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ORIGINAL ARTICLE

Autologous Micro-fat Injection in the Treatment of Posttraumatic Atrophic Scars

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Abstract

Background: **Autologous fat grafting has been presented as the treatment of choice for atrophic scars and form deformation. It does not only develop form but also fill areas that lack volume brought about by injury, profound consumption, or medical procedure, yet progressively there has been an emphasis on its capacity to recover and redesign encompassing tissues.**

Aim: **To evaluate the efficacy and safety of micro-fat injection in posttraumatic atrophic scars using two objective methods: Vancouver scar scale and patient observer scar assessment scale.**

Patients and methods: **Thirty-eight patients with atrophic posttraumatic scars with a mean age of 23.39 presented to the Dermatology outpatient clinic, Al-Azhar University Hospital (Assuit) to inject micro-fat after scar subcision as a filling agent for the avoidance of scar redepression.**

Results: **VSS, O-POSAS, and P-POSAS (from 5.16 ± 1.33 to 4.37 ± 1.24), (from 18.47 ± 2.58 to 16.16 ± 2.14), and (from 15.16 ± 3.02 to 13.47 ± 1.62), respectively, $P > 0.00001$, >0.001, and 0.009 with significant differences in the two scales preprocedure and postprocedure (0.79 ± 0.96), (2.31 ± 3.12), and (1.68 ± 3.40), respectively.**

Conclusion: **Autologous micro-fat injection is a valuable tool for the treatment of atrophic posttraumatic scars and has better results with fewer side effects.**

Keywords: Atrophic posttraumatic scars, Autologous, Micro-fat

1. Introduction

Ten million people gain horrendous scars each year which are brought about by surgeries and other awful wounds around the world. Scarring is viewed as one of the inescapable results of injury. The horrendous scars particularly those on the face and neck are cosmetically unappealing due to dyschromia and sporadic surface contrasted with the encompassing skin.[1]

Autologous fat grafting has become very famous in tissue recreation and expansion throughout the last 10 years. Its regenerative properties and useful impacts on skin surface have been seen in a few studies.[2]

It does not just enjoy the benefit of good tissue similarity, but at the same time is possible to use, bounteously accessible and financially savvy, so it is broadly applied in plastic surgery.[3]

Autologous fat grafting has been presented as the treatment of atrophic scars and shape distortion. It not only further develops form but fills areas of inadequacies brought about by injury, and medical procedure; however, progressively there has been an emphasis on its capacity to recover and redesign encompassing tissues.[4]

Therefore; this study aims to evaluate the efficacy and safety of autologous micro-fat grafting in improving the cosmetic outcome of posttraumatic atrophic scars.

2. Patient and methods

A total of 38 patients with posttraumatic atrophic scars irrespective of sex or body site attending the

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Dermatology Outpatient Clinic at Al-Azhar University Hospitals in Assuit, between April 2021 and June 2022 were enrolled in this quasi-experimental clinical study. Informed written consent was obtained from all participants before conducting the study, where concept advantages and complications of the procedures were explained to the participants.

Age of 15 years or over, cooperative patient, and posttraumatic or surgical atrophic scars older than 6 months were included, while history of blood or cardiovascular diseases, pregnancy, psychologically disturbed patient and patients with unrealistic expectations, prior chemotherapy or radiotherapy and Keloid formation tendency were excluded.

History taking included name, age, residence, marital status, occupation, type of scar, scar duration, type of healing, and site and size of the scar. History of blood disease, bleeding disorder, psychological illness, previous chemotherapy, radiotherapy, Keloid formation tendency, and cardiovascular diseases. Examination and assessment: General and physical examination of body build and general condition, skin phototype, and availability of fat sites. Laboratory investigations including CBC, PT, PTT, and INR.

The Preoperative Vancouver Scar Scale (VSS) evaluates four factors: vascularity, level/thickness, malleability, and pigmentation. Patient impression of their particular scars is not figured into the general score. Preoperative patient observer scar evaluation scale (POSAS) in which six things ought to be assessed, scored from 1 (like typical skin) to 10 (most obviously terrible possible scar). It evaluates vascularity, pigmentation, thickness, relief, malleability, and surface region, and it consolidates patient appraisals of torment, tingling, variety, firmness, thickness, and alleviation. Preoperative photograph by department's camera (Group EOS 40D, 10.0 megapixels).

