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The Effect of Autologous Fat Grafting on Scar Quality and Appearance

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Abstract

Background and objective: Scars not only impact individuals' well-being but also strain public healthcare systems, Therefore, there is a necessity for simpler and more effective scar treatment methods. Thus, we evaluated the efficacy of autologous fat grafting on scar quality and appearance.

Methods: This prospective study at the Burn and Plastic Surgery Hospital in Sulaymaniyah, Iraq, from July 2021 to November 2023, included 20 patients aged 8-48 years with prominent scars. Fat was harvested from the abdomen primarily, processed by decantation or centrifugation, and injected into scars using a 2 mm cannula. Outcomes were assessed using the Vancouver Scar Scale at multiple postoperative intervals. Data analysis was performed using SPSS software, with $P < 0.05$ considered statistically significant.

Results: This study evaluates the impact of fat grafting on scar quality using the Vancouver Scar Scale. Significant improvements were observed in pigmentation ($P = 0.012$) and pliability ($P = 0.002$), though vascularity ($P = 0.17$) and height ($P = 0.15$) did not show significant changes. Additionally, fat grafting markedly reduced pruritus ($P = 0.019$) but did not significantly impact pain levels ($P = 0.18$). The study shows an 80% increase in patient satisfaction after fat injection.

Conclusion: The study found that autologous fat grafting is important for scar remodeling. It improves scar appearance, skin characteristics, volume, and contour. It also helps with symptoms like itching and pain. Autologous fat grafting has comprehensive benefits and can be an effective treatment for scars.

Keywords: Adipose-derived Stem Cells, Hypertrophic Scar, Scar Fibrosis, Scar Management

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Introduction

Plastic surgeons are looking for better ways to treat scars on different skin types. They want to reduce the impact of scars on people's well-being and lessen the healthcare system's annual cost of over 12 billion.[1]Injuries can lead to non-regenerating tissue, resulting in scars with cosmetic and emotional concerns, chronic pain, itching, and functional limitations. Hypertrophic scars are raised, rigid, and may cause itching, pain, and redness. Dermal scars vary in appearance, stiffness, and contour.[2] Young and Hutchison survey found 90% dissatisfaction with surgical scars due to aesthetic, psychological, and physical impacts.[3]Scar treatments include corticosteroids, silicone, pressure therapy, radiotherapy, cryotherapy, lasers, and surgery. While ongoing research explores options like growth factors and gene therapy, which have limitations such as pigmentary changes and skin atrophy.[4] Despite advancements, complications can still arise in lasers and light-based devices method.[5] There is no widely accepted best treatment for scar tissue, so success rates vary depending on the clinician's experience.[6]Adipose tissue stores fat and contains adipose stromal cells or adipose-derived stem cells (ADSCs). It has qualities that make it a great filler material. It is biocompatible, versatile, stable, non-immunogenic, long-lasting, non-migratory, non-carcinogenic, and non-teratogenic. Using it as a filler produces natural-looking results and offers low costs and minimal discomfort for the patient. Additionally, it effectively addresses lipodystrophy issues at the donor site.[7-9] Coleman discovered that placing fat under scars enhances their appearance and improves scar healing by enhancing skin elasticity, texture, thickness, and blood vessel development. Surgeons can enhance aging, sun-damaged, and scarred skin by fat graft, improving texture, reducing wrinkles and pores, enhancing skin color and thickness, reducing facial scars, increasing hydration, and providing a smoother, younger appearance.[10] Resent research found correlation between p53 gene expression in ADSCs and improvement of hypertrophic scar healing by inhibiting their growth and promoting collagen formation.[11]Studies suggest enhancing fat cell survival by using a buffered tumescent solution, larger and shorter cannulas, efficient fat processing and washing, minimizing environmental exposure, injecting slowly in multiple layers with small volumes, and advising patients to avoid pressure, stay hydrated, quit smoking, avoid weight loss, and maintain a healthy diet. Contraindications to autologous fat transfer include coagulation disorders, lipid metabolism disorders, very thin patients, chronic diseases, acute infection, and organ failure. Patients with a history of DVT, pulmonary embolism, or HIV require individual evaluation, Smokers should quit for 6 weeks before surgery to improve fat survival.[12, 13]Donor site complications include contour irregularities, bleeding, hematoma, seroma, infection, fat embolism, lidocaine toxicity, skin necrosis, and visceral perforation. Recipient site complications include swelling, edema, fat necrosis, oil cysts, contour irregularities, infection, and fat resorption.[10] In our study we will evaluate effect of fat grafting on scar quality and appearance.

