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OUTCOME IN PATIENTS WITH FACIAL BURN HYPERPIGMENTATION AND SCARS BEING TREATED WITH NANOFAT GRAFT

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Keywords

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Abstract

Background: *Facial burn scars and hyperpigmentation can be considered as long-term consequences of burns, and these can have a significant impact on their aesthetic appearance, psychological wellbeing, and quality of life. The results of conventional therapeutic approaches can be inconsistent, which makes it important to develop efficient regeneration therapies. Nanofat grafting has been proven to be a possibility with enhancing regeneration and scar properties as well as pigmentation abnormalities.*

Objective: *To determine the outcome of nanofat grafting in patients with facial burn hyperpigmentation and scars.*

Methods: *This descriptive study was done in Department of Plastic Surgery, Lady Reading Hospital, Peshawar during 6 months. Patients aged 15-70 years with post-burn scars with hyper pigmentation of the face were included in the study using non-probability consecutive sampling technique, totaling 110 patients. Nanofat was collected, treated and injected into the facial area that was affected. The Vancouver Scar Scale (VSS), hyperpigmentation, and scar appearance, patient satisfaction scores, and adverse event reporting were used to measure outcomes six months after the intervention.*

Results: *The scar quality and pigmentation were improved significantly after nanofat grafting. The median VSS score decreased from 9 to 4. 72.7% of patients had significant improvement or complete resolution of hyperpigmentation and 76.4% had significant improvement in scar appearance. 67.3% of respondents stated that they were satisfied with the*

patient satisfaction. The only minor transient complications observed were none with major adverse events reported.
Conclusion: *The study findings indicate that nanofat grafting can be a safe and effective treatment for scars and hyperpigmentation resulting from a burn in the face area, with improved scar quality, hyperpigmentation and patient satisfaction, and minimal complications.*

INTRODUCTION

Burn injuries are still a significant public health issue in the world and they are one of the most common causes of morbidity, disability and deaths in the world. Flame, scalds, contact burns, electric and radiation thermal injuries affect millions of people every year, and are disproportionately prevalent in low- and middle-income countries. While the survival rates of patients with acute burns have improved to a significant extent, long-term consequences like scar formation and pigmentary abnormalities still remain a challenge to the quality of life of the burn survivors [1].

The face is one of the most apparent and functional areas of the human body. This means that burns to the face can cause a lot of cosmetic scarring and social problems. A burn scar on the face often causes patients to feel self-conscious, socially isolated, anxious, depressed and to have poor quality of life. Psychological impact of facial deformity may last for many years after healing of the wound and such deformity is often associated with ongoing medical and social needs [2].

Scars produced by burns are a complicated biological event, which involves disruption of normal skin architecture, changes in vascularity, excessive collagen deposition, and abnormal wound healing. Scars can be hypertrophic, atrophic, contracted, hyper pigmented, hypopigmented or mixed, depending on the severity and depth of the injury. Patients with darker skin tones are more likely to develop hyper pigmentation and it can continue to be a major cosmetic issue even after the wound has been closed and the scar has matured [3].

Burn scars need to be accurately assessed for treatment outcomes and to track disease development. There are a number of validated scar assessment scales available, such as the Vancouver Scar Scale (VSS), the Manchester Scar Scale, the Patient and Observer Scar Assessment Scale (POSAS), the Stony Brook Scar Evaluation Scale and the Visual Analog Scale. Of these, the Vancouver Scar Scale is one of the most widely used instruments as it offers a standardized assessment of scar colour, vascularity, pliability and elevation [4].

Post burn scars and pigmentary abnormalities have been treated with a variety of therapeutic methods such as pressure garments, silicone gel sheets, corticosteroid injections, laser therapy, dermabrasion, scar revision surgery and skin grafting procedures. These treatments can alter the appearance of some scars, but there is not a consistent response to them, and many patients still report that they have permanent contour deformities, stiffness, discoloration, and a lack of satisfaction with the scar's appearance. In addition, there are certain interventions that are linked to long treatment duration, higher cost and procedure-related complications [5].

In the fields of reconstructive and aesthetic surgery, autologous fat grafting has become a valuable regenerative surgery due to its benefits in enhancing tissue quality and rejuvenating the skin. More recently, a new therapeutic method, called nanofat grafting has been gaining attention. Nanofat is obtained by emulsification and filtration of adipose tissue harvested and contains stromal vascular fraction, adipose derived stem cells and growth factors. It is thought that these regenerative components promote tissue repair, neovascularization, collagen remodeling and skin regeneration [6].

The results of several studies have shown promising results for scars, skin discoloration, and contour deformities treated with nanofat grafting. Nanofat has been proven to enhance the pliability, texture, thickness and overall quality of the skin at the scar site and to help correct pigmentary abnormalities. Furthermore, it is a minimally invasive procedure, and its use of an autologous tissue also has a very good safety profile with very little risk of immunological reactions or disease transmission [7].

Although a lot of patients suffer from hyper pigmentation and scars in the area of the face after burns, the evidence of nanofat grafting use in these patients is still limited. The majority of the studies that are available are conducted in relatively small patient populations and have been conducted in a variety of patient types, making it challenging to draw firm conclusions about efficacy, patient satisfaction, and safety outcomes. Furthermore, the local information on the use of nanofat grafting in the treatment of facial burn sequelae is limited. Based on this, the effect of nanofat grafting on patients with facial burn scars and hyperpigmentation was evaluated in this study, with a specific focus on the improvement of the scars, reduction of hyperpigmentation, patients' satisfaction and safety from the treatment [8].