Micro-fat gathering: the mid-region was the most generally picked site for fat collecting because of bountiful stomach fat in all members. After infusion of 2 ml of lidocaine hydrochloride 2 % intradermally at the site of section, blade. No 11 was stapled to open access for 3 mm multiport reaping cannula to get to subcutaneous fat. The gathering site was infused with tumescent anaesthesia (500 ml of 0.9 % saline solution, adrenaline 0.5 mg/ml, and 20 ml of lidocaine hydrochloride 2 % without adrenaline) was penetrated into a multicourse plane to numb the entire region and waiting that 20 min will satisfy total numbness, then beginning to push the collecting cannula (obtuse-tipped slender cannula, with a measurement of 3 mm, and four openings, each check estimating 3 mm), with slight attractions pressure made by pulling the unclogger of 20 ml luer-lock needle, at last, subcutaneous fat began to be ousted in the needle. The lipoaspirate collected by this technique is called macrofat.

For handling of macrofat, it is centrifuged at 1200 *g* for 3 min. This prompts an upper sleek, focal greasy, and lower watery layer. The sleek and watery layers are eliminated and the cleaned fat is handled. Macrofat is emulsified by moving between two needles associated by a female-to-female connector (2.4,1.5, and 1.2 mm in measurement) for a sum of multiple times. The second round of centrifugation, at 1200 *g* for 3 min, again prompts three layers, with the micro-fat being the center layer. Micro-fat is infused subcutaneously through a 21 G cannula and intradermally through a 27 G cannula infusion performed until yellowish staining of the skin appears.

Postoperative consideration in all cases comprises cautious utilization of antibacterial ointment to the treated region. Overseeing extra foundational antitoxin, heparin cream might assist with settling ecchymosis.

Pressure dressings, cooling, and effective/fundamental corticosteroids ought to stringently be kept away to permit the relocated fat unions to apply their reparative capabilities and backing fat unions to settle at their beneficiary site. Manual lymphatic waste ought to be begun in the third postoperative week; delicate scar back rub ought to start around a month and a half after the medical procedure.

The scars were assessed using POSAS and Vancouver scar scale previously and a month after infusion. Shooting the scars previously and a month after the system utilizing similar views and lighting preoperatively. Following up with the members to notice secondary effects like fat blisters, diseases, unfamiliar body responses, super durable stains, or opposite secondary effects straightforwardly after the treatment and in the subsequent period that reaches out to 90 days.

Factual examination was performed using GraphPad Crystal adaptation 8.0.2 (GraphPad Programming, La Jolla, CA). Clear measurements for quantitative information were communicated in tables as the mean ± SD, while subjective information was communicated as number and rate. Chi-square test was used to inspect the distinctions between downright factors. P-esteem was viewed as critical if < 0.05.

3. Results

Concerning demographic information of the concentrated on patients the mean age was 23.39 ± 5.49 years with a reach somewhere in the range

Table 1. Clinicodemographic data of patients.

Age (years)	
Mean ± SD	23.29 ± 5.61
Range	15–39
Sex (%)	
Female	23 (60.5)
Male	15 (39.5)
Duration of the scar (years)	
Mean ± SD	5.71 ± 4.16
Range	1–20

when compared with the preoperative score. Comparing the post operative score of the P-POSAS scale to the preoperative score showed an exceptionally huge improvement with p-value = 0.009 (Table 4, Figs. 4–7).

4. Discussion

There are different measures for atrophic scar treatment such as ablative partial laser treatment,

Table 2. Comparison of changes in preoperative and postoperative vancouver score according to scar characteristics.

	Preoperative	Postoperative	Mean difference	*P*-value
Pigmentation	1.53 ± 0.51	1.74 ± 0.45	0.21 ± 0.41	0.005*
Vascularity	0.26 ± 0.55	1.37 ± 0.49	1.10 ± 0.65	<0.001*
Pliability	2.00 ± 0.74	0.79 ± 0.53	1.21 ± 0.41	<0.001*
Height	1.37 ± 0.49	0.47 ± 0.51	0.89 ± 0.31	<0.001*
Total	5.16 ± 1.33	4.37 ± 1.24	0.79 ± 0.96	<0.001*

Table 3. Comparison of changes in preoperative and postoperative observer scar assessment scale score.

