ORIGINAL ARTICLE

EFFECT OF FAT GRAFTING ON IMPROVEMENT OF SCAR-AN INTERVENTIONAL STUDY

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Background: Scars are inevitable after effect of wound healing, a natural process that restores tissue integrity following injury, burns or surgery. They can be aesthetically displeasing and functionally impairing, depending on their location, size, and depth. Depending on the severity of the injury, scars can be hypertrophic, atrophic, or keloid. These variations can lead to pain, itching, contractures (limited movement), and psychological distress, impacting a patient's quality of life. Objective was to evaluate the efficacy of autologous fat grafting in improving the appearance and quality of scars, with a focus on patients presenting with facial scars due to burns, trauma, surgery or acne at a tertiary care hospital in Karachi, Pakistan. **Methods:** In this quasi-experimental study, 30 patients of age 18 years to 60 years, irrespective of gender having facial scar because of burn, trauma, surgery or acne were included in the study. A comprehensive scar assessment was performed using the Patient and Observer Scar Assessment Scale (POSAS) before treatment, and follow-up evaluations were conducted on the seventh day, at three months, and at six months post-fat grafting. Fat grafting was executed using a tumescent technique based on Klein's formula, with the aspirated fat injected into the subdermal plane of the scar. Data analysis was performed using SPSS version 23. **Results:** The patient cohort had a mean age of 26.77 years, with a predominance of female participants (73.3%). Trauma was the most common cause of scars (50%), with the forehead being the most frequent location (36.67%). Significant improvements in scar quality were observed, with both patient and observer POSAS scores showing notable reductions from baseline to 6 months (p<0.05). All patients (100%) demonstrated an improvement in scar appearance. **Conclusion:** Fat grafting presents a promising treatment for improving the appearance and quality of facial scars.

Keywords: Fat grafting; Scar improvement; Patient and Observer Scar Assessment Scale (POSAS); Regenerative medicine; Facial scars

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INTRODUCTION

Scars are inevitable after effect of wound healing, a natural process that restores tissue integrity following injury, burns or surgery.[1] They can be aesthetically displeasing and functionally impairing, depending on their location, size, and depth.[2,3] Depending on the severity of the injury, scars can be hypertrophic, atrophic, or keloid. These variations can lead to pain, itching, contractures (limited movement), and psychological distress, impacting a patient's quality of life.[1,4]

The conventional management of scar include pressure therapy, silicone gel sheets, and topical/injectable corticosteroids.[5] While these methods can improve scar appearance to some extent, they often yield limited and inconsistent results, particularly for more severe scars.[5–7] In recent years, regenerative medicine has emerged as a promising approach for scar treatment, offering the potential to improve scar quality and function.[1] First introduced in the 1890s by Neuber and later popularized by Coleman in the 1990s, fat grafting utilizes adipose tissue, a rich source of mesenchymal stem cells (MSCs) and adipose-derived stromal vascular fraction (SVF).[3,8,9] These components possess regenerative properties, including the ability to promote tissue repair, angiogenesis, and immunomodulation.[1] Studies revealed that fat grafting has a favourable effect on scars via angiogenesis, immunological modulation, and lipofilling, among other things, making it a potential therapy.[10–13]

Klinger M *et al*. revealed that fat grafting is a successful treatment for burn scars, trauma scars, post-surgery scars, and post-radiation scars.[4] Recently, Ishaque et al. also found that fat grafting is a successful technique for the improvement of post burn scar of hands and face.[14] Moreover, it has become a common procedure in aesthetic and reconstructive surgeries due to its high biocompatibility and availability.[3,9]

Despite its promising outcomes, there remains a dearth of local data exploring the full potential of this treatment. Therefore, the aim of current study was to evaluate the efficacy of fat grafting for improvement of scar among patients presenting at a tertiary hospital of Karachi, Pakistan. This study would help plastic surgeons who are constantly seeking for techniques to improve scar quality.

MATERIAL AND METHODS

It was a quasi-experimental study conducted at the Plastic surgery department, Civil hospital Karachi, Pakistan from 03-04-2023 to 02-01-2024. Sample size was calculated using WHO sample size calculator by taking pre-treatment POSAS score as 35.83±4.08 (baseline) and post-treatment POSAS as 27.50±3.04 (at six months) among surgeons,[3] power of test as 80% and 99% confidence level. The estimated sample size was 10, but we included 30 patients in order to increase the generalizability of the results. Patients of age 18 years to 60 years of either gender having facial scar because of burn, trauma, surgery or acne were included in the study. Patients with keloids and contractures were excluded from the study. Non-random consecutive sampling technique was employed for sample selection.

