Review Article

Autologous fat transfer for hand rejuvenation: A systematic review on technique and outcome

Nicolas Vermeersch a,b,*, Maxime De Fré a,b, Veronique Verhoeven c, Judith E. Hunter d, Thierry Tondu a,b, Filip E.F. Thiessen a,b

a Department of Plastic, Reconstructive, and Aesthetic Surgery, Multidisciplinary Breast Clinic, Antwerp University Hospital, University of Antwerp, Drie Eikenstraat 655, B-2650 Antwerp, Belgium
b Department of Plastic, Reconstructive, and Aesthetic Surgery, Ziekenhuis Netwerk Antwerpen, Lindendreef 1, B-2020, Antwerp, Belgium
c Department of Primary and Interdisciplinary Care (ELIZA), University of Antwerp, Antwerp, Belgium
d Department of Plastic and Reconstructive Surgery, Charing Cross Hospital, Imperial College Healthcare NHS Trust, London, UK

A R T I C L E   I N F O

Article history:
Received 23 February 2022
Accepted 3 March 2022
Available online 11 March 2022

Keywords:
Autologous fat transfer
lipofilling
aging hand
hand rejuvenation
volume augmentation

A B S T R A C T

Background: Age-related changes to the dorsum of the hand present as dyschromia, soft-tissue atrophy, and volume loss, resulting in wrinkles and prominent deep structures. Volume augmentation by means of autologous fat transfer (AFT) is one of the options to rejuvenate the hand; theoretically, autologous fat is the ideal filler because of durability and biocompatibility.

Objective: This systematic review aims to summarize and describe the current evidence on the technique, effectiveness, and safety of AFT in hand rejuvenation.

Methods: Three major databases, PubMed, Embase, and Web of Science, were systematically searched up to November 2020 for studies reporting on AFT and hand rejuvenation.

Results: A total of 10 articles were included, reporting on a total of 320 patients treated by AFT to improve the aesthetic appearance of the dorsum of the hand. Some degree of postoperative oedema was present in nearly all patients. Other complications were infection (0.67%), cysts/irregularities (1.3%), temporary dysesthesia (5.3%), and ecchymosis (7%). There were no major compli-

* Corresponding author: Dr. Nicolas Vermeersch.
E-mail address: Nicolas_vermeersch@hotmail.com (N. Vermeersch).

https://doi.org/10.1016/j.jpra.2022.03.001
2352-5878/© 2022 The Authors. Published by Elsevier Ltd on behalf of British Association of Plastic, Reconstructive and Aesthetic Surgeons. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/)
Introduction

Aesthetic surgery is a popular and successful way to counteract changes as a result of aging; however, it focuses mainly on the face. There has been a growing interest in hand rejuvenation over the last few years. This could be especially worthwhile in patients also considering facial aesthetic surgery because the hands are the most visible parts of the body after the face and neck. Potential changes as a result of aging are dyschromia or age spots, soft-tissue atrophy, and volume loss, resulting in wrinkles, thin translucent skin and prominent veins, and tendons and bones. These findings are most profound on the dorsal aspect of the hand. Therapeutic options to improve the appearance of the aging hand include chemical peels, laser therapy, sclerotherapy, dermal fillers, and autologous fat transfer.

Autologous fat transfer (AFT), also known as lipofilling or fat grafting, is a frequently used surgical technique in plastic surgery. Its use is well established to correct soft-tissue contour deformities and volume deficits. However, the use of AFT is not simply related to its volumizing effect. AFT is assumed to have regenerative qualities and has been successfully applied for scar treatment and tissue restoration.

When volume augmentation is desired in hand aesthetic surgery, the options are dermal fillers or autologous fat transfer. Although dermal fillers require no anaesthesia and cause no donor-site morbidity, their effects are temporary and may cause foreign-body granuloma, often requiring surgical treatment. AFT on the other hand is slightly more invasive, but it seems to be the ideal filler because it is biocompatible and durable, with possible dermal regeneration.

During the last decade, many reports have been published regarding AFT for hand rejuvenation: most of these are overview articles on hand rejuvenation or a description of technique; however, very few articles actually assess effectiveness and safety of this treatment. We systematically report, according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, the evidence on the technique and outcome of AFT in hand rejuvenation. The aim of this study is to identify and describe the current evidence on hand rejuvenation and AFT to combine available evidence to promote or discourage this treatment option.

Methodology

The systematic review was conducted by following a predefined protocol using Patient, Intervention, Comparison, and Outcome (PICO) and clearly set inclusion and exclusion criteria. The PRISMA guidelines were followed.

Search Methodology

A systematic literature search of PubMed, Embase, and Web of Science was performed for studies published up to and including 7th November 2020. The search strategy was identical in all databases:
(fat OR lipo*) AND (aging hand OR hand rejuvenation OR hand volume loss OR hand augmentation). There were no limits, and all fields (both free-text and index terms) were searched. Additionally, the reference list of the selected articles was manually screened for further publications.