Scar characteristics	Preoperative	Postoperative	Mean difference	*P* value
	Mean ± SD			
Vascularity	1.37 ± 0.82	3.00 ± 0.46	1.63 ± 0.99	<0.001*
Pigmentation	1.84 ± 0.49	3.05 ± 0.52	1.21 ± 0.41	<0.001*
Thickness	1.47 ± 0.76	3.26 ± 0.92	1.79 ± 1.17	<0.001*
Relief	4.63 ± 1.05	2.11 ± 0.73	2.57 ± 0 .89	<0.001*
Pliability	4.53 ± 1.06	2.42 ± 0.83	2.11 ± 1.35	<0.001*
Surface area	4.63 ± 0.82	2.32 ± 0.57	2.32 ± 0 .81	<0.001*
Total	18.47 ± 2.58	16.16 ± 2.14	2.31 ± 3.12	<0.001*

Table 4. Comparison of changes in preoperative and postoperative patient scar assessment scale score.

Scar characteristics	Preoperative	Postoperative	Mean difference	*P* value
	Mean ± SD			
Pain	1.05 ± 0.23	1.26 ± 0.64	0.21 ± 0.70	0.062
Itching	1.00 ± 0.00	1.05 ± 0.23	0.05 ± 0.23	0.157
Color	2.53 ± 1.06	3.05 ± 1.01	0.53 ± 1.52	0.077
Stiffness	3.53 ± 1.41	2.26 ± 0.55	1.26 ± 1.57	<0.001*
Thickness	1.68 ± 0.74	3.53 ± 0.83	1.84 ± 1.10	<0.001*
Irregularity	5.37 ± 1.24	2.32 ± 0.87	3.05 ± 1.16	<0.001*
Total	15.16 ± 3.02	13.47 ± 1.62	1.68 ± 3.40	0.009*

of 15 and 39 years. Out of those patients, 23 (60.5 %) patients were females, and the others were males. The span of the scar differed from 1 to 20 years with a typical term of 5.71 ± 4.16 years (Table 1). Likewise, the all-out Vancouver score showed an exceptionally critical improvement at the endpoint with p-value <0.001 (Table 2). The O-POSAS showed a critical reduction in the score relief, malleability, and surface region of the scar postoperatively with exceptionally huge p-value <0,001. Then again, vascularity, pigmentation, and thickness of the scar fundamentally expanded postoperatively with p-value <0.001 (Table 3). Besides, the all-out P-POSAS uncovered an exceptionally huge improvement at the endpoint

nonablative laser treatment, dermabrasion, substance strip treatment, and careful strategies such as subcision, injectables, and combined treatment. Every one of them limits scarring yet does not dispose it totally.[5]

Therefore, our study aimed to evaluate the efficacy and safety of micro-fat injection in posttraumatic atrophic scars by two objective methods of scar assessment, which have not been reported together in the literature to the best of our knowledge to add more accurate evaluation to the studied scars pre- and post-procedure. In our study, 38 patients, A23 (60.5 %) of them were females, and the others were males. Suffering from atrophic (depressed), mature,