Patients and methods

Our prospective study, conducted at the Burn and Plastic Surgery Hospital in Sulaymaniyah, Iraq, from July 2021 to November 2023, enrolled 20 patients with significant scars from various causes and locations. Participants, aged 8 to 48 years (average 25.3), provided written consent, and the study was approved by the Medical Ethics Committee of the Kurdistan Higher Council of Medical Specialties. The cohort included nine males and 11 females, with 12 having

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atrophic scars, five with depressed scars, and three with textural scars.The study included patients with prominent scars from burns, surgery, and trauma. Exclusion criteria were severe comorbid conditions, mental disorientation, previous chemo/radiotherapy, pregnancy, active infections, recent steroid/scar treatments within the past month, and keloid scars.Abdomen was the primary site for fat harvesting, we used both general and local anesthesia for smaller incisions. For every 1000 ml of saline, we added 1 mg/ml of adrenaline and 30-50 ml of 2% lidocaine hydrochloride. The wetting solution was infiltrated based on the desired fat volume. Fat was harvested with a 3 mm cannula and a 10 ml syringe. We processed the aspirated fat using two methods. The decantation method involved letting the fat settle for 30 minutes, suitable for smaller amounts. Alternatively, the fat was placed in 10 ml syringes and centrifuged at 1,000 rpm for 1 minute, followed by washing and repeated centrifugation as needed.The procedure involved using a 3-ml syringe with a 2-mm blunt cannula. A small incision was made, and the cannula released scar tissue and created subcutaneous tunnels in a fan-like pattern for fat injection at various depths. In cases with significant fibrosis, a sharp needle was used initially. The fat graft amount was based on scar size, with slight overcorrection for optimal results. Digital pressure and gentle massage were applied to minimize contour irregularities. Patients received a seven-day course of antibiotics and medications for swelling and pain.Scars were assessed using the Vancouver Scar Scale (VSS) before and after the procedure, with follow-ups at 5 days, 2 weeks, 1, 3, and 6 months. Aesthetic appearance, patient satisfaction, and complications were documented. The VSS evaluates pigmentation, vascularity, pliability, and height, with scores ranging from 0 to 13 with higher scores indicating more extensive scarring Table (1). Data analysis was performed using SPSS software, describing quantitative variables with means, standard deviations, and ranges, and qualitative variables with numbers and percentages. The X^2 test compared qualitative variables, with $P < 0.05$ indicating statistical significance.

Table (1): Vancouver scar scale

	Scar characteristics	score
vascularity	Normal	0
	Pink	1
	Red	2
	purple	3
Pigmentation	normal	0
	hypopigmentation	1
	hyperpigmentation	2
Pliability	Normal	0
	Supple	1
	Yielding	2
	Firm	3
	ropes	4
	contracture	5
Height	Flat	0
	<2 mm	1
	2-5 mm	2
	>5 mm	3
	Total score	13

Results

Through the utilization of VSS, we were able to evaluate and compare different aspects of scars pre- and post-surgery, such as pigmentation, vascularity, pliability, and height. The findings revealed a notable improvement in scar quality following the intervention Table (2).

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Table (2): Vancouver Scar Scale before and after fat grafting. Notable improvement with scar characteristics after fat grafting.

	score	Before (N (%))			score	Before (N (%))	After (N (%))
vascularity	0	5 (25)	8 (40)	Pigmentation	0	8 (40)	17 (85)
	1	7 (35)	10 (50)		1	1 (5)	0 (0)
	2	7 (35)	2 (10)		2	11 (55)	3 (15)
	3	1 (5)	0 (0)		P = 0.012*		
	P = 0.17				X^2 = 8.81		
	X^2 = 4.99						
Pliability	0	2 (10)	11 (55)	Height	0	4 (20)	10 (50)
	1	1 (5)	5 (25)		1	8 (30)	6 (30)
	2	11 (55)	4 (20)		2	6 (30)	4 (20)
	3	5 (20)	0 (0)		3	2 (10)	0 (0)
	4	1 (5)	0 (0)		P = 0.15		
	5	0 (0)	0 (0)				
	P = 0.002*				X^2 = 5.25		
	X^2 = 18.16						

N= number of patients, X^2= chi square test, P = p value, *Statically significant.