Study Selection and Eligibility Criteria

After the exclusion of duplicates, all records were screened for title and abstract. Full texts of all relevant articles, ensuring their relevance to AFT and hand rejuvenation, were assessed for eligibility. The PICO question was stated as: (P) adults with aging of the dorsal aspect of the hand, (I) autologous fat transfer to the dorsum of the hand, (C) no treatment or a different treatment for which the results will not be included in the review unless it was by another AFT technique, and (O) patient/surgeon/independent observer evaluation, volume measurements, and complications.

The following inclusion/exclusion criteria were defined before data collection:

- Case reports, case series, observational studies, and clinical trials on AFT and hand rejuvenation, with or without the comparator arm and without restrictions on the sample size or minimal follow-up period.
- Articles in English.
- Conference proceedings, book chapters, editorials, letters, technical notes, and overview articles were excluded.
- Postoperative data should be available.

The final selection of included articles was performed independently by two reviewers. Where disagreement existed, this was solved through discussion until consensus was reached.

Data extraction

Data were extracted from the articles, including tables and figures, independently by two authors. The extracted data included: author(s), year of publication, study design, patient demographics, technique of fat harvest, processing and injection, duration of follow-up, and determinants of clinical outcome.

Assessment of quality

Level of evidence (LOE) for each article was determined using the American Society of Plastic Surgeons (ASPS) guidelines. Additionally, included randomized controlled trials (RCT) were scored with the PEDro critical appraisal tool and the Cochrane risk of bias tool. Observational studies with a comparison group were scored with the Newcastle-Ottawa quality assessment scale. Case reports and case series were not scored but automatically classified as low quality.

Results

Study characteristics and quality of included studies

The initial database search resulted in 5143 articles. An additional two articles were identified from other sources (reference list screening). After the removal of duplicates, a total of 3975 articles were screened on the title and abstract. This resulted in 45 potential studies that were assessed for eligibility by full-text screening. A total of 10 studies met our inclusion criteria and were selected for data extraction. Figure 1 shows the flow diagram of the search strategy.

The included studies were published between 1992 and 2019, with two RCTs, two observational studies with a comparison group, and six case series. The level of evidence for these studies was 2, 3, and 4, respectively. The two RCTs were scored using the PEDro tool and the Cochrane risk of bias tool. These articles scored 3 and 5 of 11 for PEDro and were low quality according to Cochrane. These low scores were mainly related to methodological flaws in selection,
performance, and processing of outcome data. The two observational studies that included a comparison group were scored with the Newcastle-Ottawa scale and had scores of 8 and 9 of 9, indicating low risk of bias. All other studies were considered low quality because of the lack of comparison, small numbers of patients, variable but mostly short follow-up, and lastly since selection, treatment, and assessment of outcome were often performed by the same clinician. All studies involved a total of 320 patients treated with AFT for hand rejuvenation purposes. Of these patients, 93.1% are female. The mean age varied between 49.2 and 58.0 years. Mean follow-up varied between 3 and 12 months (range 3-88 months). Results are shown in Table 1.

**Fat grafting technique**

All included articles described, to some extent, the technique of fat harvest, processing, and injection (Table 2). The abdomen was the most frequently used donor site. Only Aboudib et al. used either manual aspiration or a liposuction device to harvest the fat, and all other authors manually harvested the fat\(^\text{12}\). The fat was harvested with 2-3 mm cannulas, attached to either 10 or 20 ml syringes. The preparation of fat was performed solely by centrifugation in five studies\(^\text{13, 16, 17, 20, 21}\), Other authors used NaCl wash before centrifugation\(^\text{19}\), decantation alone\(^\text{18}\), NaCl wash before decantation\(^\text{12}\), or decantation and centrifugation combined\(^\text{14, 15}\). One study compared the result of AFT prepared by decantation and centrifugation with decantation alone\(^\text{14}\), and one study compared the use of fresh and frozen fat\(^\text{15}\). Fat enrichment was performed in only two studies; platelet-rich plasma (PRP)\(^\text{21}\) and stromal vascular fraction (SVF)\(^\text{17}\) were used to supplement the fat in two comparative studies. In nine of 10 studies, injection cannulas were blunt and ranged from 1-1.4 mm\(^\text{13-21}\), whereas Aboudib et al. injected the fat with a 1 or 2 mm needle\(^\text{12}\). Some variation existed regarding injection technique. The oldest article reported bolus injection followed by digital manipulation\(^\text{12}\), whereas all other authors
### Table 1
Study characteristics.

