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Hand

Autologous Fat Grafting in Hand Surgery: A Systematic Review

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Background: Autologous fat grafting (AFG) has gained popularity in both cosmetic and reconstructive surgery, including hand surgery, due to its regenerative potential and dual benefits of enhancing aesthetics and function. This systematic review aims to evaluate the efficacy of AFG in treating various hand pathologies.

Methods: A systematic review was conducted following PRISMA guidelines. PubMed, Cochrane Library, and Embase databases were searched for studies published between January 2001 and October 2022 using the terms "(autologous fat grafting) AND (hand)." Of 224 studies identified, 14 met the inclusion criteria. These studies were analyzed based on study design, pathology treated, type of AFG used, and primary outcomes.

Results: The review included 14 studies: 9 prospective/retrospective studies, 3 case reports, and 2 randomized control trials. Digital ulcers related to systemic sclerosis and hand osteoarthritis were the most frequently treated pathologies. AFG was predominantly used to address symptoms/pain (71.4%), with aesthetics as a secondary benefit in 21.4% of cases. The studies reported improvements in pain, functionality, and patient satisfaction. However, the variability in techniques and outcomes limited the ability to perform a meta-analysis.

Conclusions: AFG shows promise as a minimally invasive treatment option for various hand pathologies, offering both symptomatic relief and aesthetic enhancement. Although initial findings are favorable, further high-quality studies are needed to standardize techniques and confirm long-term efficacy. The versatility and safety profile of AFG suggest it has the potential to become a widely adopted technique in hand surgery. *(Plast Reconstr Surg Glob Open 2025; 13:e6466; doi: 10.1097/GOX.0000000000006466; Published online 28 January 2025.)*

INTRODUCTION

Autologous fat grafting (AFG), also coined as fat transfer or lipofilling, has a history that has evolved for more than a century.[1] It has gained traction since the modernization of liposuction in the 1950s and has benefited from the enhanced reliability of minimally invasive approaches for fat harvesting.[1] These advancements have subsequently led to the development of standardization in fat grafting techniques and improved the survival rate of transferred adipose cells.[2]

Current applications of AFG encompass a broad spectrum of cosmetic and reconstructive procedures. In aesthetic breast surgery, it has been used for augmentation, implant replacement, contouring after radiation therapy, and correcting deformities such as tuberous breast or brassiere strap grooves.[3–7] In reconstruction, it has found use in rhinoplasty, gluteoplasty, and laryngoplasty, owing to its role in regenerative medicine.[4,8–15] When taken together, its improvements in aesthetics and functionality have led to its rise in popularity and have motivated adoption in other fields of medicine.

In the field of hand surgery, AFG has been regarded for its dual aesthetic and functional benefits. Most studies cite 2 main biological ideas when choosing to implement AFG as a treatment modality. First, autologous fat grafts have been hypothesized to have potential restorative ability, as they contain rich populations of adipose-derived

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stem cells, making them an enticing treatment for degenerative diseases such as osteoarthritis (OA). Second, these grafts can provide simple volume restoration in tissue spaces with minimal concern for graft site reactivity given their underlying autologous nature. Thus, with its minimally invasive nature and regenerative capacity, AFG is hypothesized to be an effective biologic filler for restoring volume and enhancing tissue quality.[16] This regenerative capability has been hypothesized to play a crucial role in improving postsurgical or traumatic scars by softening tissue, generating new collagen fibers, enhancing mobility, and improving overall appearance.[15] Although still limited in its use, AFG is being trialed as a treatment modality for a variety of hand pathologies.

This systematic review provides an overview of the use of AFG in hand surgery. In addition, this study discusses the pathologies it has been trialed to treat and its overall efficacy in the field to guide clinicians in improving patient outcomes.

Takeaways

Question: What is the efficacy of autologous fat grafting (AFG) in treating various hand pathologies?

