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Effect of Nano Fat Injection on Post-Burn Scars in Suez Canal University Hospital

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ABSTRACT

Background: Burn scars can hinder daily activities and have an adverse effect on one's quality of life by causing aesthetic and functional issues. Injecting adipose tissue that has been acquired by liposuction into the dermis and/or subcutis of the targeted body location is known as lipofilling. It has been acknowledged as a promising procedure for the treatment of scars as well as the correction of volume shortage and skin renewal.

Objective: The objective of this study was to evaluate the effect of Nano fat injection on post-burn scar patients in Suez Canal University Hospital using the Patient and Observer Scar Assessment Scale (POSAS).

Patients and Methods: A total of 26 individuals with post-burn scars at Suez Canal University Hospital Plastic Surgery Clinic participated in this randomized controlled clinical trial. Patients underwent a clinical examination that included determining the location, size, shape, and time of the scar, as well as their complaints of disfigurement, itching, burning, discomfort, or contracture. Every patient had liposuction, either from the thigh or the belly. After the fat was processed, Nano fat was reinjected into the scar.

Results: Mean age of the patients was 29.65±3.94 years with 84.6% females. Scaled burn with the commonest type by 61.5%. The scars were distributed between the Upper trunk (11.5%), lower trunk (69.2%), and head and neck (19.2%). The main harvest site was the lower abdomen (69.2%) followed by the inner thigh (30.8%). The mean amount of the fat injected was 46.54±18.34 ranging from 15 to 80cc. Comparing the pre and post-operative observer scores, showed that the improvement of the score in all items (vascularity, pigmentation, thickness, relief, and surface area) is statistically significant.

Conclusion: Our study's findings revealed a considerable improvement in the various scar parameters following Nano fat injection, making it an effective treatment option for treating post-burn scars and enhancing patients' quality of life.

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INTRODUCTION

Burns are organic tissue injuries that can arise from exposure to dangerous thermal components such as hot liquids or solids, fire, radiation, or electricity **[1]**. Many burn survivors struggle with anxiety, sadness, and poor self-confidence, among other psychological problems. Additionally, some survivors can experience long-term harm to their appearance or functionality **[2]**. The quality of life can be significantly impacted by post-burn scars. They can be immature or mature, atrophic, hypertrophic, or keloid, stable or unstable, and either hypo- or hyper-pigmented (as in vitiligo) **[3]**. Scar evaluations may be either objective or subjective **[4]**. In contrast to subjective assessments, which depend on the observer, the scar's quantification is provided through objective evaluations. At least five scar scales that were initially intended to evaluate subjective factors objectively are currently available. The Stony Brook Scar Evaluation Scale (SBSES), the Visual Analog Scale, the Patient and Observer Scar Assessment Scale, the Manchester Scar Scale, and the Vancouver Scar Scale **[5]**.

Devices to objectively quantify scar assess parameters such as 3D topography, color, perfusion, thickness, pliability of the skin, and stiffness **[6]**.

For the treatment of scars, there are many therapeutic options. Technically difficult scar fat injection. Scar tissue has few spaces for the inser-

tion of lipo aspirate since it is predominantly acellular, stiff, rigid, and fibrotic. Excess ECM, in particular collagen fiber deposition with abnormal organization, is a defining characteristic of scarred skin **[7]**. As a result, when the fat injection is used to treat scars, it is frequently paired with a percutaneous scar release procedure in which the fibrous ECM is broken up with needles to provide room for the injection of the lipo aspirate **[8]**. It has been demonstrated that the use of Nano fat injection is beneficial in the treatment of atrophic scars, wrinkles, and skin discolorations. While only slightly improving pigmentation and vascularity, it is highly effective at heightening and enhancing the pliability of all scars **[9]**. It can be easily paired with conventional fat grafting, which can help in the treatment of post burn scar irregularities as in depressed, adherent and atrophic scars. Nano fat works well on scars and discolorations that are reddish and somewhat raised **[10]**. The objective of this study was to evaluate the effect of Nano fat injection on post-burn scar patients in Suez Canal University Hospital using the Patient and Observer Scar Assessment Scale (POSAS).

PATIENTS AND METHODS

Study design: The study was conducted as a clinical trial with randomization.

Study population: Patients visiting the Suez Canal University Hospital from January 2021 to June 2022 primarily complained of discomfort and disfigurement in their post-burn scars.

