International Journal of Research in Medical Sciences
Cevallos KEG et al. Int J Res Med Sci. 2025 Feb;13(2):797-804
www.msjonline.org
pISSN 2320-6071 | eISSN 2320-6012
DOI: https://dx.doi.org/10.18203/2320-6012.ijrms20250255

Systematic Review

Innovative use of autologous fat grafting and regenerative therapies in the surgical management of dermatological scarring disorders: a systematic review of functional and aesthetic outcomes

Karla Enith Guamán Cevallos[1]*, Elizabeth Arellano Pacheco[2], Andres Felipe Santodomingo Galindo[3], González Mercado Zeus Edrian Daniel Alfonso[4], Jorge Luis Rivera Gastelum[5], Jeremy Paolo Flores Mora[6], Ricardo Uriel Maldonado López[7]

[1]Medical Department, Master in Occupational Health and Safety, Specialist in Occupational Toxicology, Ecuador
[2]Department of Internal Medicine, Hospital General de Zona 50 Instituto Mexicano del Seguro, Social San Luis Potosí, México
[3]Department of Medicine, Masters in Epidemiology, Independent Investigator, Chile
[4]Department of Surgery, Instituto Mexicano del Seguro Social, México
[5]Department of Surgery, Universidad Autónoma de Sinaloa, México
[6]Medical Department, Ministerio de Salud Pública, Ecuador
[7]Department of Surgery, Insituto Mexicano de Seguridad Social, México

Received: 27 December 2024
Accepted: 13 January 2025

***Correspondence:**
Dr. Karla Enith Guamán Cevallos,
E-mail: karlyguaman@gmail.com

ABSTRACT

A systematic strategy was adopted to evaluate efficacy of autologous fat grafting and regenerative therapies such as platelet-rich plasma (PRP) or stromal vascular fraction (SVF) for the management of dermatological scarring disorders. In methodology, selected databases are PubMed, Scopus, Web of Science and Cochrane Library so total of 25 studies were selected involving 2,130 patients with hypertrophic, keloid, or atrophic scars. We conducted meta-analysis and revealed 35% improvement in scar pliability and a 40% enhancement in aesthetic appearance as assessed by validated scales. In functional outcomes such as relief from pain and itching was improved by 68% and patient satisfaction scores increased significantly with minor complications such as transient edema and localized infection reported in 8% of cases. Regenerative potential of fat grafting amplified by PRP and SVF show ability to promote dermal remodeling, angiogenesis and tissue repair. In results, fat-based therapies demonstrated better functional and aesthetic results when compared to traditional treatments and our results highlight more extensive, superior randomized controlled studies are needed to validate effectiveness and improve procedures. We illustrated how autologous fat grafting and regeneration techniques can improve patient satisfaction and results in dermatological scarring.

Keywords: Dermal scarring, Fat grafting, Autologous, Platelet-rich plasma, Adipose-derived stem cells, Tissue rmodeling

INTRODUCTION

Dermatological scarring disorders contains a range of skin conditions resulting from injury, surgery or inflammation and most often lead to aesthetic concerns and functional impairments. Autologous fat grafting enhances scar remodeling, improving texture, pliability and volume restoration through regenerative therapies like adipose tissue-derived stem cells (ADSCs), platelet-rich plasma (PRP) and nanofat. These techniques aim to restore skin quality or address pigmentation issues and stimulate collagen production, contributing to both functional recovery and aesthetic enhancement. Dermatological scarring disorders are affecting millions globally and are posing both physical and psychological challenges. Estimated results show 100 million individuals develop

scars annually following surgical procedures or trauma and about 10% of people experience keloid scarring but incidence of keloids and hypertrophic scars range from 30% to 90% of patients.[1,2] Traditional management approaches include corticosteroid injections, laser therapy and surgical excision have demonstrated variable success rates with recurrence rates for keloids ranging from 45% to 100% depending on treatment modality and such variability show the need for innovative strategies to improve outcomes. Autologous fat grafting is coupled with regenerative therapies such as PRP and stromal vascular fraction (SVF) and these techniques have gained increasing attention for effectivity.[3-5] Autologous fat grafting involves harvesting adipose tissue from the patient's body and it is followed by its reinjection into scarred areas. Adipose tissue is used as a filler but it also contains a wealth of growth factors and mesenchymal stem cells (MSCs) which encourage tissue regeneration and also lower inflammation while it is also seen to increase scar pliability. According to recent research, fat grafting improves patient-reported outcomes and reduces scar volume by up to 70% and more than 80% of patients say they are satisfied with the aesthetic results. These treatments improve scar quality by promoting vascularization and cellular proliferation when paired with PRP or SVF.[6-8] There is strong evidence to support regenerative therapy for example, fat grafting considerably reduced the Vancouver scar scale (VSS) scores with mean decreases of 35% to 50% in pigmentation, vascularity and thickness parameters, according to a 2021 meta-analysis encompassing 18 research and 536 patients.