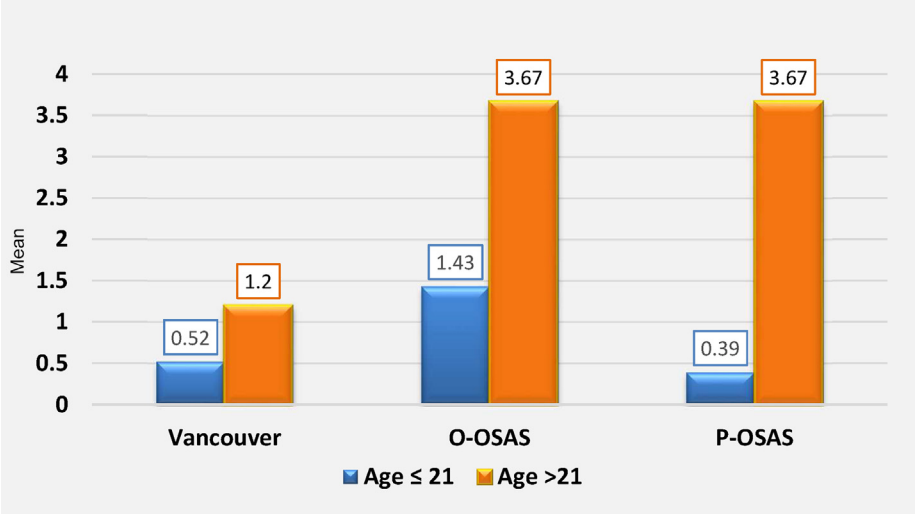

Fig. 1. Relationship between improvement of scar estimated by Vancouver and POSAS total and age of patients.

posttraumatic or surgical scars for more than 6 months up to 20 years with a mean duration of 5.71 ± 4.16. Their ages ranged between 15 and 39 years, the mean age was 23.39 ± 5.49 years, and their skin phototypes ranged between type 3 and 5, which reflect the predominance of younger age groups and female Sex owing to the psychological trauma and social embarrassment to the younger and female patients compared with older and male ones.

According to a previous study, **Padion *et al.*** [6] reported that the site of fat harvesting in 100 % of patients in the study was in the lower abdomen because of the abundant abdominal fat in all participants. Padoin and his team noticed that the concentration of lipoaspirate in the lower abdomen and inner thighs was significantly higher than in other sites as these sites might be sources of adult mesenchymal cells and this could improve the viability of injected fat, in line with our results.

In our study; Vancouver scar scale results showed significant improvement pre-and post-procedure (from 5.16 ± 1.33 to 4.37 ± 1.24) with significant difference (0.79 ± 0.96) and *P* was >0.001. When regarding the POSAS scale, the results showed significant improvement in O-POSAS and P-POSAS (from 18.47 ± 2.58 to 16.16 ± 2.14) and (from 15.16 ± 3.02 to 13.47 ± 1.62) respectively, $P > 0.001$ and 0.009 with significant differences in the two scales pre- and post-procedure (2.31 ± 3.12), and (1.68 ± 3.40), respectively.

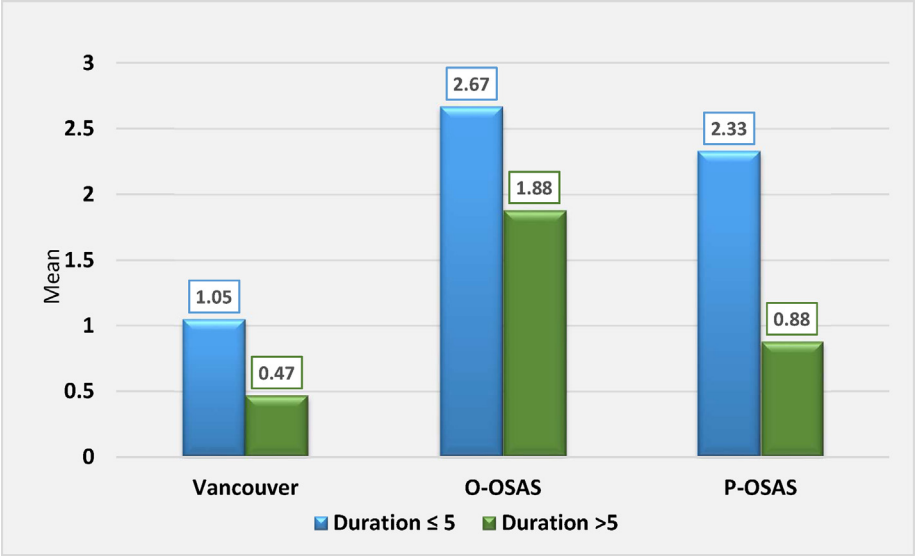

Fig. 2. Relationship between improvement of scar estimated by Vancouver and POSAS total and duration of scar.