Inclusion criteria: Patients in their middle years who had partial thickness (2nd degree) scald, flame, or chemical burns and had post-burn scarring. The scars must all be fully developed.

Exclusion criteria: Skin infections, keloid scars, hypertrophic scars, skin masses at burn sites, etc. Patients with known bleeding tendency disorder (e.g., thrombocytopenia, hyperfibrinogenemia, platelet dysfunction, etc.) in the epidermis, dermis, or vascular system; hemoglobin level less than 10g/dl (moderate to severe anemia); current use of oral anticoagulants; use of corticosteroids (up to 6 weeks prior to the procedure); non-steroid anti-inflammatory drugs 48 hours prior to the procedure; extreme age.

Methods: The following procedures were applied to all patients.

1- *Preoperative assessment:*

All patients underwent a thorough clinical evaluation, were questioned and had their personal information documented. Patients' names, ages, sexes, phone numbers for follow-up, chronic illnesses, blood diseases, skin diseases, the type and timing of their burns, and the main symptoms of their scars-disfigurement, itching, burning, pain, or contracture-will all be included in this information. The following were examined locally: The scar's location, size, shape, and onset. Preoperative medical photography with patient consent for the scar.

2- *Operative technique:*

Donor site selection: The patients underwent surgery while lying flat. The lower abdomen and thighs were noted as potential donor areas as these sites are richer in SVF, and ADSCs. Following the process of draping and skin preparation, injection of tumescent, with (500ml normal saline + 30ml lidocaine 2% + 1mg adrenalin) using a special cannula (2mm cannula), gets infiltrated gently and gradually. Skin incised with a small stab, the infiltration of the tumescent using injection 2mm cannula, and a 2mm incision was made in the donor area. To maximize the tumescent solution's potential, we waited 20 minutes after tumescent infiltration before beginning liposuction. Then liposuction proceeded under low pressure using 3mm cannula. in a “spokes-of-a-wheel” using a 3mm cannula attached to 20ml syringe. The harvested fat is then processed until it becomes emulsified and completely liquefied and then nano fat is prepared by a nano filter or three ways connection. Using a fat injection cannula measuring 1.2 millimeters, Nano fat is injected intradermal to create tiny bumps resembling papules. Three months following the final session, the outcomes will be assessed by contrasting the digital camera's pre- and post-improvement pictures. Patient and Observer Scar Assessment Scale (POSAS).

Statistical analysis:

Data was imported into Statistical Package for the Social Sciences (SPSS version 21) software for analysis. According to the score of data, the Mean and standard deviation will be estimated for each continuous variable. Student *t*-test and chi-square test will be used to assess the statistical difference between variables, each test according to the type of variable. Study results will be described in tables and graphs; Data was presented using the Microsoft Word computer package.

RESULTS

The study was conducted as a randomized controlled clinical trial that included patients with post-burn scars at Suez Canal University Hospital Plastic Surgery Clinic. The study participants were 26 randomly chosen patients who underwent Nano Fat injection with mean age 29, there were 22 (84.6%) Females and 4 (15.4%) Males. The post-burn scar etiology was scaled burns 61. 5 percent, flame burns 30.8 percent, and chemical burn 7.7 percent of the study population. 18 (69.2%) of the patients had scars in the lower trunk, 5 (19.2%) had scars in the head and neck, and 3 (11.5%) had scars in the upper trunk. The site, length, width, and duration of the scars are described in Table (1) which shows that scar length ranges from 5-30cm and scar width ranges from 0.5-8cm. The fat harvest mean was 46.54-18.34 cc and ranged from 15 to 80 cc with the most frequent donor site being the lower abdomen. complications include moderate infection (8%) and minor hematoma (3.8%); and persistent edema lasting longer than three weeks (11.54%). All complications were resolved by medical treatments only. Assessment of the scars by the best observer score pre-operatively showed vascularity (3.25±0.95) and the worst score is pigmentation (8.62±1.33). The total score of 6 items is (39.33±3.1) which is above 30 and the overall opinion is (7.33±1.5) Table (2). Post-operatively, the best observer score assessment, is relief (2.1±1.2) and the worst score is pigmentation (5±1.45), the total score of 6 items is (19.5±2.5) which is below 30 and the overall opinion is (3.5±1.2) Table (3). Fig. (1), shows the difference between (Before and After) regarding Observer Score. Distribution of the studied cases according to the Patient Assessment Score Before Injection of Nano Fat included Itching, Color, Thickness, Pain, Stiffness, and Irregularity and showed that the best patient score before operatively was pain (3.39±1.23), and the worst score color (7.93±0.85). The total score of 6 items is (46.6±4.4) which is above 30 and the overall opinion is (7.1±1.4). Postoperatively, the best patient score was itching (2.02±0.37) and the worst score was color (6.04± 2.26). The total score of 6 items is (22±2.1) which is below 30 and the overall opinion is (4.1±0.5). Fig. (2) shows the difference between (Before and After) Patient Scores. Comparing the pre and post-operative observer scores showed that the improvement of the score in all items is statistically significant. The most affected item was the thickness (CI 4.7) Table (4). The relation between Observer Score and Patient Score is clarified in Table (5).