Findings: Fourteen studies were included. They reported improvements in pain, functionality, and patient satisfaction. However, the variability in techniques and outcomes limited the ability to perform a meta-analysis.

Meaning: AFG shows promise as a minimally invasive treatment option for various hand pathologies, offering both symptomatic relief and aesthetic enhancement. Although initial findings are favorable, further high-quality studies are needed to standardize techniques and confirm long-term efficacy. The versatility and safety profile of AFG suggest that it has the potential to become a widely adopted technique in hand surgery.

MATERIALS AND METHODS

A systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Searches were performed across PubMed, Cochrane Library, and Embase databases for articles published between January 2001 and October 2022 using the search terms "(autologous fat grafting) AND (hand)." This search yielded 224 studies, of which 94 were removed as duplicates (Fig. 1).

The remaining 130 articles were screened independently by 2 reviewers (N.J. and E.J.H.), and 24 studies were identified as potentially relevant based on their titles and abstracts. These articles were further reviewed in full by 3 authors (B.H., A.D.P., and L.A.H.) to assess their relevance to AFG in hand surgery. Discrepancies in the assessment were resolved through discussion with the senior author (B.J.M.).

Inclusion criteria are as follows:

- Clinical studies investigating the use of AFG in hand surgery;
- Prospective, retrospective, or randomized controlled trials;
- Studies reporting quantitative data on clinical outcomes.

Exclusion criteria:

- Non-English language studies;
- Review articles, abstracts, and posters;
- Studies with no available full text.

Analysis of the articles was done using Microsoft Excel to determine the percentages of articles in each category. Categories analyzed included study design, study topic or theme, type of AFG, and reason for AFG. No meta-analysis was able to be performed, as the data pool was small, a variety of pathologies were treated, and studies were not standardized regarding AFG implementation, follow-up, and patient-reported outcomes. To characterize risk of bias and assess the quality of each study, article level of evidence was scored based on the Oxford Centre for Evidence-Based Medicine 2011 guidelines (Tables 1–3).[30]

RESULTS

A total of 14 studies were reviewed based on the following categories: author, year published, country, study design, population, type of AFG, pathology treated, and reason for AFG. Additionally, the main findings of each study were also summarized (Tables 1–3).

When classified by study design: 64.3% (9 of 14) were prospective/retrospective studies, 21.4% (3 of 14) were case reports, and 14.3% (2 of 14) were clinical trials. Digital ulcers (DUs) related to systemic sclerosis (SSc) were addressed in 28.6% (4 of 14), hand OA in 21.4% (3 of 14), and hand rejuvenation in 14.3% (2 of 14), and the remaining 35.7% (5 of 14) discussed a variety of topics, including Raynaud phenomenon, hand atrophy, hand burns with and without scar contractures, flexion contractures, ulnar nerve neuropathy, and painful hand neuromas. Types of AFG were mainly lipoaspirate (92.9%, 13 of 14) or solid fat graft (7.1%, 1 of 14). Reasons for AFG use were symptoms/pain in 71.4% (10 of 14), aesthetics in 21.4% (3 of 14), and both symptoms/pain and aesthetics in 7.1% (1 of 14). These results are displayed in Figure 2.

DISCUSSION

This review of AFG provides insight into the most widely used types of fat grafting, the hand pathologies treated by the technique, and whether pain or cosmetic appearances can improve with usage.