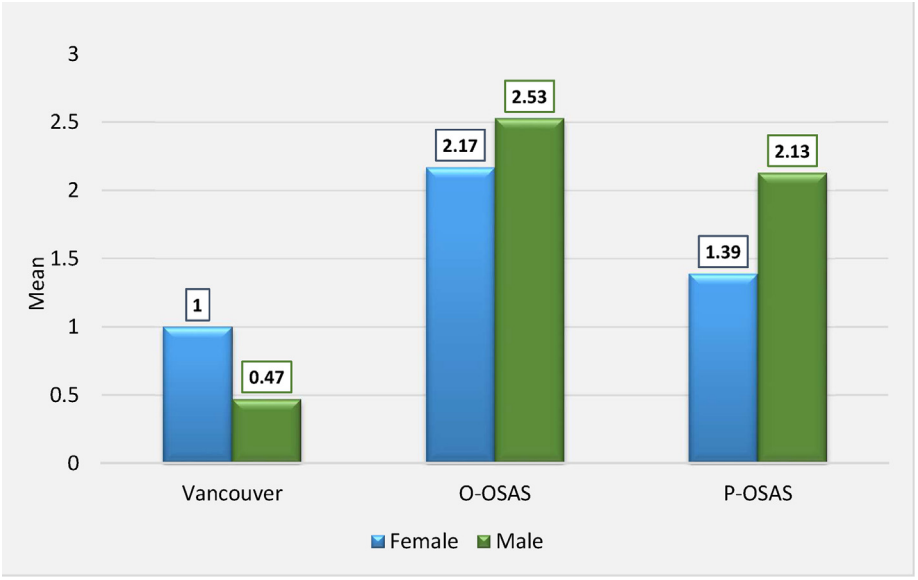

Fig. 3. Relationship between improvement of scar estimated by Vancouver and POSAS total and patients' Sex.

As previously observed; our study showed that VSS (vascularity, pliability, and height) was found to be significantly improved from (0.26 ± 0.55), (2.00 ± 0.74), and (1.37 ± 0.49) to (1.37 ± 0.49), (0.79 ± 0.53), and (0.47 ± 0.51), respectively, with *P* value < 0.001, which matches with the results of **Lee *et al.*,**[4] and confirmed by **Ramaut *et al.***[7] and **Fernandes and Signorini**[8] studies, which found,

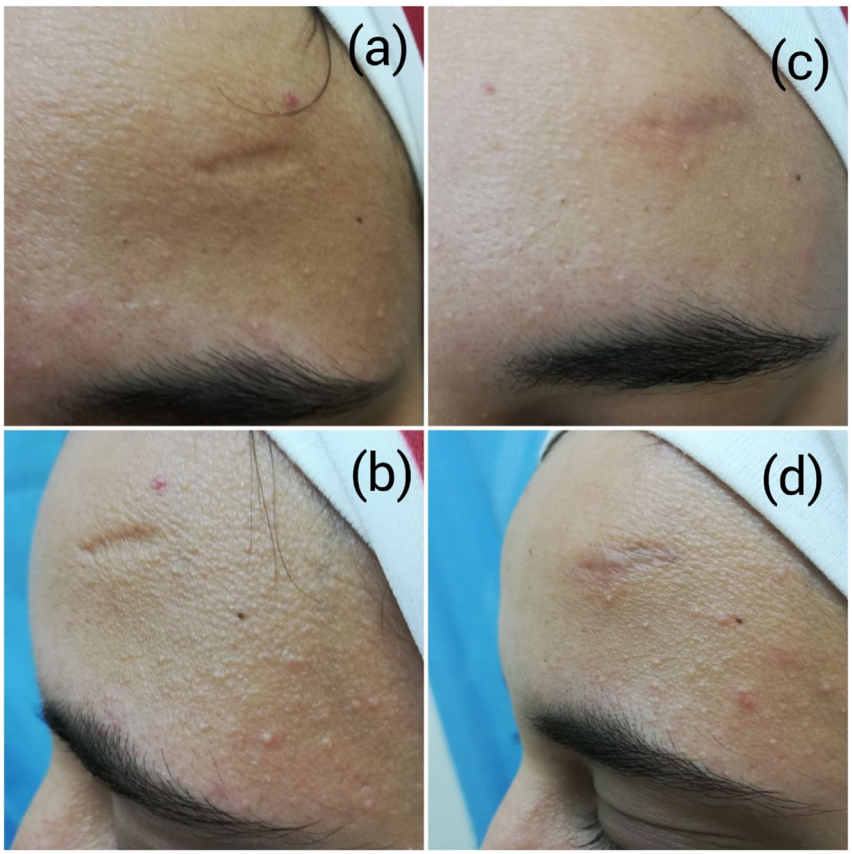

Fig. 4. A 24-years-old female patient presented with atrophic posttraumatic scar: (a) and (b) shows pretreatment, (c) and (d) shows posttreatment after 1 month of micro-fat injection with good results.