Our analysis showed that fat grafts reduced pain and itching. Itching intensity was measured on a verbal scale from "none" to "severe" with values (0-3), pain intensity was evaluated on the same scale Table (3).

Table (3): Pruritus and pain results. Significant and good improvement in pruritis/pain after fat grafting.

pruritus	Before (N (%))	After (N (%))	pain	Before (N (%))	After (N (%))
0	8 (40)	17 (85)	0	11 (55)	17 (85)
1	7 (35)	3 (15)	1	7 (35)	3 (15)
2	4 (20)	0 (0)	2	2 (10)	0 (0)
3	1 (5)	0 (0)	3	0 (0)	0 (0)
Total	20 (100)	20 (100)	Total	20 (100)	20 (100)
X^2	9.84		X^2	4.88	
P	0.019*		p	0.18	

N= number of patients, X^2= chi square test, P= p value, *Statically significant.

The study shows an 80% increase in patient satisfaction after fat injection, Patient satisfaction levels were gauged on a scale from 0 to 10, with 10 indicating the highest satisfaction level. The assessment criteria included improvements in scar appearance, color, flexibility, pain relief, itching relief, and absence of complications post-procedure as shown in table (4). The study identified only three cases of fat resorption as postoperative complications associated with fat grafting for scar treatment. Results shown in Figures (1-3).

Table (4): Patient satisfaction with results

Personal satisfactions	N (%)
Excellent (9-10)	10 (50)
Good (5-8)	6 (30)
Fair (3,4)	2 (10)
Bad (0-2)	2 (10)

N= number of patients.

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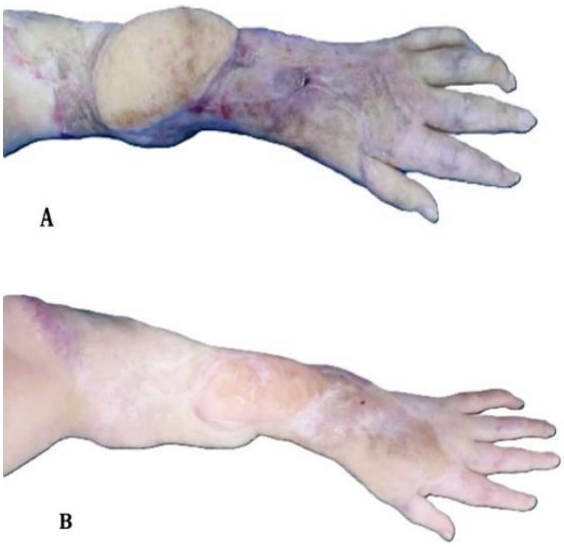

Figure (1): 31-year-old female with previous mutilating forearm injury, underwent free flap reconstruction, (A) before and (C) and 6 months after fat graft.

Figure (2): 40-year-old female with history of previous neck surgery, A. before fat graft, B. 4 months after fat graft.