Of the included studies, nearly all chose to harvest autologous fat tissue from either the abdominal or pelvic regions via manual liposuction. In a unique case, Ribak et al[24] harvested a solid fat block from a patient's elbow. This was transferred to the first interdigital space to correct significant muscle atrophy secondary to ulnar nerve damage and had a low rate of graft resorption.[24] In a similar fashion, Elgayar et al[28] reported a low rate of graft resorption to the dorsal hand after using a transferred lipoaspirate combined with platelet-rich plasma. Although resorption is common to all fat grafting procedures, rates can vary

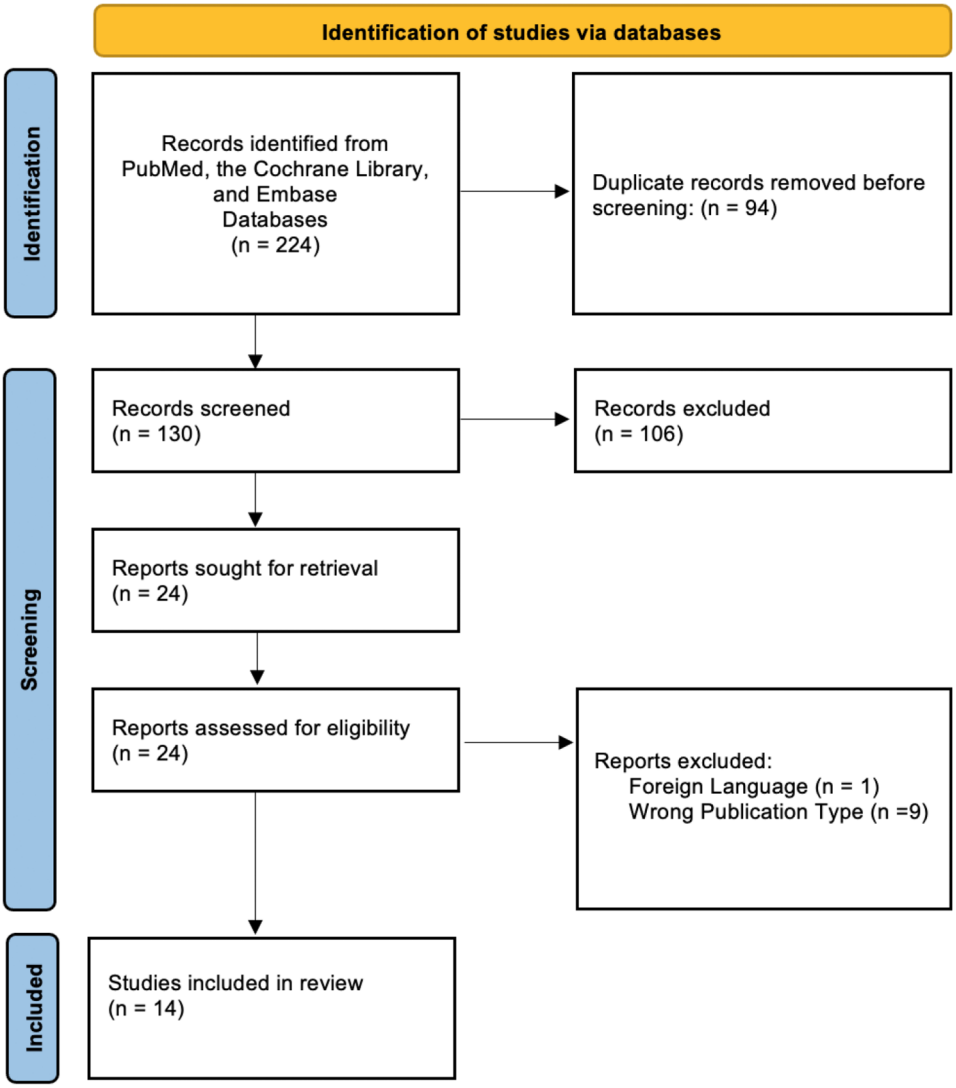

Fig. 1. PRISMA flowchart for article selection.

from 30% to 70%.[31] It is likely the type of graft used influences these rates. Further research is needed to understand whether decreased graft resorption is seen with solid or liquid fat transfer.