| Study design                        | LOE | Quality | No. of patients | Female patients (%) | Mean age in years (range) | Reported outcomes                                                                 | Follow-up (months) |
|-------------------------------------|-----|---------|-----------------|---------------------|--------------------------|-----------------------------------------------------------------------------------|-------------------|
| Aboudib et al., 1992               | 4   | NA      | 72              | NR                  | 58 (35-78)               | Technique, Satisfaction, and Complications                                        | 12                |
| Coleman, 2002                      | 4   | NA      | 22              | 20 (90.9)           | NR (range 36-83)         | Technique and complications                                                        | NR                |
| Butterwick, 2002                   | 2   | 5/11<sup>1</sup> | 14 (28 hands) | 14 (100)            | 53.5 (41-64)             | Technique, satisfaction, and complications                                        | 5                 |
| Butterwick et al., 2006            | 2   | 3/11<sup>1</sup> | 10 (20 hands)  | 10 (100)            | 53 (41-66)               | Technique, satisfaction, and complications                                        | 5                 |
| Agostini et al., 2015              | 4   | NA      | 22              | 22 (100)            | 55.9 (41-72)             | Technique, satisfaction, and complications                                        | mean 38 (range 10-88) |
| El Kahky et al., 2017              | 3   | 8/9<sup>3</sup> | 20 (40 hands) | 20 (100)            | 49.2 (45-55)             | Technique and satisfaction                                                        | 3                 |
| Fantozzi, 2017                     | 4   | NA      | 65              | 50 (76.9)           | 51.3 (33-81)             | Technique, satisfaction, and complications                                        | 12                |
| Zhou et al., 2017                  | 4   | NA      | 17              | 17 (100)            | 51.5                     | Technique, satisfaction, volumetric measurements, and complications              | mean 8.3 (range 6-12) |
| Yun-Nan et al., 2018               | 4   | NA      | 68              | 68 (100)            | 56 (38-70)               | Technique, satisfaction, and complications                                        | mean 32 (range 10-64) |
| Sasaki, 2019                       | 3   | 9/9<sup>3</sup> | 10 (20 hands) | 10 (100)            | 54.4 (46-67)             | Technique, satisfaction, volumetric measurements, and complications              | 12                |

<sup>1</sup> PEDro scale  
<sup>2</sup> Cochrane risk of bias tool  
<sup>3</sup> Newcastle-Ottawa  

Abbreviations: LOE = level of evidence; NA = not applicable; NR = not reported
| Donor site          | Harvest                  | Harvest cannula + syringe | Preparation | Enrichment | Injection cannula + syringe | Injection technique | Injection plane | Volume injected | No. of sessions | Postoperative care                                                                 |
|---------------------|--------------------------|---------------------------|-------------|------------|-----------------------------|---------------------|-----------------|-----------------|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Aboudib et al.      | Medial knee, abdomen, and hip | MA or LD 2-3 mm          | NaCl wash + decantation | None       | 2 mm or 18-gauge needle + 10 ml syringe | Dorsal bolus followed by gentle digital manipulation | NR              | 10-15 ml        | NR              | Elevate (1 wk). No physical activity (4 wks). Slight compression with microfoam tape (3-4 d).  |
| Coleman             | Abdomen and medial thigh | MA 3 mm + 10 ml syringe  | Centrifugation | None       | 17-gauge + 1 ml syringe      | Multiple incisions, retrograde, and fanning      | Subdermal        | >20 ml          | 1 (20)/2 (2)    | Elevate (1 wk). Normal activity allowed.                                                                                             |
| Butterwick          | Medial knee, hip, and thigh | MA 12-gauge + 10 ml syringe | Decantation + centrifugation | None       | 18-gauge + 1 ml syringe      | Single incision (wrist), retrograde, and fanning | NR              | 10 ml           | 1               | Elevate (1 wk). Normal activity allowed.                                                                                             |
| Butterwick et al.   | Medial knee, hip, and thigh | MA 12-gauge + 10 ml syringe | Decantation + centrifugation | None       | 18-gauge + 1 ml syringe      | Single incision (wrist), retrograde, and fanning | NR              | 10 ml           | 1               | Elevate (1 wk). Normal activity allowed.                                                                                             |
| Agostini et al.     | Abdomen                  | NR blunt + 10 ml syringe | Centrifugation | None       | 16-gauge + 1 ml syringe      | Multiple incisions and retrograde fanning (hand + fingers) | Superficial layer | 10-20 ml        | NR              | Elevate (2 d). Avoid manual activity (1 wk). Foam pad dressing (10 d). Light compression bandage (48 h). Elevate (24 h). No strenuous manual activity (1 wk) |
| El Kahky et al.     | Abdomen                  | MA Coleman microcannula + 10 ml syringe | Centrifugation | None       | NR                           | Single incision (wrist), retrograde, fanning, and massage | NR              | ±10 ml          | 1               |                                                                                                                                         |