Table (1): Site, length, width and duration of the scars.

	Variants	No.=26
Site of fat harvesting	Inner thigh Lower abdomen	8 (30.8%) 18 (69.2%)
Duration of scar (years)	Mean ± SD Range	4.42±1.75 2-8
Amount of fat injection (cc)	Mean ± SD Range	46.54±18.34 15-80
Length of scar (cm)	Mean ± SD Range	20.19±7.30 5-30
Width of scar (cm)	Mean ± SD Range	3.15±2.32 0.5-8

Table (2): Assessment of the scars by the best observer score pre-operatively.

Before	No.=26	
	Mean ± SD	Range
Vascularity	3.37±1.23	1.1-5.48
Pigmentation	8.62±1.33	6.41-10
Thickness	7.93±0.85	5-9.9
Relief	3.25±0.95	2.2-6.3
Pliability	7.58±1.01	3.9-9.1
Surface Area	7.53±1.02	6.2-9.65
Total of six items	39.33±3.1	24.8-50.3
Overall opinion	7.33±1.5	5-9

Table (3): The best observer score assessment post-operatively.

After	No.=26	
	Mean ± SD	Range
Vascularity	2±1.32	1.5-3
Pigmentation	5±1.45	2-7
Thickness	3.2±1.01	2.4-5.8
Relief	2.1±1.2	1-3.4
Pliability	3.47±0.92	2.35-6.65
Surface Area	3.83±0.95	2.7-5.2
Total of six items	19.5±2.5	12-31
Overall opinion	3.5±1.2	2-5

Table (4): Pre- and post-operative observer score.

	Before No.=26	After No.=26	95% Confidence Interval	Test value•	*p*-value	Sig.
Itching:						
Mean ± SD	3.72±1.33	2.02±0.37	1.7000	6.2791	0.0001	HS
Range	1-6.41	1.1-2.5	1.1562-2.2438			
Color:						
Mean ± SD	7.93±0.85	6.04±2.26	11.8900	3.9913	0.0002	HS
Range	6-9.9	2-9.9	0.9389-2.8411			
Thickness:						
Mean ± SD	7.58±1.01	3.2 ±1.01	4.3800	15.6360	0.0001	HS
Range	6-9.9	2.1-3.8	3.8174-4.9426			
Pain:						
Mean ± SD	3.39±1.23	2.32±0.42	1.0700	4.1978	0.0001	HS
Range	2.2-6.3	1.7-3.2	0.5580-1.5820			
Stiffness:						
Mean ± SD	7.58±1.01	3.06±0.48	4.5200	20.6103	0.0001	HS
Range	1.1-5.48	2.3-3.9	4.0795-4.9605			
Irregularity:						
Mean ± SD	7.93±0.95	2.85±0.35	5.0800	25.5852	0.0001	HS
Range	6.2-9.3	2.1±3.8	4.6812-5.4788			

Table (5): The relation between Observer Score and Patient Score.