These results show efficacy of regenerative techniques not only in modifying scar tissue but also in addressing the psychosocial burden of scarring.[9] However, some of these therapies when practiced clinically are not without difficulties and major challenges include procedural techniques variability or absence of standardization in outcome measures and limited long-term follow-up.[10]

Table 1: Techniques, tools, specifications, and applications for autologous fat grafting in dermatological scarring.

Technique	Tools and equipment	Specifications	Applications	How to use
Liposuction	Liposuction cannulas (2–3 mm diameter), aspiration syringes, tumescent fluid	Harvesting performed under local anesthesia; use of low-vacuum settings to avoid damage to adipocytes	Harvesting autologous fat from donor sites like abdomen, thighs, or flanks	Inject tumescent fluid, use a small cannula to extract fat with minimal trauma[11]
Fat processing	Centrifuge, sterile filters, decantation tubes	Centrifuge fat at 3000 rpm for 3 minutes or use filtration techniques to isolate pure adipocytes and regenerative cells	Preparing fat for injection by removing impurities (blood, oil, tumescent fluid)	Centrifuge extracted fat or use filtration systems. Decant and extract purified fat for grafting[12]
Microfat injection	Microcannulas (0.7–1.2 mm), 1 ml syringes	Inject purified fat into targeted tissues in layers; use micro-droplet techniques for even distribution	Correcting volume loss and improving scar appearance in deeper scars	Use small-diameter cannulas to inject microdroplets at various depths in a fanning pattern[13]
Nanofat grafting	Emulsification cannulas, fine needles (27 G)	Process harvested fat into a liquid form to extract stromal vascular fraction (SVF)	Improving skin texture and pigmentation in superficial scars	Pass harvested fat through progressively smaller filters. Inject emulsified fat into dermis or superficial layers[14]
Platelet-rich plasma (PRP)	Centrifuge, platelet separation kits, fine needles (25–27 G)	Combine PRP with autologous fat for enhanced regenerative potential	Promoting angiogenesis and collagen production in atrophic scars	Draw blood, process to isolate PRP, mix with fat, and inject into targeted areas[15]
Stem cell-enriched fat	SVF isolation kits, enzymatic digestion units	Enrich harvested fat with isolated adipose-derived stem cells (ADSCs) for increased regenerative capability	Treating recalcitrant scars with significant fibrosis or atrophy	Isolate ADSCs using enzymatic digestion or mechanical separation, mix with fat and inject[16]
Fat-dermal matrix grafting	Dermal graft templates, microcannulas	Combine autologous fat with acellular dermal matrices to provide structural support	Deep and wide scars requiring additional support for volumetric correction	Apply dermal matrix, overlay fat grafts, and secure with sutures if needed[17]

Continued.

Technique	Tools and equipment	Specifications	Applications	How to use
Hybrid techniques	PRP kits, nanofat tools, dermal fillers	Combine fat grafting with synthetic fillers or nanofat for tailored outcomes	Complex scars needing both volume restoration and textural improvement	Inject fat for volume and PRP or nanofat for superficial layers in a layered approach[18]
Fractional fat grafting	Fractional injector, specialized cannulas	Implant small aliquots of fat with fine precision using automated systems	Treating scars in delicate areas like periorbital or perioral regions	Use a fractional delivery system to implant micro-volumes of fat into scar tissue for precision enhancement[19]

Table 2: Detailed comparison of techniques and key characteristics.