histologically, a significant increase in collagen deposition at 6 months, along with a 40 % increase of the epidermal thickness and normal rete ridges at 1 year after treatment. Also **Rageh *et al.*,**[9] assessed epidermal thickening, collagen, and elastic fiber density by histological evaluation, which showed an increase in epidermal thickness, increased number and density of collagen and elastic fibers along with neovascularization.

In our study, POSAS observer scale, on one hand, such as vascularity, thickness, pliability, relief, and surface area show significant improvement with $P < 0.001$. On the other hand POSAS patient scale in which patients evaluate their scar in terms of stiffness, thickness, and irregularity shows significant improvement with $P < 0.001$ in our study which matches with the results of **Jan *et al.***[10] and **Gu *et al.*,**[11] and confirmed by **Abd Elfatah *et al.***[12]

In our study, pigmentation increased postoperatively in both VSS and POSAS, which mismatch with the results of studies that used both scales, which could be explained by the fact that **Gu and his team in their** study on 25 atrophic hypopigmented facial **scars noticed improvement in pigmentation. Also Tonnard and his team notice some** risks of fat injection including persistent post-inflammatory hyperchromia, especially in patients of Fitzpatrick skin types III–V, which is the same phototype like our patients although this side effect renders normal color in a further follow-up **Gu *et al.*,**[11] and **Tonnard *et al.***[13]

In another study by **Jan *et al.*,**[10] scar pliability originates from the stimulation of collagen deposition and elastin synthesis by ADSCs within the micro-fat leading to improvement in scar pliability in addition to the filling effect of fat itself that improves the height of the treated scars.

Regarding the relation between improvement and demographic data of patients, we found that younger age was associated with a lower score of scars assessment scale; however, the Sex of patients and duration of the scar did not show a statistically significant difference (Tables 6 and 7, Figs. 1–3). In line with our findings; **Klinger *et al.***[14] and **Brongo *et al.***[15] proved that a highly significant correlation existed between improvement and demographic data.

In our study, the harvest site complications, 27 (71 %) of the studied patients had tenderness and 34 (63 %) had edema; however, no patients are documented any organ injury. In contrast, all patients