(continued on next page)
| Donor site | Harvest | Harvest cannula + syringe | Preparation | Enrichment | Injection cannula + syringe | Injection technique | Injection plane | Volume injected | No. of sessions | Postoperative care |
|------------|---------|---------------------------|-------------|------------|---------------------------|--------------------|-----------------|-----------------|----------------|------------------|
| Fantozzi18 | Abdomen and medial thigh or knee | MA 3 mm + NR | Decantation | None | 1.4 mm + NR | Fanning | Superficial layer | 10-30 ml | 1 (58)/2 (7) | Antibiotics (7 d) |
| Zhou et al.19 | Abdomen or thigh | MA 20-gauge + 20 ml syringe | NaCl wash + Centrifugation | None | 17-gauge + NR | Low pressure, low speed, low volume, multi-tunnels, multi-planes, and multi-points | Superficial and deep layer | 13-39 ml (avg. 25.5 ml) | 1-2 (NS) | NR |
| Yun-Nan et al.20 | Abdomen or thigh | MA 2.5 mm + 10 ml syringe | Centrifugation | None | 16-gauge + 1 ml syringe (MAFT-gun®) | Multiple incisions, multi-layered micro-autologous fat transfer | Deep, middle, and superficial layer | avg. 13.9 ml | 1 | Antibiotics (3 d). No strenuous activity (4 wk). Lymphatic-drain massage after 7 days. Elevate and minimize aggressive hand movements (1 wk) |
| Sasaki21 | Abdomen | MA 2.1 mm + 20 ml syringe | PRP Centrifugation Saline | 18-gauge + 1 ml syringe | Multiple incisions, retrograde, and fanning | Subdermal | 10 ml | 1 | |

Abbreviations: MA = manual aspiration; LD = liposuction device; NR = not reported; NS = not specified; SVF = stromal vascular fraction; PRP = platelet-rich plasma
used a retrograde, fanning/weaving injection technique with multiple passes in multiple directions via either single or multiple incisions. Agostini et al. also injected the dorsum of the fingers. The injection plane was not specifically reported in four articles and was in the subdermal or superficial layer in four articles. Zhou et al., however, transferred fat in both the superficial and deep layers and Yun-Nan et al. in all three layers of the hand dorsum. The volume of injected adipose tissue ranged from 10 to 39 ml. Mostly only one session of fat grafting was necessary to achieve the desired result. Postoperative management was very similar in all studies; patients were instructed to elevate and limit activities. Only two studies prescribed postoperative antibiotics.

**Volumetric measurements**

Two studies used objective measurements to demonstrate effectiveness of AFT in hand rejuvenation. Zhou et al. demonstrated results by means of ultrasound and 3D topography scanning. After injecting on average 25.5 ml fat and after an average of 8.3 months follow-up, soft-tissue thickness was measured by ultrasound to be 1.52 ± 0.53 mm preoperatively and increased to 4.04 ± 0.70 mm postoperatively. Topography scanning revealed an average of 10.3 ml volume increase. The study performed by Sasaki used 3D Vectra analysis after 12 months of follow-up to indicate a 54.8 ± 53.8% and 89.2 ± 87.2% change from baseline in the saline and PRP group, respectively.

**Patient, Surgeon, and Independent observer evaluation**

Seven studies evaluated patients’ opinion on the final result. In six studies, patient satisfaction is evaluated with two to 10-point Likert scales. Overall, self-reported satisfaction rate over a total cohort of 254 patients was very high with 97.6%.

In two articles, both patients and surgeons evaluated the final result. In the article written by El Kahlky et al., the Merz Hand Grading Scale (MHGS) was used by patients and surgeons to evaluate the final result of treatment. An improvement in scores was clearly seen when comparing preoperative and postoperative figures. Butterwick evaluated and asked their patients to evaluate the result regarding the prominence of veins and depth of the metacarpal space using a Four-point Likert scale. However, no preoperative scores are available to compare with. Similarly, in the article by Butterwick et al., surgeons evaluated the results using the same scale. But again, no preoperative scores are available. Lastly, in three studies, independent observers were asked to evaluate the result of treatment. By using three- or four-point Likert scales, clearly an improvement of aesthetic result was observed.