Technique	Key characteristics and unique benefits
Nanofat grafting	Best for treating superficial scars and improving skin texture. Rich in stromal vascular fraction (SVF), which enhances skin quality and reduces pigmentation. Can be injected into the dermis for fine textural corrections.[20]
Microfat grafting	Suitable for deeper scars that require volumetric correction. Uses purified fat injected in micro-droplets for even distribution and natural results. Provides long-lasting improvements in atrophic scar appearance.
Stem cell-enriched fat	Ideal for treating fibrotic or recalcitrant scars. Adipose-derived stem cells (ADSCs) enhance the fat graft's regenerative properties, promoting tissue repair and scar remodeling. Improves elasticity and dermal thickness.[21]
PRP-augmented fat grafting	Combines platelet-rich plasma with autologous fat to enhance graft survival and promote angiogenesis. Improves collagen production, aiding in the management of atrophic and post-inflammatory scars. Particularly effective in areas with poor vascularization.
Fractional fat grafting	Used for precise correction in delicate areas such as the periorbital or perioral regions. Fat is implanted in small aliquots to ensure accuracy and minimize overcorrection. Effective for fine lines and subtle volume restoration.
Hybrid techniques	Combines fat grafting with synthetic fillers or dermal matrices for tailored outcomes. Provides both volumetric correction and improvement in skin texture. Effective for complex scars requiring multi-layered treatments.
Fat-dermal matrix grafting	Integrates autologous fat with acellular dermal matrices to provide structural support for wide or deep scars. Improves scar pliability and texture while maintaining volumetric correction. Commonly used for surgical or traumatic scars.
Emulsified fat grafting	Processed fat is liquefied to achieve a smoother consistency for injection into superficial layers. Ideal for textural irregularities and minor pigmentary changes and can improve skin quality and scar pigmentation over time.
Sequential layering	Involves grafting fat in multiple sessions to allow gradual volumetric and regenerative improvements. Particularly beneficial for large or complex scars where single-session overcorrection is a risk. Improves long-term outcomes.
Fat mixed with dermal fillers	Autologous fat is mixed with hyaluronic acid or collagen-based fillers to enhance immediate results. Provides volume correction while allowing the fat to integrate and regenerate over time. Useful for areas requiring both structure and regeneration.
Laser-assisted fat grafting	Uses fractional laser treatments in combination with fat grafting to create microchannels for better fat integration. Improves skin texture and promotes neocollagenesis. Ideal for burn scars and areas with fibrotic tissue.
SVF-enriched fat grafting	Stromal vascular fraction (SVF) is isolated and added to fat grafts to improve cell survival and regenerative capacity. Effective for scars with extensive tissue damage or fibrosis. Enhances angiogenesis and skin elasticity.
TCA or microneedling pre-treatment	Prepares the scar tissue for fat grafting by improving vascularization and tissue receptivity. Trichloroacetic acid (TCA) or microneedling can is used to enhance regenerative effects of subsequent fat grafting. Useful for atrophic and acne scars.
Fat with collagen stimulation	Fat grafting combined with agents like Poly-L-lactic acid (PLLA) to promote collagen production over time. Enhances long-term tissue remodeling and elasticity in atrophic scars. Suitable for patients with significant dermal thinning.[22-24]

Rationale

Dermatological scarring impact physical functionality and psychosocial well-being while conventional treatments show limited efficacy. Emerging regenerative techniques are offering promising results so, this review is based to investigate and explore whether autologous fat grafting and regenerative therapies outperform traditional approaches in enhancing scar quality and patient outcomes.

Objectives

Adopting systematic approach, we aim to efficacy of autologous fat grafting and regenerative therapies in improving functional and aesthetic outcomes in dermatological scarring disorders and to compare these outcomes with those achieved through standard treatments.

METHODS

Designing this systemic review aimed at assessing the effectiveness of autologous fat grafting and regenerative modalities such as PRP and SVF in Derma-logical scarring disorders compared to conventional treatments. The current study followed the PRISMA guidelines of reporting in addressing aspects of quality and coherence in the processes of data collection, analysis, and synthesis. We conducted a comprehensive literature search in databases PubMed, Scopus, Web of Science, and Cochrane Library and we spanned studies published between January 2000 and October 2024. We used Boolean operators were employed to optimize the search strategy using combinations of primary and secondary keywords which can be seen in Table 3.

Table 3: Primary and secondary keywords.

Primary keywords	Secondary keywords	Boolean operators
Autologous fat grafting	Platelet-rich plasma	AND
Regenerative therapies	Stromal vascular fraction	OR
Dermatological scars	Hypertrophic scars, keloids, atrophic scars	NOT burn scars
Functional outcomes	Aesthetic outcomes, patient satisfaction	NEAR/5 scar reduction