In the treatment of various hand pathologies, AFG was often tried after failure of traditional treatment methods. For example, DUs related to SSc were successfully treated with AFG in multiple studies.[17,18,26] In a case report by Giuggioli et al,[26] a 60-year-old woman affected by SSc with recurrent treatment resistant DUs of the right-hand sustained progression of her condition due to nonhealing amputation stumps. After receiving autologous fat lipoaspirate to the wound edges and subdermal plane all around the finger stumps, her ulcers and pain resolved within 3 months, and further amputation procedures were deemed unnecessary.[26] From the reported cases, the use of AFG in the treatment of DU appears to be a viable management option. However, higher powered longitudinal studies are required to further evaluate this proposal.

In studies where AFG was trialed as an initial treatment option, indications typically included OA of the hand.[20–22] In their comparative study of AFG versus Lundborg resection arthroplasty in the treatment of trapeziometacarpal joint OA, Erne et al[22] noted that both groups saw improvements in pain and disability index scores at 6-month and 2-year follow-ups. However, the AFG group had significantly shorter operating room times (13 versus 31 min for the AFG and Lundborg resection arthroplasty groups, respectively) and experienced a quicker recovery and improvement of symptoms.[22] Their findings suggest that as a less invasive procedure, AFG may be able to provide similar benefits to more involved surgical techniques. In their case series, Froschauer et al[20] used AFG to manage thumb carpometacarpal joint OA and found similar success in treating patients' symptoms for up to 2 years. Long-term follow-up, however, found that with continued progression of arthritis, many patients ultimately went on to require more definitive surgical intervention after 2 years.[20] This

Table 1. Article Demographics and Main Findings Following Review of the Included Prospective/Retrospective Studies

Author(s), Year, Country	Study Design	Population	Type of AFG	Pathology Treated	Reason for AFG	Main Findings	OCEBM Score
Bene et al (2014),[17] Italy	Prospective Study	9 Patients (8F, 1M, 43–76, average = 63)	Lipoaspirate	SSc	Symptoms/ pain	10 DUs treated with AFG completely healed by 8-12wk. Most patients reported pain improvement and decreased analgesic usage	3
Pignatti et al (2020),[18] Italy	Prospective study	25 Patients (19F, 6M, 46.4–64.9, average = 55.7)	Lipoaspirate	SSc	Symptoms/ pain	Of the 25 patients, 12 had hand symptoms, and 9 experienced DUs. After 2 or 3 rounds of AFG, 8/9 patients' DUs completely healed, and the last patient had improvement. Raynaud condition scores significantly improved. Subjective improvements in hand tension and disability perception	3
Strong et al (2021),[19] USA	Prospective study	10 Patients (all women, 25–78, average = 48.7)	Lipoaspirate	SSc	Symptoms/ pain	Of the 10 patients, 5 received AFG to both face and hands to improve skin fibrosis. After 1–4 rounds of AFG, subjective improvements in skin elasticity, hand pain, and mobility	3
Froschauer et al (2020),[20] Austria	Prospective study	31 Patients (27F, 4M, 46.4–78.3, average = 57.5)	Lipoaspirate	OA	Symptoms/ pain	31 thumbs received AFG to improve pain and grip strength. At 6 mo and 2 y, both pain and disability index scores significantly improved	3
Kemper et al (2018),[21] Germany	Prospective study	12 Patients (10F, 2M, 30–67, average = 46)	Lipoaspirate	OA	Symptoms/ pain	12 patients with early thumb CMC joint OA received arthroscopic synovectomy and AFG. After 2 y, patients reported overall improvement in pain and disability indexes	3
Erne et al (2018),[22] Germany	Retrospective study	21 Patients (unable to ascertain gender or age)	Lipoaspirate	OA	Symptoms/ pain	Of the 21 patients, 9 received AFG and 12 received LRA for TMC joint OA. Pain, grip, and disability index improved in both groups, but AFG provided shorter operation and recovery times	3
Haravu et al (2024),[23] USA	Retrospective study	17 Patients (16F, 1M, 42.3-64.7, average = 53.5)	Lipoaspirate	Raynaud phenomenon	Symptoms/ pain	AFG treatment of 17 patients with Raynaud's Disease led to reduced attack intensity, frequency, and duration. Patients reported about 1 y of relief before symptoms began to return	3
Ribak et al (2017),[24] Brazil	Retrospective study	15 Patients (3F, 12M)	Fat block	Hand atrophy	Aesthetics	15 Patients with ulnar nerve lesions received AFG to the first interdigital space. Fat blocks were inserted to aesthetically improve the muscular atrophy. Average follow-up time was 22.9 mo, and 14/15 patients reported satisfaction	3
Deptula et al (2022),[25] USA	Retrospective study	5 Patients (3F, 2M, 42–71, average = 60.4)	Lipoaspirate	OA hand burn, flexion contracture, neuropathy	Symptoms/ pain + aesthetics	5 patients received AFG for 5 different pathologies: thumb basilar OA, full-thickness hand burn, fixed PIP flexion contracture, ulnar nerve neuropathy, and thumb CMC joint OA. Follow-up range was 2–36 mo, and 100% of patients reported satisfaction and good functional outcomes	4