**Complications**

Of all included studies, nine reported on complications. Data from 300 patients are available. Six studies reported some degree of postoperative oedema to be present in all patients, whereas Fantozzi describes oedema to be present in only 3 patients and two
Table 4  
Results—Satisfaction

| No. Patients | Patient satisfaction/evaluation | Surgeon satisfaction/evaluation | Independent observer satisfaction/evaluation |
|--------------|---------------------------------|---------------------------------|-----------------------------------------------|
| **Aboudib et al.**<sup>12</sup> | 72 | **Two-, three-, or five-point scale**<br>Happy 98.6%/unhappy 1.4% | NR | NR | **Three-point scale** | Not improved 0%/significantly improved 18.2%/very much improved 81.8% | NR |
| **Agostini et al.**<sup>16</sup> | 22 | Dissatisfied 4.5%/satisfied 13.6%/very satisfied 81.8% | NR | NR<sup>3</sup> | **Four-point scale (0 = natural and smooth contour; 4 = serious atrophy)** | Preoperative = mean 2.65/postoperative = mean 0.95 | NR |
| **Fantozzi**<sup>18</sup> | 65 | Satisfied 84%/moderately satisfied 12%/dissatisfied 4% | NR | NR<sup>3</sup> | **Four-point scale (0 = natural and smooth contour; 4 = serious atrophy)** | Preoperative = mean 2.65/postoperative = mean 0.95 | NR |
| **Zhou et al.**<sup>19</sup> | 17 | Very satisfied 58.9%/satisfied 35.3%/unsatisfied 5.9% | NR | NR<sup>3</sup> | **Four-point scale (0 = natural and smooth contour; 4 = serious atrophy)** | Preoperative = mean 2.65/postoperative = mean 0.95 | NR |
| **Yun-Nan et al.**<sup>20</sup> | 68 | Very satisfied 58.8%/satisfied 39.7%/neutral 1.5%/unsatisfied 0%/preoperative = mean 2.65 and postoperative = mean 0.97 | NR | NR | **Four-point scale (0 = natural and smooth contour; 4 = serious atrophy)** | Preoperative = mean 2.65/postoperative = mean 0.95 | NR |
| **El Kahky et al.**<sup>17</sup> | 20 | 10 (9.5-10) + preoperative: 3 (3-4), postoperative: 0 (0-1) | Preoperative: 4 (3-4), postoperative: 1 (0-1) | NR | **Four-point scale (preoperative -4 = severe loss of volume, 0 = no loss of volume/postoperative 0 = no change, +4 = significant improvement)** | -2 ± 1.0/+2 ± 1.0 | NR |
| **Sasaki**<sup>21</sup> | 10 | NR | NR | NR | **Four-point scale (preoperative -4 = severe loss of volume, 0 = no loss of volume/postoperative 0 = no change, +4 = significant improvement)** | -2 ± 1.0/+2 ± 1.0 | NR |
| **Butterwick**<sup>14</sup> | 10 | NR | NR | NR | **Four-point scale (preoperative -4 = severe loss of volume, 0 = no loss of volume/postoperative 0 = no change, +4 = significant improvement)** | -2 ± 1.0/+2 ± 1.0 | NR |
| **Butterwick et al.**<sup>15</sup> | 10 | NR | NR | NR | **Four-point scale (preoperative -4 = severe loss of volume, 0 = no loss of volume/postoperative 0 = no change, +4 = significant improvement)** | -2 ± 1.0/+2 ± 1.0 | NR |

Abbreviations: SVF = stromal vascular fraction; PRP = platelet-rich plasma; MHGS = Merz Hand Grading Scale
other studies making no mention of perioperative oedema\textsuperscript{14, 15}. Infection was seen in 2 patients (0.67\%) and was treated by oral antibiotics. Cysts, irregularities, or bumps was seen in 4 patients (1.3\%), temporary dysesthesia in 16 (5.3\%), and transient dusky skin discoloration or ecchymosis in 21 patients (7\%).

### Discussion

A systematic review of the literature concerning the use of AFT in hand rejuvenation was conducted. The review was based on a broad search strategy, performed in three major medical databases. This study was performed to create a comprehensive review on current available evidence on the technique and outcome (effectiveness and safety) of AFT to rejuvenate the dorsum of the hand. Most articles regarding this topic are overview articles or technical notes\textsuperscript{22-25}, whereas only 10 articles were found to report on postoperative data.

When looking at the results regarding the fat grafting technique, great difference exists. Clearly, the technique of AFT in hand rejuvenation is variable among different surgeons. It is known that the entire procedure of fat harvest, processing, and re-injection affects the fat graft take, resorption, and final result of AFT. In general, the goal is to maintain as many viable adipocytes and stromal vascular fraction cells as possible (while discarding oil and blood) and to combine this with an optimal injection technique to increase fat graft survival. Many authors have been searching for the optimal technique; however, because of a lack of high-quality data, there is no evidence that supports the specific standardization of technique\textsuperscript{26-28}. Today, we do know that after fat grafting, only the most peripheral layer of adipocytes survives the hypoxia, and globules with a radius of more than 1.6 mm will suffer from central necrosis\textsuperscript{29, 30}. Therefore, fat graft delivery should be performed through many different cannula passes to leave small rays of microdroplets to achieve the best results. This innovation is also seen in the review: in the oldest article included in the review, fat was still injected in lumps and subsequently distributed over the hand dorsum, whereas in most articles, graft delivery was performed by retrograde injection, multiple cannula passes, and a fanning or weaving motion (Coleman technique) but only in the subdermal or superficial plane. In 2010, Bidic et al. highlighted the dorsal hand anatomy relevant to volumetric rejuvenation, and this resulted in surgeons injecting fat in multiple layers of the dorsal aspect of the hand, which could theoretically result in a more anatomical