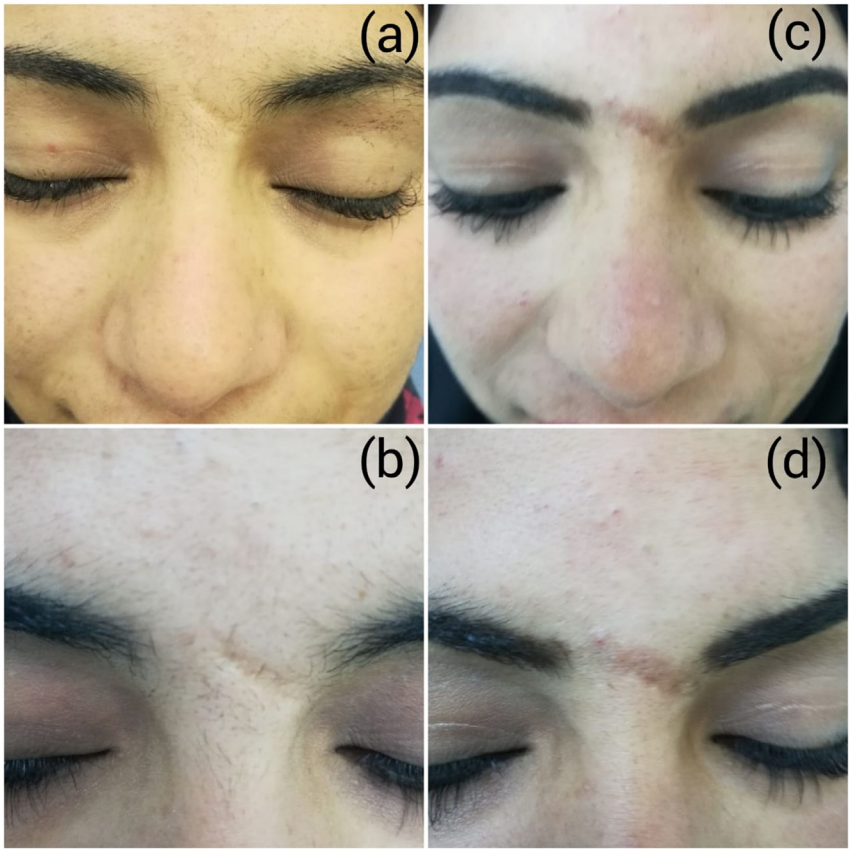

Fig. 5. A 20-year-old female patient presented with atrophic posttraumatic scar: (a) and (b) show pretreatment, (c) and (d) show posttreatment after 3 months of micro-fat injection with good results.

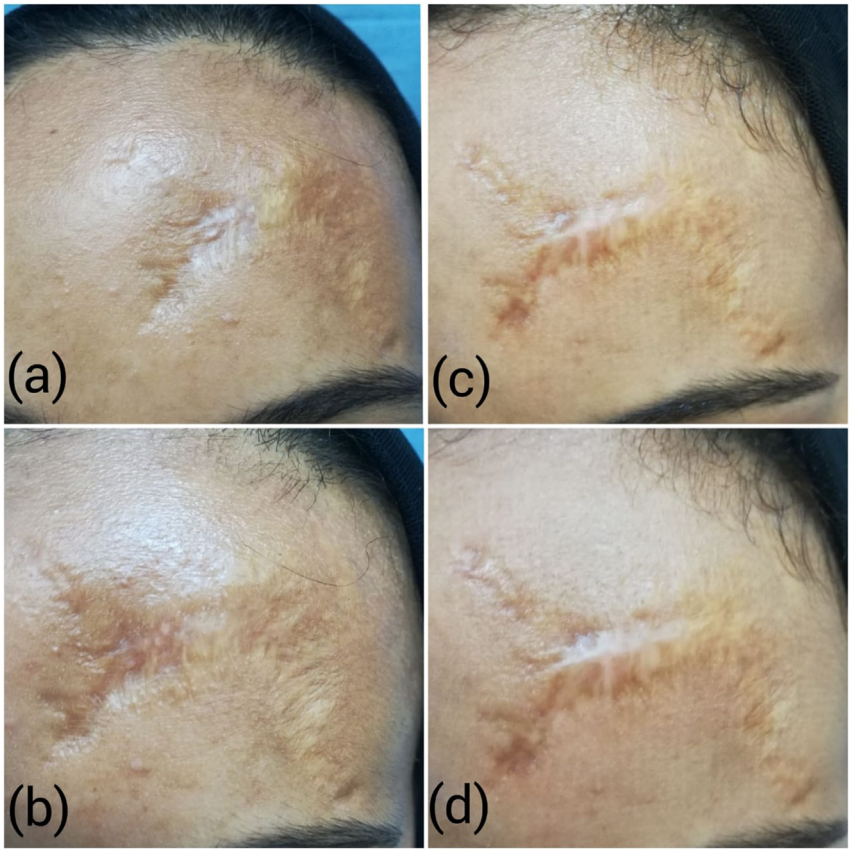

Fig. 6. A 21-year-old female patient presented with atrophic posttraumatic scar: (a) and (b) show pretreatment, (c) and (d) shows posttreatment after 1 month of micro-fat injection with good results.