CMC, carpometacarpal; LRA, Lundborg resection arthroplasty; OCEBM, Oxford Centre for Evidence-based Medicine; TMC, trapeziometacarpal; PIP, proximal interphalangeal.

suggests that although AFG use may improve symptoms associated with OA, it serves more to delay rather than remove the need for more definitive management. Thus, AFG may serve as a helpful symptomatic bridging therapy in the management of OA affecting the hand.

Interestingly, the majority of the included studies cited AFG use to treat symptoms, pain, and functional deficits of the hand experienced by patients, such as limited range of motion due to SSc or burn scar contractures, debilitating joint pain due to OA, or neuropathy secondary to a neuroma, although the minority used it solely for improving the hand's cosmetic appearance. This is somewhat paradoxical given that in other body regions where AFG has become common practice, such as the breast and face,

Table 2. Article Demographics and Main Findings Following Review of the Included Case Reports

Author(s), Year, Country	Study Design	Population	Type of AFG	Pathology Treated	Reason for AFG	Main Findings	OCEBM Score
Giuggioli et al (2021),[26] Italy	Case report	1 Patient (female, 60)	Lipoaspirate	SSc	Symptoms/pain	A 60-y-old woman had parts of her right index and middle fingers amputated due to DUs. Three months after AFG treatment, the DUs were completely healed, and her pain improved	4
Al-Hayder et al (2017),[14] Denmark	Case report	1 Patient (female, 7)	Lipoaspirate	Burn scar hand contracture	Symptoms/pain	A 7-y-old girl with a severe palmar scar contracture and limited ROM received Z-plasty and AFG to improve skin quality. After 1 y, she regained full ROM, and the skin was pliable	4
De Jongh et al (2020),[27] the Netherlands	Case report	1 Patient (female, 48)	Lipoaspirate	Painful hand neuroma	Symptoms/pain	A 48-y-old experienced severe neuropathic pain woman from a neuroma on the dorsal hand. After other treatments failed, she received AFG. As of 1 y postoperative, she was pain free	4

OCEBM, Oxford Centre for Evidence-based Medicine; ROM, range of motion.

Table 3. Article Demographics and Main Findings Following Review of the Included RCTs

Author(s), Year, Country	Study Design	Population	Type of AFG	Pathology Treated	Reason for AFG	Main Findings	OCEBM Score
Elgayar et al (2023),[28] Egypt	Randomized control trial	60 Patients (all women, 25–61, average = 45.1)	Lipoaspirate	Hand aging	Aesthetics	60 patients were randomly selected to either receive AFG with PRP or AFG with PRP + CO_2 lasering to their dorsal hands. In both groups, most (90%) patients reported being satisfied or markedly satisfied at 6 mo. The lasering group saw additional pigmentation improvement	2
Sasaki (2019),[29] USA	Randomized control trial	10 Patients (all women, 46–67, average = 54.4)	Lipoaspirate	Hand aging	Aesthetics	10 patients were randomly selected to either receive AFG + PRP or AFG + normal saline in their hands. No significant differences were seen between the groups, and dorsum volume restoration lasted about 1 y before visible resorption was apparent	2

CO_2, carbon dioxide; OCEBM, Oxford Centre for Evidence-based Medicine; PRP, platelet-rich plasma.