The institute's ethical review committee approved the study (ERC#: IRB-2943/DUHS/Approval/2023/146). Before data collection begins, all eligible individuals were provided written informed consent. Data regarding age, gender, cause for the scar, and location of the scar was also obtained from patient. Before fat grafting, both the patient and a plastic surgeon examined the scar and scored it using the patient and observer scar evaluation scale (POSAS). A tumescent solution based on Klein's formula (lidocaine 800 mg/l and adrenaline 1:1000,000) was administered to the donor site. Fat was extracted 10 minutes after infiltration of tumescent solution using 3mm cannulas with side holes of 1-2 mm. Syringe of harvested fat was allowed to sit on end and sedimentation occurred that separate fat from oil and aqueous component.

Aspirated fat was transferred to 1 cc syringes with 1mm cannula for injection into the scar. Only the subdermal plane at the recipient location was injected with fat. The scar quality was re-scored on the POSAS scale by both the patient and the same surgeon on the seventh day, three months, and six months. The decrease in POSAS score at 6th month was deemed as improvement. Some of the cases are displayed in figure 1 to 3.

Figure-1: A 40-year-old female with history of fire burn 6 months back A. Pre-operative B. Post operative after 2 sessions of fat grafting

Figure-2: A 27-year-old female with history of road traffic accident in childhood having scar in left sided periorbital region A. Pre-operative B. Post operative after two sessions of fat grafting

Figure-3: A 19-year-old female with history of trauma on glabellar region A. Pre-operative B. Post-operative after 1 session of fat grafting

Data was analyzed using SPSS version 23. Mean and standard deviation were reported for age, POSAS at baseline, at 7th day, at 3 months and at 6 months. Frequencies and proportions were reported for sex, reason of scar, location of scar and improvement. Pre- and post-operatively POSAS were compared using Repeated Measure ANOVA. Post-hoc analysis was performed to assess the pair-wise comparison. Level of significance was set at 1%.

RESULTS

The mean of the patients age was 26.77±6.60 years. Most of the patients were females (73.3%) and 26.7% were males. The most common cause is trauma (50.00%) and most frequent location is the forehead (36.67%) Table-1. The mean baseline POSAS scores were approximately 54 (patient) and 55 (observer), indicating the initial scar assessment scores. By the 6-month follow-up, the mean POSAS scores decreased to around 44 (patient) and 42 (observer). Repeated Measures ANOVA revealed significant changes in both patient and observer POSAS scores over time (Patient scores: $F(3,87) = 15.67$, $p<0.001$; Observer scores: $F(3,87) = 17.24$, $p<0.001$). Furthermore, all patients (100%) showed improvement in scar appearance Table-2.

The pair-wise comparisons using Tukey's Honest Significant Difference (HSD) test for both Patient and Observer Scar Assessment Scale (POSAS) scores are displayed in table 3. There is a significant reduction in the patient POSAS score by 7.33 points from baseline to 3 months, with a *p*-value of 0.001. While, observers noted a more pronounced reduction in POSAS score, with a difference of 9.73 points, also significant at $p=0.001$. The change in patient scores between 3 and 6 months is -3.07, with a *p*-value of 0.0785, which is not statistically significant. While, observers noted a significant mean difference of -3.13 points with a *p*-value of 0.0325. A significant improvement in patient scores by 5.43 points from the 7th day to 3 months ($p=0.0002$). While, observers reported a 6.67 points improvement, significant at $p=0.001$. A minor improvement of 1.9 points from baseline to the 7th day is noted, but this change is not statistically significant ($p=0.4404$. While, observers noticed a slightly more significant improvement of 3.07 points, with a *p*-value of 0.038. Both patients and observers reported significant improvements in scar quality from the 7th day to 6 months (8.5 and 9.8 points respectively, both $p=0.001$). However, the greatest improvements are seen from baseline to 6 months, with patients reporting a 10.4 points improvement and observers 12.87 points, both statistically significant ($p=0.001$).