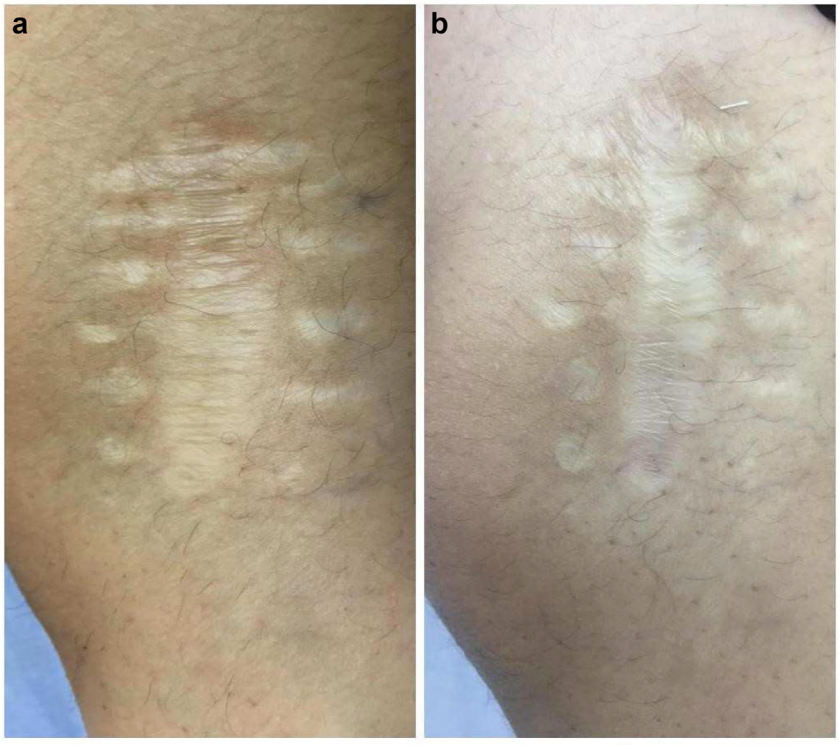

Fig. 7. A 18-years-old female patient presented with atrophic posttraumatic scar: (a) shows pretreatment and (b) shows posttreatment after 3 months of micro-fat.

Table 5. Postoperative harvest site and injection site complication.

Complication	*n* (%)
Harvest site	
Organ injury	0 (0.0)
Tenderness	27 (71.1)
Edema	24 (63.2)
Injection site	
Erythema	38 (100.0)
Infection	0 (0.0)
Foreign body reaction	0 (0.0)
Edema	33 (86.8)
Hyperpigmentation	34 (89.5)
Injection cyst	0 (0.0)

Table 6. Relationship between improvement of scar estimated by Vancouver and POSAS total and demographic data of patients.

	Vancouver Mean ± SD	*P* value	O-OSAS Mean ± SD	*P* value	P-OSAS Mean ± SD	*P* value
Age						
≤21	0.52 ± 0.79	0.032*	1.43 ± 2.79	0.029*	0.39 ± 2.31	0.002*
>21	1.20 ± 1.08		3.67 ± 3.20		3.67 ± 3.90	
Duration						
≤5	1.05 ± 0.92	0.065	2.67 ± 3.75	0.449	2.33 ± 3.20	0.195
>5	0.47 ± 0.94		1.88 ± 2.15		0.88 ± 3.57	
Sex						
Female	1.00 ± 0.74	0.096	2.17 ± 2.71	0.734	1.39 ± 3.34	0.518
Male	0.47 ± 1.19		2.53 ± 3.76		2.13 ± 3.56	

Table 7. Correlation between scar assessing score and demographic of patients.

	Vancouver	*P* value	O-OSAS	*P* value	P-OSAS	*P* value
	r		r		r	
Age	0.63	<0.001*	0.45	0.005*	0.461	0.004*
Duration	−0.36	0.024*	−0.08	0.632	−0.04	0.789

exhibited injection site erythema, 33 (86.8 %) had edema; hyperpigmentation was documented in 34 (89.5 %) of our patients. On the other hand, infection, foreign body reaction, or injection cyst did not appear in any of our analyzed cases (Table 5).

As previously mentioned in the **Brongo *et al.***[15] study for major complications like internal organ injury and vascular occlusion during injection with good results, autologous micro-fat injection is a valuable tool for the treatment of atrophic post-traumatic scars and has better results with fewer side effects.

4.1. Conclusion

In conclusion, autologous micro-fat injection is a valuable tool for the treatment of atrophic post-traumatic scars and has better results with fewer side effects.

4.2. Recommendations

Autologous micro-fat injection is a better tool in the treatment of atrophic posttraumatic scars. Subcision before the procedure of micro-fat injection especially for fibrotic scars improve the outcome of scar appearence.

Authorship

All authors have a substantial contribution to the article.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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Conflicts of interest

The authors declared that there were no conflicts of interest.

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