	Before No.=26	After No.=26	95% Confidence Interval	Test value•	*p*-value	Sig.
Itching:						
Mean ± SD	3.72±1.33	2.02±0.37	1.7000	6.2791	0.0001	HS
Range	1-6.41	1.1-2.5	1.1562-2.2438			
Color:						
Mean ± SD	7.93±0.85	6.04±2.26	11.8900	3.9913	0.0002	HS
Range	6-9.9	2-9.9	0.9389-2.8411			
Thickness:						
Mean ± SD	7.58±1.01	3.2±1.01	4.3800	15.6360	0.0001	HS
Range	6-9.9	2.1-3.8	3.8174-4.9426			
Pain:						
Mean ± SD	3.39±1.23	2.32±0.42	1.0700	4.1978	0.0001	HS
Range	2.2-6.3	1.7-3.2	0.5580-1.5820			
Stiffness:						
Mean ± SD	7.58±1.01	3.06±0.48	4.5200	20.6103	0.0001	HS
Range	1.1-5.48	2.3-3.9	4.0795-4.9605			
Irregularity:						
Mean ± SD	7.93±0.95	2.85±0.35	5.0800	25.5852	0.0001	HS
Range	6.2-9.3	2.1-3.8	4.6812-5.4788			

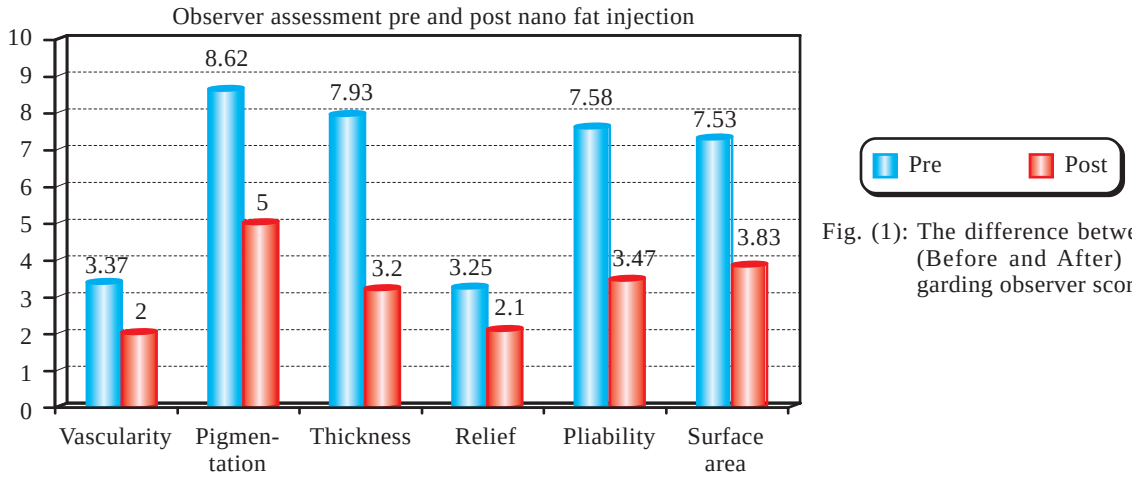

Fig. (1): The difference between (Before and After) regarding observer score.

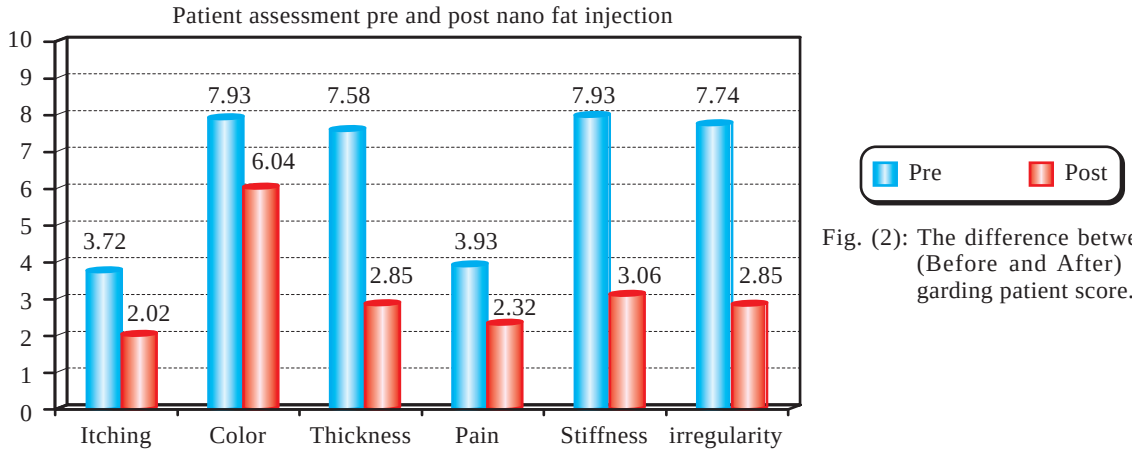

Fig. (2): The difference between (Before and After) regarding patient score.