Table-1: Baseline characteristics of study variables (n=30)

Characteristic	Statistics
Age	
Mean (SD)	26.77 (6.60) years
Gender	
Female	22 (73.33%)
Male	8 (26.67%)
Reason of Scar	
Trauma	15 (50.00%)
Post acne	11 (36.6%)
Burn	2 (6.7%)
Post-surgery	2 (6.7%)
Location of Scar	
Forehead	11 (36.67%)
Cheek	9 (30.00%)
Temple	4 (13.33%)
Chin	4 (13.33%)
Nose	2 (6.67%)

Table-2: Change in patient and observer POSAS scores over time (n=30)

Time Point	Patient Score Mean (SD)	*p*-value	Observer Score Mean (SD)	*p*-value
Baseline	53.97 (5.05)	0.001	54.77 (4.88)	0.001
7th Day	52.07 (4.75)		51.70 (4.07)	
3 Months	46.63 (5.19)		45.03 (4.50)	
6 Months	43.57 (4.61)		41.90 (4.01)	

Table-3: Post-hoc pair-wise comparisons for patients and observer POSAS scores (n=30)

Comparison	Patient Mean Difference	*p*-value	Observer Mean Difference	*p*-value
3 Months vs. Baseline	7.33	0.001	9.73	0.001
3 Months vs. 6 Months	-3.07	0.0785	-3.13	0.0325
3 Months vs. 7th Day	5.43	0.0002	6.67	0.001
7th Day vs. Baseline	1.9	0.4404	3.07	0.038
6 Months vs. 7th Day	8.5	0.001	9.8	0.001
6 Months vs. Baseline	10.4	0.001	12.87	0.001

DISCUSSION

Scarring, an inevitable outcome of the wound healing process, often presents both aesthetic and functional challenges that significantly impact individuals' lives.[15] Traditional treatments have yielded limited success in severe cases, prompting the exploration of more effective interventions.[16] Fat grafting, with its regenerative capabilities, has emerged as a promising technique, offering not just volumetric improvements but also biological changes in scar tissues that promote healing and improve scar appearance and functionality.[17,18] In the current study, we investigated the efficacy of fat grafting as a method for improving scar appearance, particularly in patients with facial scars due to various causes. The study was conducted

in Dr Ruth K.M Pfau Civil Hospital Karachi, Pakistan, and aimed to fill the gap in local data regarding fat grafting for scar improvement.

Our study revealed significant improvements in scar quality following fat grafting, as evidenced by the reduced POSAS scores. This suggests that fat grafting induces biological improvements in scar tissue, corroborating the hypothesis that the procedure extends beyond mere defect filling to stimulate biological healing and improve scar characteristics.

Our findings are similar with those in the literature, highlighting fat grafting's potential in scar management. The study by Bhooshan *et al*. on autologous emulsified fat injection for rejuvenation of scars further supports the regenerative potential of fat grafting. The study utilized the POSAS and showed significant improvements in scar symptoms (e.g., pain, itching, stiffness) and characteristics (e.g., vascularity, pigmentation, pliability) post treatment.[19] Similarly, Gargano *et al*. evaluates the outcomes of the SUFA technique, which combines subcision (a method used to break fibrous strands of scar tissue) and autologous fat grafting, in 9 patients with contracted burn scars. They found significant improvements in dermal thickness and a reduction in scar contracture ($p<0.05$), highlighting fat grafting's role in enhancing dermal properties and reducing scar severity.[20] Likewise, studies by Klinger *et al.* validate our findings, highlighting fat grafting's success across various scar types, including burns, trauma, and post-surgery scars.[4,21] The review by Alexandra Condé-Green *et al*. on the effect of fat grafting on scars also identified improvements in burn scar size, texture, and function, including enhanced angiogenesis and reduced inflammation.[22] While there's a consensus on fat grafting's beneficial effects, variations in outcomes may relate to differences in techniques, the severity of scars, and individual patient factors. The regenerative effects observed, possibly attributed to the stem cells within grafted fat as suggested by some studies, offer a pathway for enhanced healing beyond simple volumization. However, the variability in fat resorption rates and the occasional need for multiple sessions highlight areas where the technique could be further optimized.[2,12,23–25]

The strength of current study is its methodological rigor and comprehensive evaluation of fat grafting's effects on scars. Nevertheless, the limitations, such as the small sample size and lack of long-term follow-up data, highlight the need for further research. Future studies should delve into the mechanisms behind fat grafting's regenerative effects, optimal fat processing techniques, and patient selection criteria to refine this promising technique's efficacy.

CONCLUSION

Fat grafting presents a promising treatment for improving the appearance and quality of facial scars. This study substantiates the potential of fat grafting to induce positive biological changes in scar tissues, offering a significant advancement in scar management. Further research is warranted to optimize this technique and explore its full regenerative potential.

AUTHORS' CONTRIBUTION

SS, MN: Literature search. SS, WS: Conceptualization of study design. SS, FA, FZ, US: Data collection. SS, MN: Data analysis. SS, FZ: Data interpretation. SS: Write-up. FA, WS: Proof reading.