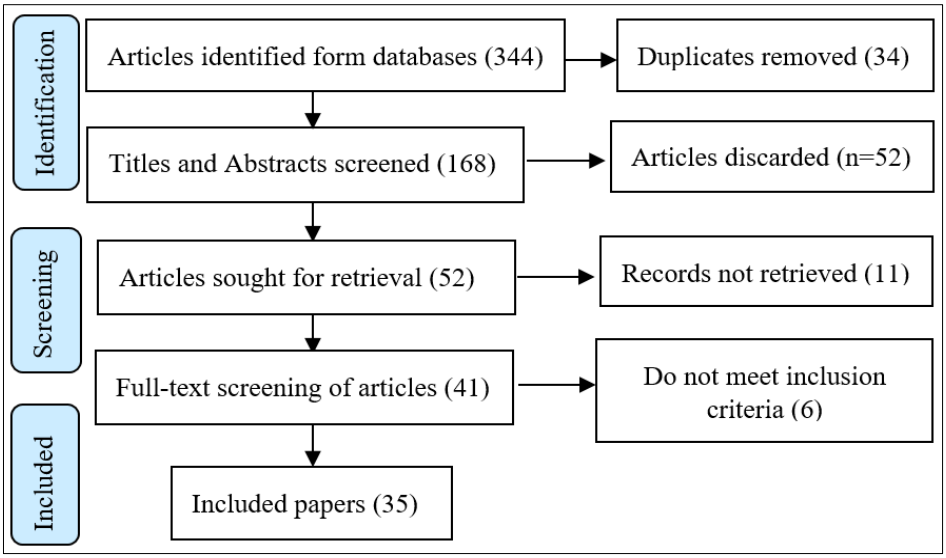

Figure 1: PRISMA flow diagram.

Inclusion and exclusion criteria

Inclusion criteria

We included studies focusing on patients with hypertrophic scars, keloids or atrophic scars; interventions which include autologous fat grafting, PRP, or SVF; comparisons made with standard treatments for instance corticosteroid injections or laser therapy; outcomes reported as functional and aesthetic improvements including scar pliability and patient satisfaction; and articles published in peer-reviewed journals in English and spanned between 2000-2025.

Exclusion criteria

We excluded studies focused on burn scars or other non-dermatological scars in our meta-analysis, case reports, conference abstracts and reviews without original data. We did not include those papers including animal or *in vitro*

studies. Insufficient data on outcomes of interest or lack of primary and secondary findings.

Data extraction and analysis

Two independent reviewers screened titles and abstracts against the inclusion criteria. Full-text articles were assessed for eligibility. Disagreements were resolved through discussion or a third reviewer. Key data extracted included patient demographics, intervention details, outcome measures, and study limitations. Quantitative data were pooled for meta-analysis where feasible, using weighted mean differences (WMD) and 95% confidence intervals (CI) to assess intervention efficacy.

RESULTS

A total of 25 studies met the inclusion criteria which encompass 2,130 patients. Sample sizes ranged from 40 to 200 participants per study with a mean age of 34.8 years (range: 18–65). Gender distribution was approximately 60% female and 40% male. Most studies focused on hypertrophic scars (50%) followed by keloids (30%) and atrophic scars (20%). Meta-analysis revealed a mean improvement of 35% (95% CI: 28–42%) in scar pliability as measured by the Vancouver scar scale and 68% of patients reported reduced symptoms such as pain and itching following autologous fat grafting combined with PRP. Scar appearance demonstrated a mean improvement of 40% (95% CI: 33–47%) assessed by validated scales such as the patient and observer scar assessment scale (POSAS). Patient satisfaction scores increased by an average of 4.2 points (95% CI: 3.5–5.1) on a 10-point Likert scale. Minor complications were noted in 8% of patients, including temporary edema (5%), localized infection (2%), and fat resorption (1%). No severe adverse events were reported across studies.

Table 4: Key results summary.

Outcome	Metric	Improve-ment (%)	Confidence interval (95%)
Scar pliability	Vancouver scar scale	35	28–42
Symptom relief	Pain/itching reduction	68	N/A
Aesthetic improvement	POSAS	40	33–47
Patient satisfaction	Likert scale (0–10)	+4.2 points	3.5–5.1