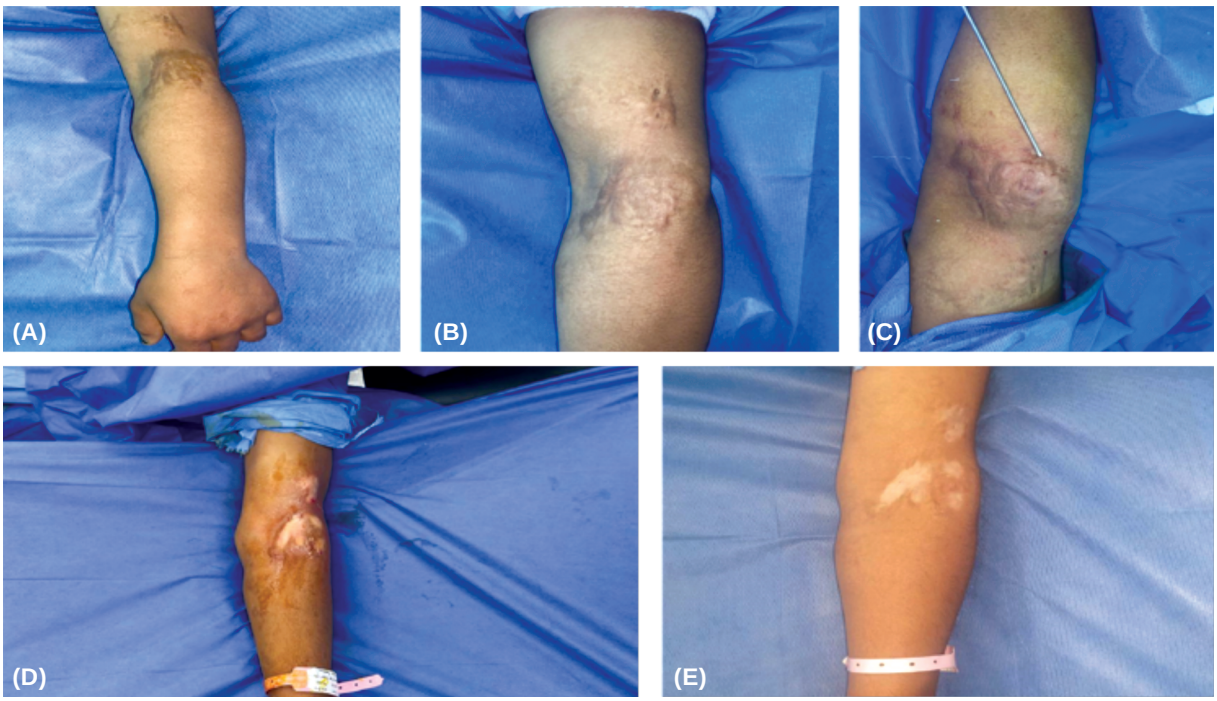

Fig. (3): A case of 27 years old female patient, presented with ugly scar at left forearm, post scald burn, 10 years ago. Previous Photo show Before, intra operative and after nanofat injection. (A&B) Before, (C) intra operative nano fat injection using 3mm diameter cannula, (D) 3 months after first session, (E) 3 months after 2nd session.

Fig. (4): A case of 24 years old female patient, presented with post flame burn scar, 5 years ago. Photos show: (A&B) Before, (C&D) 3 months After nano fat injection.