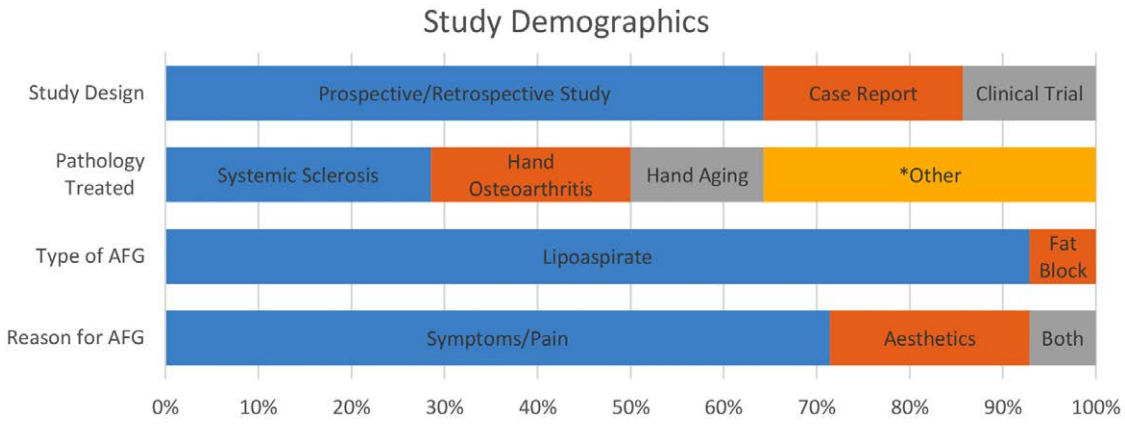

Fig. 2. The distribution of the 14 included studies with overlayed descriptions of categories based on study design, pathology treated, the type of AFG used, and the reason for AFG treatment. *The "Other" category included the following pathologies: Raynaud phenomenon, correcting hand atrophy, hand burns with and without scar contractures, flexion contractures, ulnar nerve neuropathy, and hand neuromas.

treatment is generally centered on aesthetic reconstruction or enhancement.[32,33]

Despite the positive outcomes observed in this review, several limitations must be noted. First, the heterogeneity of the included studies, particularly in terms of study design, patient populations, and outcome measures, limits the ability to draw definitive conclusions. Additionally, many studies had small sample sizes, reducing the generalizability of the findings. The variability in fat harvesting, processing, and grafting techniques across studies further complicates comparisons. Moreover, the short follow-up periods in several studies make it difficult to assess the long-term effectiveness of AFG in hand surgery. Finally, the absence of standardized outcome measures,

particularly regarding functional and aesthetic improvements, highlights the need for more uniform assessment tools in future research. Addressing these limitations in future studies will help provide more robust evidence on the efficacy of AFG in hand surgery.

CONCLUSIONS

AFG is emerging as a promising therapeutic option for the management of various hand pathologies, owing to its inherent advantages of availability, versatility, and biocompatibility. Demonstrating a favorable safety profile, AFG has shown potential in both the treatment of medical conditions and the enhancement of cosmetic outcomes in hand surgery. Continued research endeavors are warranted to elucidate the specific hand pathologies that are most amenable to AFG intervention. Based on the findings of this review, it is anticipated that the utilization of AFG in hand surgery will expand to encompass a wider range of hand pathologies, thereby solidifying its position as a valuable technique available to hand surgeons.

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