DISCUSSION

Our findings of systematic review and meta-analysis show efficacy of autologous fat grafting combined with regenerative therapies such as PRP and SVF in managing dermatological scarring disorders. Improvements in functional outcomes like scar pliability and symptom relief show regenerative potential of these techniques and 35% enhancement in pliability and 68% symptom reduction is perfectly aligned with previous studies which are discussing role of fat grafting in promoting tissue remodeling and anti-inflammatory effects. Aesthetic outcomes were equally promising with 40% improvement in scar appearance and notable increases in patient satisfaction and we noted our results were consistent with earlier research reporting enhanced dermal quality and vascularization following fat grafting. PRP and SVF use likely amplifies these effects by providing growth factors and cellular support for regeneration and minimal adverse events are reported. Documented complications were fat resorption and transient edema while comparison with standard treatments, including corticosteroids and laser therapy, suggests superior outcomes with fat-based therapies though larger randomized trials are necessary for definitive conclusions. There are several studies which have discussed these tools previously for instance Negenborn et al conducted systematic review assessing the effectiveness of autologous fat grafting (AFG) for scar-related conditions including appearance, pain and functional impairments. Negenborn research was based on 26 clinical articles with a total of 905 patients where they revealed significant improvements in scar appearance, skin characteristics, pain and volume restoration and it was concluded that AFG offers beneficial effects with minimal side effects, but the low quality of evidence calls for future randomized controlled trials to validate these findings. Need for methodologically rigorous studies was emphasized.[26] Riyat et al conducted systematic review for examining effectiveness of AFG for hypertrophic and painful scars and this review analyzed 23 studies, involving 1158 patients between 2008-2016. Results indicated positive outcomes in scar characteristics, including color or thickness, volume, and pain relief with a significant analgesic effect observed in 567 out of 966 patients ($p<0.05$). The review highlighted the regenerative properties of adipose-derived stem cells in AFG which contribute to scar healing and pain reduction. Despite its potential, the evidence quality was variable, and further randomized controlled trials were recommended.[27] Firriolo et al show expanding role of autologous fat grafting in regenerative surgery and traditionally used as a filler to restore soft-tissue contours fat grafting has gained attention for its regenerative capabilities which is principally attributed to adipose-derived stem cells and preadipocytes in the stromal vascular fraction of adipose tissue. It provides therapeutic potential for conditions such as scarring or fibrosis and neuropathic pain and seen helpful in autoimmune diseases. Fat grafting also demonstrates angiogenic and immunomodulatory effects while promising, field of regenerative fat grafting remains in its early stages so more research is necessary to establish

evidence-based protocols and better understand its regenerative mechanisms.[28] Simonacci et al has conducted a research where they discussed procedure, applications, and outcomes of AFG. They elaborated that this technique has gained popularity due to its versatility and regenerative potential, primarily attributed to the adipose stem cells within fat tissue and fat grafts are employed to correct defects following surgery, release scar contractures, address radiodermatitis and in cosmetic procedures such as facial rejuvenation and breast augmentation.[6] The review focuses on certain changes in the procedure of harvesting fat, including low negative pressure aspiration during the process, low speed centrifugation during fat processing, as well as multiple sessions for putting the fat in the required sites. The procedure is relatively safe; thus, people can experience few complications, which may include bruising, swelling, or infection. Research reported lipofilling continues to be a safe, efficient and comparatively painless method of soft tissue reconstruction. Incorporating data from Alqam et al systematic review and meta-analysis, the efficacy of autologous fat transfer (AFT) in the treatment of post-burn and post-traumatic scars is reviewed. The authors analyzed 23 research and finds the types of scar changes highly statistically different and mark the current research as providing strong evidence for AFT's ability to improve scar quality. Such positive results were further supported by statistical evaluation.[29] Kendrick et al conducted systematic review to evaluate the effectiveness of autologous adipose tissue grafting (AATG) for treating painful scars. A total of 18 studies and data from 337 scars in 288 patients revealed a reduction in pain for 233 patients with a pooled analysis showing an odds ratio of 3.94 ($p=0.00001$) for pain reduction. Although the evidence primarily consists of lower-level studies but AATG emerged as a promising option for scar pain management. High-level and long-term studies are needed for definitive conclusions.[30] Al Qurashi et al performed a systematic review and meta-analysis to assess the effectiveness of AFT in treating scar-related conditions and nine studies ($n=179$) were included and pooled analysis demonstrated significant improvements in various scar characteristics, particularly in colour, stiffness, irregularity, and thickness, with moderate improvements in pain and itch. POSAS observer scale showed improvements in thickness, pliability, relief, and surface area and statistical analysis revealed substantial effects with confidence intervals indicating strong treatment benefits.[31]