| Author(s)          | No. of patients | Complications (%) | Treatment               |
|--------------------|-----------------|-------------------|-------------------------|
| Aboudib et al.\textsuperscript{12} | 72              | Infection (1.4\%)  | Antibiotics             |
|                    |                 | Irregularities (2.8\%) | NR                     |
|                    |                 | Oedema (100\%)     |                         |
| Coleman\textsuperscript{13}     | 22              | Oedema (100\%)     | Slight compression + elevation |
| Butterwick\textsuperscript{14}  | 14              | Infection (7.1\%)  | Antibiotics             |
|                    |                 | Temporary dysesthesia (21.4\%) | NR       |
|                    |                 | Transient dusky discoloration (21.4\%) | NR      |
| Butterwick et al.\textsuperscript{15} | 10      | Cysts (10\%)      | Steroid injections      |
|                    |                 | Temporary dysesthesias (30\%) | NR       |
|                    |                 | Transient dusky discoloration (80\%) | NR      |
| Agostini et al.\textsuperscript{16} | 22      | Sensory dysfunction fingers (13.6\%) | Spontaneous recovery |
|                    |                 | Oedema (100\%)     |                         |
| Fantozzi\textsuperscript{18}    | 65              | Temporary paraesthesia (10.8\%) | Spontaneous recovery |
|                    |                 | Oedema (4.6\%)     |                         |
| Zhou et al.\textsuperscript{19}  | 17              | Ecchymosis (17.6\%) | Conservative            |
|                    |                 | Bumps (5.9\%)      | NR                     |
|                    |                 | Oedema (100\%)     | NR                     |
| Yun-Nan et al.\textsuperscript{20} | 68      | Oedema (100\%)     | NR                     |
| Sasaki\textsuperscript{21}      | 10              | Oedema, erythema, slight bruising, firmness, and tenderness (100\%) | NR |

Abbreviations: NR = not reported
restoration\textsuperscript{19, 20, 31}. However, with current available data, we cannot reliably compare these injection techniques. Some authors\textsuperscript{14, 15, 17, 21} compared different ways of fat preparation or enrichment by performing split treatments to both hands, but only small differences were noted.

When looking at patient outcomes, we consistently notice few complications and high satisfaction, irrespective of fat grafting technique. Major complications such as fat embolism or severe infection were not seen, indicating AFT in hand rejuvenation is a safe technique. Fat necrosis was not reported in any study. Postoperative oedema, although not reported in all studies, is expected to be present in all patients but is advocated by some authors not be seen as a complication, but rather as part of the operation\textsuperscript{22}.

Patient, surgeon, and independent evaluator satisfaction rates are generally high. Only the studies of Butterwick show less convincing figures; however, they are difficult to interpret because there are no preoperative figures. Satisfaction is subjective, and evaluations were performed using various Likert scales, which is a weakness. Only the MHGS is validated to grade the appearance of the dorsum of the hand\textsuperscript{33}. Only two authors used the objective assessment of volume gain by ultrasound and/or 3D scanning, but they did reveal volume gain in all patients\textsuperscript{19, 21}. Besides the volume augmentation, the fat’s regenerative effect on the skin quality was reported by some authors; however, this was not properly measured in any study\textsuperscript{16, 20}.

An unpredictable graft resorption is the greatest drawback of AFT for volume augmentation purposes such as hand rejuvenation. Therefore, multiple fat transfer sessions might be necessary to achieve the desired result. Fat graft survival rates varies between 30 and 83\% in the current literature\textsuperscript{34}. In all included studies, graft resorption was never an outcome parameter. Anecdotally, Aboudib et al. mention moderate fat graft resorption after one year\textsuperscript{12}, and Yun-Nan et al. mention approximately 50\% fat resorption after one session of AFT in his discussion\textsuperscript{20}. Still, from volumetric measurements, some assumptions can be made regarding graft resorption. In the study by Zhou et al., an average of 25.5 ml of fat was injected, and after at least six months of follow-up, an average volume increase of 10.3 ml was demonstrated by 3D scanning. This indicates a fat graft survival of around 40\%\textsuperscript{19}.