REFERENCES

1. 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.
2. Brown JC, Shang H, Yang N, Pierson J, Ratliff CR, Prince N, *et al*. Autologous Fat Transfer for Scar Prevention and Remodeling: A Randomized, Blinded, Placebo-controlled Trial. Plast Reconstr Surg Glob Open 2020;8(5):e2830.
3. Parikh N, Darshan J. An intervention study of autologous fat transfer for scar tissue rejuvenation in the setup. Int Surg J 2018;5(3):815–22.
4. 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.
5. Kim SW. Management of keloid scars: noninvasive and invasive treatments. Arch Plast Surg 2021;48(2):149–57.
6. Puri N, Talwar A. The efficacy of silicone gel for the treatment of hypertrophic scars and keloids. J Cutan Aesthet Surg 2009;2(2):104–6.
7. Yuan B, Upton Z, Leavesley D, Fan C, Wang XQ. Vascular and Collagen Target: A Rational Approach to Hypertrophic Scar Management. Adv Wound Care (New Rochelle) 2023;12(1):38–55.
8. Zhang X, Li G. Effectiveness of fat grafting in scar reduction: A systematic review and meta-analysis. J Cosmet Dermatol 2022;21(11):5804–10.
9. Gal S, Ramirez JI, Maguina P. Autologous fat grafting does not improve burn scar appearance: A prospective, randomized, double-blinded, placebo-controlled, pilot study. Burns 2017;43(3):486–9.
10. Yinpu Z, Jingming T. Research progress of autologous fat transplantation in the treatment of cicatrix. J Med Postgrad 2021;34(7):780–4.
11. Rinker BD, Vyas KS. Do Stem Cells Have an Effect When We Fat Graft? Ann Plast Surg 2016;76(Suppl 4):S359–63.
12. 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(4):897–912.
13. Sardesai MG, Moore CC. Quantitative and qualitative dermal change with microfat grafting of facial scars. Otolaryngol Head Neck Surg 2007;137(6):868–72.
14. Ishaque MA, Mirza MAR, Sharif M, Arshad AW, editors. Facial and Hand Scars Appearance after Autologous Nanofat Grafting in Patients with Post Burn Scars. Proceedings 2020;34(1):25–9.
15. Han SK. Innovations and advances in wound healing. 3rd ed. Singapore: Springer Nature; 2023.

16. Fernández-Guarino M, Bacci S, Pérez González LA, Bermejo-Martínez M, Cecilia-Matilla A, Hernández-Bule ML. The Role of Physical Therapies in Wound Healing and Assisted Scarring. Int J Mol Sci 2023;24(8):7487.
17. Piccolo NS, Piccolo MS, de Paula Piccolo N, de Paula Piccolo P, de Paula Piccolo N, Daher RP, *et al*. Fat grafting for treatment of facial burns and burn scars. Clin Plast Surg 2020;47(1):119–30.
18. Krastev TK, Schop SJ, Hommes J, Piatkowski A, van Der Hulst RR. Autologous fat transfer to treat fibrosis and scar-related conditions: a systematic review and meta-analysis. J Plast Reconstr Aesthet Surg 2020;73(11):2033–48.
19. Bhooshan LS, Devi MG, Aniraj R, Binod P, Lekshmi M. Autologous emulsified fat injection for rejuvenation of scars: A prospective observational study. Indian J Plast Surg 2018;51(1):77–83.
20. Gargano F, Schmidt S, Evangelista P, Robinson-Bostom L, Harrington DT, Rossi K, et al. Burn scar regeneration with the "SUFA" (Subcision and Fat Grafting) technique. A prospective clinical study. JPRAS Open 2018;17:5–8.
21. Klinger M, Klinger F, Caviggioli F, Maione L, Catania B, Veronesi A, *et al*. Fat Grafting for Treatment of Facial Scars. Clin Plast Surg 2020;47(1):131–8.
22. Condé-Green A, Marano AA, Lee ES, Reisler T, Price LA, Milner SM, *et al*. Fat Grafting and Adipose-Derived Regenerative Cells in Burn Wound Healing and Scarring: A Systematic Review of the Literature. Plast Reconstr Surg 2016;137(1):302–12.
23. Cheng C, Xie Y, Li Q. Current state and exploration of fat grafting. Chin J Plast Reconstr Surg 2021;3(4):209–12.
24. Varghese J, Griffin M, Mosahebi A, Butler P. Systematic review of patient factors affecting adipose stem cell viability and function: implications for regenerative therapy. Stem Cell Res Ther 2017;8(1):45.
25. Shukla L, Yuan Y, Shayan R, Greening DW, Karnezis T. Fat Therapeutics: The Clinical Capacity of Adipose-Derived Stem Cells and Exosomes for Human Disease and Tissue Regeneration. Front Pharmacol 2020;11:158.

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