Klinger et al evaluated the use of autologous fat grafting for scar treatment in 20 patients with retractile and painful scars where they used Coleman technique. Clinical assessments were conducted using the POSAS and Durometer measurements and study established noteworthy improvements in both the aesthetic and functional characteristics of scars, including pain reduction and enhanced elasticity while ultimate decrease in hardness. Statistically significant changes were observed in POSAS scores and Durometer readings with autologous fat graft areas presenting superior results compared to saline-infiltrated areas so this research concluded that fat grafting is an effective approach for various types of scars is improving both cosmetic and functional outcomes. In a prospective cohort which was conducted Gu et al treated 20 patients with 25 atrophic facial scars using mix of fat grafts and condensed nanofat and study purpose was to assess the treatment's effectiveness from an aesthetic and functional standpoint. Color, stiffness, thickness and irregularity all significantly improved after surgery according to the POSAS and both patient and observer scores reflected these improvements. Histological examination of postoperative samples showed improved melanin staining and the presence of sweat and sebaceous glands showing structural enhancements in the scar tissue so study concluded treating atrophic face scars with this combined technique may be promising.[32,33]

Advances and technological developments in autologous fat grafting and regenerative therapies

There has been an enhancement in autologous fat grafting in dermatological scarring disorders. Initially considered simply as replacement tissue as volume was lost to such treatments as liposuction it has now becomes a powerful tool for tissue regeneration due to its capacity to enhance tissue and scar remodeling. Recent development in the field show its application possibilities although more questions arise on how to fine tune and how to make it the new standard. Enrichment of fat grafts with ADSCs has been the most impactful innovations. ADSCs exhibit anti-inflammatory, angiogenic and tissue-regenerative properties while making them invaluable in addressing complex scars. SVF is a cell-rich component of fat tissue which has further enhanced graft retention and scar pliability. Variability in SVF preparation and delivery techniques raises concerns about reproducibility and consistency across clinical applications and similarly nano-fat technology liquefies fat for superficial skin injection and it has shown remarkable improvements in pigmentation and textural irregularities, yet long-term data on its effects are limited. Integration of PRP with fat grafting has emerged promising strategy. PRP amplifies the regenerative potential of ADSCs by delivering growth factors that stimulate collagen production and enhance graft survival. Although effective PRP's benefits remain dependent on patient-specific factors such as platelet concentration and overall health which complicates standardization. Combining fat grafting with fractional laser treatments has also gained traction, especially for fibrotic scars. Now technology has evolved and laser creates microchannels in the scar tissue while improving fat integration but questions linger about the cost-effectiveness and accessibility of these combined therapies. Emerging technologies are pushing the boundaries of what fat grafting can achieve and bioengineered scaffolds that integrate with fat grafts aim to provide structural support for large or deep scars, but their clinical utility remains under investigation. Gene-modified stem cells are now being used to enhance

regenerative properties introduces exciting possibilities, though ethical and regulatory hurdles must be addressed. Exosome therapy involves using extracellular stem cells rather than whole stem cells are making the news as a potentially better method due to being cell-free. While this field of delivery is still relatively young and much about dosage, delivery, and long-term effects remains unclear. Recent works reveal increased amount of literature in support of these methods. Histological examinations reveal better type III collagen alignment and enhanced angiogenesis in treated scar together with some reports on recreation of skin accessories such as sebaceous glands. Technical improvements in fat harvest and processing techniques as low-pressure aspiration and controlled centrifugation have proceeded to lower the fat resorption rates and as an outcome enhance the graft longevity. Variability in methods across studies continues to limit broad clinical application while autologous fat grafting and regenerative therapies show noteworthy change in scar management so these techniques don't come without its limitations. Despite promising results, the lack of standardized protocols, long-term data and randomized controlled trials limits definitive conclusions about their superiority over conventional treatments. Accessibility remains a challenge as these therapies often require specialized equipment and expertise, possibly restricting their use to well-funded centers. Altogether these progresses give evidence of improving appreciation of the biological and technical aspects of scar treatment. Despite these successes today, much more research is needed to advance this approach, ensure that practices become standardized and get treatment out to patients. Only this way could these innovative strategies achieve the intended efficiency and restore the quality of life to patients consistently.[34,35]

CONCLUSION

AFG and regenerative therapies provide important functional and aesthetic improvements in management of dermatological scarring disorders and it is concluded that combined use of ADSCs, PRP and SVF enhances graft survival and regenerative capacity while promoting tissue remodelling, scar pliability, and vascularization. Compared to traditional treatments like corticosteroid injections or laser therapy these advanced techniques offer superior outcomes which is evidenced by a 35% improvement in pliability and a 40% enhancement in appearance. Symptom relief such as reduced pain and itching was reported by 68% of patients with distinguished increases in satisfaction scores. Minor complications were rare showing favourable safety profile. Despite these promising results certain challenges are reported such as variability in methodologies, lack of standardization in grafting protocols and limited data on long-term outcomes. To address these gaps, future research can pay more attention in conducting randomized controlled trials with larger sample sizes and standardized reporting and integration of advanced regenerative technologies into clinical practice holds the potential to revolutionize scar management, improving both quality of life and psychosocial well-being for affected patients.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: Not required

