must address these gaps through robust comparative trials to define evidence-based consensus guidelines.

## Conclusions

Hand rejuvenation has evolved from a niche interest to a central component of aesthetic medicine. This review highlights that while single modalities targeting specific layers—such as chemical peels for the epidermis or fillers for volume loss—are effective, the complex nature of hand aging often necessitates a combined approach. Evidence suggests that integrating energy-based devices with injectable treatments yields superior and more harmonious results. Ultimately, successful outcomes depend on a personalized assessment of the patient's anatomy and aging grade, moving away from a “one-size-fits-all” strategy. Future research must prioritize high-quality, randomized controlled trials to define standardized guidelines

and validate comprehensive scoring systems, bridging the gap between clinical practice and evidence-based medicine.

**Conflict of interest disclosure:** The authors declare that they have no conflict of interest.

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