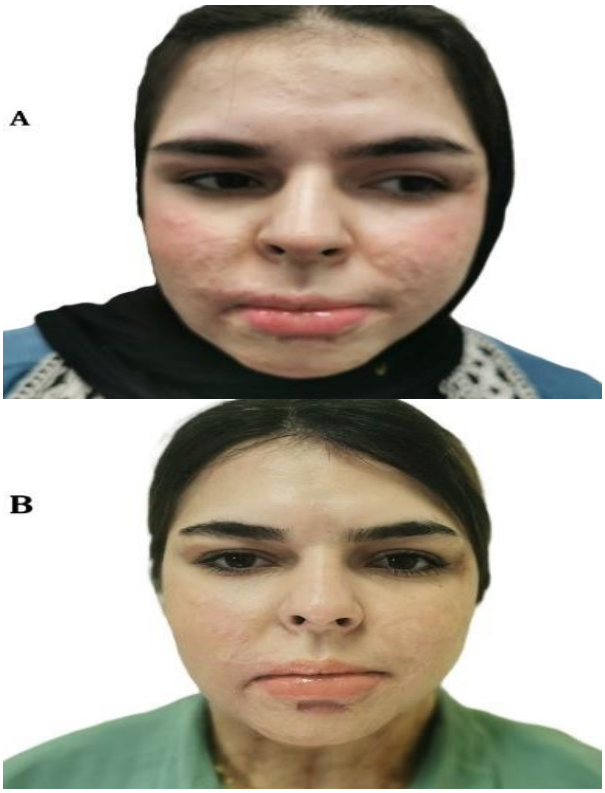

Figure (3): 29-year-old female with old burn scar to right side of her face, (A) before and (B) and 6 months after fat graft.

Discussion

Scarring on visible body parts can severely impact well-being and pose health risks, sometimes leading to psychological issues such as thoughts of self-harm. [14] Various treatments are available, including corticosteroid injections, silicone gel sheets, pressure therapy, radiotherapy, cryotherapy, lasers, surgery, growth factors, collagen synthesis inhibitors, anti-inflammatory agents, minocycline, ACE inhibitors, and gene therapy.[5,6] Autologous fat transfer, rich in mesenchymal stem cells (MSCs), is effective for treating soft tissue defects from trauma, burns, or surgery.[15] mesenchymal stem cells enhance tissue repair and regeneration, providing benefits such as shorter hospital stays, fewer complications, and ease of use.[16] In our study, females were more affected by scarring than males, with 11

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cases (55%) in females and 9 cases (45%) in males. Post-traumatic scars were present in 15 cases (75%). The average age of patients was 25.3 years, with 93% under 40, suggesting a higher psychological impact on younger individuals. This contrasts with Cervelli et al., who reported an average age of 40 for fat injections treating chronic ulcers.[17] Similarly, Fontdevila et al. conducted a study on fat grafting for rejuvenation and reported that the average age of their subjects was 45 years.[18] The volume of fat injected according to this study ranged from 6 to 40 ml, with an average of 20.26 ml. Guyuron et al. reported 1 to 4 ml for facial augmentation,[19] while Cervelli et al. used about 120 ml with platelet gel for treating progressive hemifacial atrophy.[20] We primarily harvested fat from the lower abdomen (75%), using the thigh and buttock for slim or muscular individuals (15% and 10%, respectively). Roerich et al. found viable cells from various areas,[21] but Padoin et al. noted higher cell concentrations in the lower abdomen and inner thighs,[22] which Guyuron and et al. also preferred.[19]Successful fat grafting for scars requires thorough release of scar tissue adhesions. We used a blunt cannula for fat injection and a 3-mm multiperforated cannula for fat collection. Trepsat used a similar method for facial injections.[23]Clinically, we observed significant improvements in scar quality using the Vancouver Scar Scale (VSS), and reductions in pain and itching, with 80% patient satisfaction. Klinger et al. also reported benefits of autologous fat injections for scars, noting improved elasticity, softness, and texture.[24] Our study found significant improvements in quality of life, with 80% of patients reporting higher satisfaction. Jakson et al. reported 96% satisfaction, though noted inconsistent volume "take" in some cases.[25]Autologous fat grafting shows promise in reducing or preventing dermal scars post-injury. The mechanisms behind its effects on scarring and pain reduction are not fully understood, but adipose-derived stromal cells (ADSCs) are believed to play a key role, influencing tissue remodeling, angiogenesis, and inflammation control in wound healing.[26]

Conclusion

The study found that autologous fat grafting is important for scar remodeling by improving both aesthetic and function. It improves scar appearance, skin characteristics, volume, and contour. It also helps with symptoms like itching and pain. Autologous fat grafting has comprehensive benefits and can be an effective treatment for scars.

Conflict of Interest

The author reports no conflict of interest.

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