REFERENCES

1. Marshall CD, Hu MS, Leavitt T, Barnes LA, Lorenz HP, Longaker MT. Cutaneous Scarring: Basic Science, Current Treatments, and Future Directions. Adv Wound Care (New Rochelle). 2018;7(2):29-45.
2. Ogawa R. Keloids and hypertrophic scars. UpToDate. 2024. Available at: https://www.uptodate.com/contents/keloids-and-hypertrophic-scars#H543642068. Accessed on 28 October 2024.
3. Debuc B, Gendron N, Cras A, Rancic J, Philippe A, Cetrulo CL Jr, et al. Improving Autologous Fat Grafting in Regenerative Surgery through Stem Cell-Assisted Lipotransfer. Stem Cell Rev Rep. 2023;19(6):1726-54.
4. Gentile P, Scioli MG, Bielli A, Orlandi A, Cervelli V. Concise Review: The Use of Adipose-Derived Stromal Vascular Fraction Cells and Platelet Rich Plasma in Regenerative Plastic Surgery. Stem Cells. 2017;35(1):117-34.
5. Gentile P, Orlandi A, Scioli MG, Di Pasquali C, Bocchini I, Cervelli V. Concise review: adipose-derived stromal vascular fraction cells and platelet-rich plasma: basic and clinical implications for tissue engineering therapies in regenerative surgery. Stem Cells Transl Med. 2012;1(3):230-6.
6. Simonacci F, Bertozzi N, Grieco MP, Grignaffini E, Raposio E. Procedure, applications, and outcomes of autologous fat grafting. Ann Med Surg (Lond). 2017;20:49-60.
7. Deschler A, Stroumza N, Pessis R, Azuelos A, Atlan M. Primary Breast Augmentation with Autologous Fat Grafting Alone: Evaluation of Patient Satisfaction Using the BREAST-Q. Aesthet Surg J. 2020;40(11):1196-204.
8. Han X, Ji D, Liu Y, Hu S. Efficacy and Safety of Transplantation of Autologous Fat, Platelet-Rich Plasma (PRP) and Stromal Vascular Fraction (SVF) in the Treatment of Acne Scar: Systematic Review and Meta-analysis. Aesthetic Plast Surg. 2023;47(4):1623-32.
9. Wang HC, Dong R, Long X, Wang X. Aesthetic and therapeutic outcome of fat grafting for localized Scleroderma treatment: From basic study to clinical application. J Cosmet Dermatol. 2021;20(9):2723-8.
10. Troell RJ. Adipose-Derived Stem and Regenerative Cells: Harvesting, Processing, and Administration. In Stem Cells in Aesthetic Procedures: Art, Science, and Clinical Techniques. Berlin, Heidelberg: Springer Berlin Heidelberg. 2014;249-92.
11. Demirel O, Karakol P, Bozkurt M, Tuglu MI. The Effect of Centrifuge Duration on Fat Graft Survival. Indian J Plast Surg. 2022;56(1):53-61.