Another option to treat age-related volume loss to the dorsal aspect of the hand is the use of dermal fillers. Although high-quality clinical studies on AFT and hand rejuvenation are rare, several randomized clinical trials assessing the effectiveness of calcium hydroxylapatite (CaHA) and hyaluronic acid (HA) in hand rejuvenation have been published\textsuperscript{35-38}. Several major differences are noted compared with AFT. First of all, the use of dermal fillers is a non-surgical treatment and does not require anaesthesia. The injection volume is much lower and rarely exceeds 3 ml per hand. Different injection techniques are used. Effects are temporary; thus, frequent touch ups are not unusual. Lastly, in these articles, satisfaction rates are high, and only mild complications are seen, which is similar to AFT\textsuperscript{35-38}. Nevertheless, foreign-body granulomas is a known and severe complication of dermal fillers and is also described after hand rejuvenation. Treatment often requires surgical excision\textsuperscript{6}.

This systematic review has several limitations. First, most studies included in the review are case series, which are inherently low-quality articles. Secondly, in most articles, patient cohort sizes are small, and follow-up was short. Thirdly, the patient- or surgeon-reported satisfaction is measured using various nonvalidated Likert scales, and objective data on volume retention were present in only two studies. Also, there is heterogeneity in technique and reported outcomes, making it difficult to combine data and draw conclusions. Furthermore, regarding the reporting of complications, it is important to mention that some authors use different definitions of a complication. For example, postoperative oedema is reported by some authors to be present in all cases, whereas other authors made no mention of this at all. It is assumed that some authors did not consider this as a true complication. Lastly, there is an inherent bias for publication of positive results. Obviously, all of these limitations may bias the results of this systematic review, and further evidence will be welcome.

Conclusion

In conclusion, this systematic review summarizes the current evidence on the technique and outcome of AFT in hand rejuvenation. Although several limitations exist, by combining the current evidence, AFT is considered a promising and safe technique to rejuvenate the aging hand with very high
patient satisfaction. AFT has several advantages related to biocompatibility and longevity; however, the drawback of fat graft resorption, which is inherent to AFT in any indication, should be taken into account. Also, one single optimal technique cannot be recommended above others. Future research, using validated patient questionnaires, objective volumetric measurements, and longer follow-up, is needed to confirm these results.