DISCUSSION

Scar treatment has been attempted using many different techniques, however, most of them have been ineffective. The search for a treatment method that is both safe and effective and produces outstanding aesthetic results is still a top priority **[11]**. The term 'Nanofat grafting' was conceived by Tonnard and colleagues. Tonnard and colleagues have produced Nano fat for skin rejuvenation **[12]**. Nano fat's primary clinical use is to promote tissue remodeling and regeneration. In reality, since adipocytes could not survive the emulsification process, it is possible to dispute if a Nano fat transfer genuinely constitutes a "fat grafting" method. One possibility for in-vivo tissue engineering is Nano fat injection **[9]**. The purpose of this work was to assess, utilizing patient symptoms including pain, itching, color, and stiffness, the efficacy of Nano fat on post-burn scar through the Patient Observer Scar Assessment Scale (POSAS) and clinical photographs. Following the session of Nano fat injection utilizing a straightforward procedure needing no special equipment, scar appearance was statistically superior on practically all measures. Muhammad et al., (2020) reported that, in their study, the comparison of POSAS was assessed pretreatment, at 3 months and 6 months post-injection on patient and observer scores. The results showed highly significant changes at 3rd and 6th-month post-treatment **[13]**. In our study, the inner thigh of 8 patients (30.8%) and the lower abdomen of 18 patients (69.2%) were the primary sites for fat harvesting. Semra et al., (2018) who aimed to analyze the effect of Nano fat grafting on scars, wrinkles, and skin discolorations in their clinic, detected no significant difference in results depending on donor sites in their clinical application **[14]**. In the current study, the mean duration of scar (years) Was 4.42±1.75 and ranged between 2 and 8 years. According to Mahmoud et al., (2021), they sought to assess the contribution of autologous Nano fat injection to improving the aesthetic look of posttraumatic scars and to correlate the findings with pathology. They claimed that because every treated scar in their study was mature (older than two years), physiologic healing played no part in the outcomes. The majority of patients had scars on their faces **[15]**. This demonstrates that one of the main factors for people to seek therapy is the social impact of facial scars. The current study reveals that itching (2.02±0.37) and color (6.04± 2.26) are the best and worst patient scores, respectively, following surgery. The overall assessment is, given that the total score from the six items is (22±2.1), which is below 30, (4.1±0.5). Yogendra

et al., (2022) reported surgical results according to POSAS score using the cumulative results of all seven pararmeters and discovered that 78% of all patients who had underwent surgical maneuver had a POSAS score of 6 to 24, which indicated a positive outcome, while 22% of patients had a POSAS score of 25 to 60, which considered a poor result; the results was statistically significant **[16]**. Yogendra et al., (2022) reported that 56 percent of study population had scores ranging from 4 to 6. Our work also demonstrates that, on the Observer scale for pigmentation, 52 percent of patients had had scores ranging from 1 to 3, while 48 percent had scores ranging from 4 and 6. The scores of none of the patients were greater than 6. On the Observer scale for vascularity, whereas 44 percent had scores ranging from 1 to 3 on that scale. None of the patients had a POSAS score of more than 6 **[16]**. Also, the current study shows that the POSAS score on the Observer scale for pigmentation was between 1 and 3 for 52% of the patients while 48% of patients had a score between 4 and 6. None of the patients' POSAS scores were higher than 6. The majority of post-treatment scars saw good responses, according to Uyulmaz et al., (2018). (74%). Eighteen percent of the scars had good results and just 8% of the injected scars had results that were unaltered after treatment. Additionally, postoperative wrinkles and color changes were satisfactory treated in 60% and 34% of patients, respectively **[10]**. The current work revealed that there was a very statistically significant difference between Before and After Regarding Pigmentation and Height, as well as a statistically significant difference between Before and After Regarding vascular element score, Pliability, Pain, and Itching score. Yogendra et al., (2022) reported that total average scores ranges were 3.5 to 4.74. Additionally, the mean score was 22.18±11.35, statistically lower than the measured preoperative scores (39.56 ±3.45) **[16]**. Our study's findings were consistent with those of Lee et al., (2018), who concluded that combined scar revision and fat injection significantly improve the Vancouver scar scale (VSS) **[17]**. In the research by Pallua and Kim (2020), they looked at the results of fat injection treatment for facial scars. Regarding pain, color, stiffness, irregularity, pigmentation, and pliability, the POSAS scores satisfactory improved. The results of the current study showed that there was a highly statistically significant difference between Before and After in terms of the procedure's pain, itching, color, stiffness, thickness, and irregularity **[18]**.

Brown et al., (2020), in contrast to our findings, contrasted the effects of fat against injection of normal saline in the scar management. Regarding vascularity, inflammation, and epidermal thickness, there were no discernible variations histologically between the areas treated with fat and saline **[19]**. Another Chinese study looked at the impact of fat grafting and condensed Nano fat on the repair of facial scars from both a functional and aesthetic standpoint. The final follow-up exams revealed comparable findings to our study, with both patients' and observers' overall POSAS scores significantly improving **[20]**.

Conclusion:

Regarding patient complaints including pain, itching, redness, and stiffness, nano fat grafting is an efficient and secure therapy choice for post-burn scars. Regarding patient problems including pain, itching, redness, and stiffness, nano fat grafting is an efficient and secure therapy choice for post-burn scars.

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