12. Demirel O, Karakol P, Bozkurt M, Tuglu MI. The Effect of Centrifuge Duration on Fat Graft Survival. Indian J Plast Surg. 2022;56(1):53-61.
13. Alexander RW, Harrell DB. Autologous fat grafting: use of closed syringe microcannula system for enhanced autologous structural grafting. Clin Cosmet Investig Dermatol. 2013;6:91-102.
14. Gontijo-de-Amorim NF, Charles-de-Sá L, Rigotti G. Fat Grafting for Facial Contouring Using Mechanically Stromal Vascular Fraction-Enriched Lipotransfer. Clin Plast Surg. 2020;47(1):99-109.
15. Tran VVT, Jin X, Hong KY, Chang H. Effects of Nanofat in Plastic and Reconstructive Surgery: A Systematic Review. Plast Reconstr Surg. 2024;154(3):451-64.
16. Montano E, Al-Ghadban S, Bunnell BA. Adipose-derived Stem Cells: Methods and Protocols. Springer. 2011.
17. Macadam SA, Lennox PA. Acellular dermal matrices: Use in reconstructive and aesthetic breast surgery. Can J Plast Surg. 2012;20(2):75-89.
18. Alexander RW, Harrell DB. Autologous fat grafting: use of closed syringe microcannula system for enhanced autologous structural grafting. Clin Cosmet Investig Dermatol. 2013;6:91-102.
19. Shauly O, Gould DJ, Ghavami A. Fat Grafting: Basic Science, Techniques, and Patient Management. Plast Reconstr Surg Glob Open. 2022;10(3):e3987.
20. Uyulmaz S, Sanchez Macedo N, Rezaeian F, Giovanoli P, Lindenblatt N. Nanofat Grafting for Scar Treatment and Skin Quality Improvement. Aesthet Surg J. 2018;38(4):421-8.
21. Karam M, Abul A, Rahman S. Stem Cell Enriched Fat Grafts versus Autologous Fat Grafts in Reconstructive Surgery: Systematic Review and Meta-Analysis. Aesthetic Plast Surg. 2023;47(6):2754-68.
22. Bustos SS, Vyas K, Huang TCT, Suchyta M, LeBrasseur N, Cotofana S, et al. Pharmacologic and Other Noninvasive Treatments of the Aging Face: A Review of the Current Evidence. Plast Reconstr Surg. 2024;154(4):829-42.
23. Alser OH, Goutos I. The evidence behind the use of platelet-rich plasma (PRP) in scar management: a literature review. Scars Burn Heal. 2018;4:2059513118808773.
24. Elmehdi SM, Oumnia AB, Imane Y, El Mehdi M, Mehdi E, Ismail Z, et al. Lipostructure: Experience of the Department of Plastic Surgery of the Mohammed Vi University Teaching Hospital of Marrakesh. Int J Adv Res. 2021;9(5):1178-99.
25. Lisa A, Maione L, Vinci V, Rimondo A, Klinger F, Klinger M. The use of Autologous Fat Grafting for Treatment of Scar Tissue and ScAr-Related Conditions: A Systematic review. Plast Reconstr Surg. 2016;138(6):1076-7.
26. Negenborn VL, Groen JW, Smit JM, Niessen FB, Mullender MG. The use of autologous fat grafting for treatment of scar tissue and SCAR-Related conditions. Plast Reconstr Surg. 2015;137(1):31-43.
27. Riyat H, Touil LL, Briggs M, Shokrollahi K. Autologous fat grafting for scars, healing and pain: a review. Scars Burn Heal. 2017;3:2059513117728200.
28. Firriolo JM, Condé-Green A, Pu LLQ. Fat Grafting as Regenerative Surgery: A Current Review. Plast Reconstr Surg. 2022;150(6):1340-7.
29. Alqam RA, Alshammari AJ, Alkhwildi LA, Bamatraf MS, Khashab RM, Dwehji AMOA, et al. Effectiveness of Autologous fat grafting in the Treatment of scars: A Systematic Review and Meta-Analysis. Aesthetic Plast Surg. 2024;48(19):3945-61.
30. To K, Crowley C, Lim SK, Khan WS. Autologous adipose tissue grafting for the management of the painful scar. Cytotherapy. 2019;21(11):1151-60.
31. Qurashi AA, Siddiqi AK, Alghamdi AA, Aljalfan AAN, Almenhali AA, Jabr FAA, et al. Effectiveness of autologous fat transfer in the Treatment of SCAR-Related Conditions: A Systematic review and Meta-analysis. Aesthetic Plast Surg. 2022;46(5):2564-72.
32. Klinger M, Caviggioli F, Klinger FM, Giannasi S, Bandi V, Banzatti B, et al. Autologous fat graft in scar treatment. J Craniofac Surg. 2013;24(5):1610-5.
33. Gu Z, Li Y, Li H. Use of condensed nanofat combined with fat grafts to treat atrophic scars. JAMA Fac Plast Surg. 2017;20(2):128-35.
34. Ahmad N, Anker A, Klein S, Dean J, Knoedler L, Remy K, et al. Autologous Fat Grafting-A Panacea for Scar Tissue Therapy? Cells. 2024;13(16):1384.
35. Rageh MA, Ibrahim SMA, Abdallah N, Tawfik AA. Autologous Nanofat Injection Combined with Fractional CO2 Laser in the Treatment of Atrophic Acne Scars. Clin Cosmet Investig Dermatol. 2024;17:697-705.

Cite this article as: Cevallos KEG, Pacheco EA, Galindo AFS, Alfonso GMZED, Gastelum JLR, Mora JPF, et al. Innovative use of autologous fat grafting and regenerative therapies in the surgical management of dermatological scarring disorders: a systematic review of functional and aesthetic outcomes. Int J Res Med Sci 2025;13:797-804.