Funding

none

Conflicts of interest

none declared

Ethical approval

not required

References

1. Jakubietz RG, Kloss DF, Gruenert JC, Jakubietz MG. The ageing hand. A study to evaluate the chronological ageing process of the hand. Journal of Plastic, Reconstructive and Aesthetic Surgery. 2008;61:681–686.
2. Fabi SG, Goldman MP. Hand rejuvenation: a review and our experience. Dermatol Surg. 2012;38:1112–1127.
3. Butterwick K, Sadick N. Hand Rejuvenation Using a Combination Approach. Dermatol Surg. 2016;42(Suppl 2):S108–S118.
4. Khouri RK, Khouri RK. Current Clinical Applications of Fat Grafting. Plastic and Reconstructive Surgery. 2017;140:466E–468E.
5. Kühne U, Imhof M. Treatment of the ageing hand with dermal fillers. J Cutan Aesthet Surg. 2012;5:163–169.
6. Park TH, Yeo KK, Seo SW, et al. Clinical experience with complications of hand rejuvenation. J Plast Reconstr Aesthet Surg. 2012;65:1627–1631.
7. Charles-de-Sa L, Gontijo-de-Amorim NF, Maeda Takiya C, et al. Antiaging treatment of the facial skin by fat graft and adipose-derived stem cells. Plast Reconstr Surg. 2015;135:999–1009.
8. American Society of Plastic Surgeons (ASPS). ASPS Evidence Rating Scales. 2011: 2020.
9. Maher CG, Sherrington C, Herbert RD, Moseley AM, Elkins M. Reliability of the PEDro scale for rating quality of randomized controlled trials. Phys Ther. 2003;83:713–721.
10. Higgins JP, Altman DG, Gotzsche PC, et al. The Cochrane Collaboration’s tool for assessing risk of bias in randomised trials. BMJ. 2011;343:d5002.
11. Wells GA SB, O’Connell D, Peterson J, Welch V, Losos M, Tugwell P. The Newcastle-Ottawa Scale (NOS) for assessing the quality of nonrandomised studies in meta-analyses: 2020.
12. Aboudib Júnior JH, de Castro CC, Gradel J. Hand rejuvenescence by fat filling. Ann Plast Surg. 1992;28:559–564.
13. Coleman SR. Hand rejuvenation with structural fat grafting. Plast Reconstr Surg. 2002;110:1731–1744 discussion 45-7.
14. Butterwick KJ. Lipaugmentation for aging hands: a comparison of the longevity and aesthetic results of centrifuged versus noncentrifuged fat. Dermatol Surg. 2002;28:987–991.
15. Butterwick KJ, Bevin AA, Iyer S. Fat transplantation using fresh versus frozen fat: a side-by-side two-hand comparison pilot study. Dermatol Surg. 2006;32:640–644.
16. Agostini T, Perello R. Lipomodeling: An Innovative Approach to Global Volumetric Rejuvenation of the Hand. Aesthet Surg J. 2015;35:708–714.
17. El Kahky H, Diab H, Helal HA. Half-side comparison between adipose tissue stem cell–enriched fat versus standard fat injection for hand rejuvenation. Journal of the Egyptian Women’s Dermatologic Society. 2017;14:25–30.
18. Fantozzi F. Hand rejuvenation with fat grafting: A 12-year single-surgeon experience. Eur J Plast Surg. 2017;40:457–464.
19. Zhou J, Xie Y, Wang WJ, et al. Hand Rejuvenation by Targeted Volume Restoration of the Dorsal Fat Compartments. Aesthet Surg J. 2017;37:92–100.
20. Yun-Nan L, Shu-Hung H, Tsung-Ying L, et al. Micro-autologous fat transplantation for rejuvenation of the dorsal surface of the aging hand. J Plast Reconstr Aesthet Surg. 2018;71:573–584.
21. Sasaki GH. A Preliminary Clinical Trial Comparing Split Treatments to the Face and Hand With Autologous Fat Grafting and Platelet-Rich Plasma (PRP): A 3D, IRB-Approved Study. Aesthet Surg J. 2019;39:675–686.
22. Hoang D, Orgel MI, Kulber DA. Hand Rejuvenation: A Comprehensive Review of Fat Grafting. J Hand Surg Am. 2016;41:639–644.
23. Conlon CJ, Abu-Ghname A, Davis MJ, et al. Fat Grafting for Hand Rejuvenation. Semin Plast Surg. 2020;34:47–52.
24. Weiss DD, Carraway JH. Hand rejuvenation. Aesthet Surg J. 2004;24:567–573.
25. Fulton JE, Parastouk N. Fat grafting. Dermatol Clin. 2001;19:523–530 ix.
26. Strong AL, Cederna PS, Rubin JP, Coleman SR, Levi B. The Current State of Fat Grafting: A Review of Harvesting, Processing, and Injection Techniques. Plast Reconstr Surg. 2015;136:897–912.
27. Xue EY, Narvaez L, Chu CK, Hanson SE. Fat Processing Techniques. Semin Plast Surg. 2020;34:11–16.
28. Gir P, Brown SA, Oni G, et al. Fat grafting: evidence-based review on autologous fat harvesting, processing, reinjection, and storage. Plast Reconstr Surg. 2012;130:249–258.
29. Khouri Jr RK, Khouri RE, Lujan-Hernandez JR, et al. Diffusion and perfusion: the keys to fat grafting. Plast Reconstr Surg Glob Open. 2014;2:e220.
30. Eto H, Kato H, Suga H, et al. The fate of adipocytes after nonvascularized fat grafting: evidence of early death and replacement of adipocytes. Plast Reconstr Surg. 2012;129:1081–1092.
31. Bidic SM, Hatef DA, Rohrich RJ. Dorsal Hand Anatomy Relevant to Volumetric Rejuvenation. Plastic and Reconstructive Surgery. 2010;126:163–168.
32. Fournier PE. Autologous Fat Transfer Springer. Fat Transfer to the Hand for Rejuvenation; 2010 Berlin, Heidelberg.
33. Cohen JL, Carruthers A, Jones DH, et al. A Randomized, Blinded Study to Validate the Merz Hand Grading Scale for Use in Live Assessments. Dermatol Surg. 2015;41(Suppl 1):S384–S388.
34. Yu NZ, Huang JZ, Zhang H, et al. A systemic review of autologous fat grafting survival rate and related severe complications. Chin Med J (Engl). 2015;128:1245–1251.
35. Moradi A, Allen S, Bank D, et al. A Prospective, Multicenter, Randomized, Evaluator-Blinded, Split-Hand Study to Evaluate the Effectiveness and Safety of Large-Gel-Particle Hyaluronic Acid with Lidocaine for the Correction of Volume Deficits in the Dorsal Hand. Plast Reconstr Surg. 2019;144:586e–596e.
36. Goldman MP, Moradi A, Gold MH, et al. Calcium Hydroxylapatite Dermal Filler for Treatment of Dorsal Hand Volume Loss: Results From a 12-Month, Multicenter, Randomized, Blinded Trial. Dermatol Surg. 2018;44:75–83.
37. Wilkerson EC, Goldberg DJ. Small-Particle Hyaluronic Acid Gel Treatment of Photoaged Hands. Dermatol Surg. 2018;44:68–74.
38. BUSSO M, MOERS-CARPI M, STORCK R, OGILVIE P, OGILVIE A. Multicenter, Randomized Trial Assessing the Effectiveness and Safety of Calcium Hydroxylapatite for Hand Rejuvenation. Dermatologic Surgery. 2010;36:790–797.