OBJECTIVES

Primary Objective

To determine the outcome of nanofat grafting in patients with facial burn hyperpigmentation and scars.

Specific Objectives

1. To determine the efficacy of nanofat grafting in improving scar quality and reducing hyperpigmentation in patients with facial burns.
2. To evaluate patient satisfaction and subjective improvement in aesthetic appearance following nanofat grafting.
3. To investigate the safety profile of nanofat grafting in this specific patient population.

METHODOLOGY

Study Design and Setting

This descriptive study was done at the Department of Plastic Surgery, Lady Reading Hospital (LRH), Peshawar, Pakistan for six months following approval by the College of Physicians and Surgeons Pakistan (CPSP) and Institutional Review Board (IRB) of the hospital.

Sample Size and sampling technique

The sample size of 110 patients was determined using OpenEpi software based on an expected frequency of significant improvement in the quality of scar after nanofat grafting of 76%, a 95% confidence level and a margin of error of 8 percentage points [9]. A non-probability consecutive sampling technique was used for the selection of patients.

Study Participants

Patients diagnosed with facial scars and hyperpigmentation due to burns and aged between 15-70 years were screened for the eligibility. Patients with scarring and hyperpigmentation that were associated with the grafted post-burn facial skin defect and suffered from superficial, deep dermal or full-thickness burns due to flame, scald or contact burns were included in the study. Patients were only enrolled if they voluntarily wished to receive nanofat grafting and had provided informed consent in writing (medically stable).

The study excluded patients with active facial skin infection, pregnant women, nursing mothers, patients with severe coagulopathy or taking anticoagulants, and patients with known allergies to any component of the procedure, as well as patients with significant underlying medical conditions such as diabetes mellitus, hypertension, and cardiovascular disease, and those who had previously received nanofat grafts or other regenerative treatment for facial burn scars.

Data Collection Procedure

Patients attending Plastic Surgery outpatient department were approached for the study after obtaining ethical approval. The aim of the study, advantages, and possible adverse effects were outlined and informed written consent was received. Patients' data were kept confidential throughout the study.

Data collection was done on a structured proforma with basic demographic and clinical data. Information gathered encompassed age, gender, place of residence, educational level, occupation, socioeconomic status, contact information, chronic disease history, burn injury type, burn injury duration, and symptoms of scar including pain, itching, burning sensation, disfigurement, and contracture. The location, size, shape and type of scars were also recorded during the physical examination. Preoperative clinical photos were taken standardizing them with the patients' consent for later comparison.

Nanofat Grafting Procedure

All procedures were carried out under sterile conditions. Patients were placed in the supine position and lower abdomen or thighs were chosen as donor sites for fat harvesting. After skin preparation and draping, a tumescent solution (500 mL normal saline, 30 mL lidocaine 2%, and 1 mg adrenaline) was infiltrated into the donor area using a 2 mm cannula. Infiltration and vasoconstriction were allowed to occur for about 20 minutes before liposuction was carried out with a 3 mm cannula connected to a 20 mL syringe with a low-pressure "spokes-of-a-wheel" technique.

Harvested adipose tissue underwent repeated centrifugation to obtain a homogenous nanofat suspension by using a nanofilter or a three way connector system. The nanofat was then prepared and injected intradermally into the facial scar areas with a 1.2 mm blunt cannula, resulting in the formation of multiple small papule-like deposits around the scarred areas.

Outcome Assessment

The patients were monitored for 6 months post procedure. The treatment outcomes were measured by pre- and post-treatment clinical photographs and by comparing the changes in the scar characteristics using the Vancouver Scar Scale (VSS). The five-point ordinal scale was used to evaluate hyperpigmentation improvement from no improvement to complete resolution. The improvement of scar appearance and contour were also reported. The extent of satisfaction with the outcomes of treatment was assessed on a 10-point Visual Analog Scale (VAS) with higher scores representing higher satisfaction with the outcomes of treatment. On follow-up visits, any adverse events or complications of the procedure were documented.

Data Analysis

The data were coded and analysed using Statistical Package for Social Sciences (SPSS) version 25. The Shapiro–Wilk test was used to determine the normality of quantitative variables such as age, body mass index (BMI), Vancouver Scar Scale scores, and patient satisfaction scores. Means and standard deviations were used for normally distributed variables and medians and interquartile ranges (IQR) were used for non-normally distributed variables.

Categorical variables were summarised as frequencies and percentages including gender, place of residence, education level, occupation, socioeconomic status, burn characteristics, scar type and adverse outcomes. Paired t-test or Wilcoxon signed-rank test was used to compare pre- and post-treatment Vancouver Scar Scale scores as appropriate. Stratified analyses were conducted for age, gender and burn characteristics. To identify associations between categorical variables, the Chi-square test or Fisher's exact test was used. A p-value of ≤0.05 was considered statistically significant. Where applicable, results were provided in tables, figures and graphs.

RESULTS

The total number of patients that were included in the study were 110 patients with facial post-burn hyperpigmentation and scar. The mean age of the participants was 31.8 ± 11.6 years (range: 15–68 years). A majority of the participants was women (58.2%), urban population (61.8%) and flame burns (54.5%). The most frequent type of scar was hyper pigmented, followed by mixed scars with contour deformities.

The mean time from the burn injury to the nanofat grafting was 18.4 ± 9.7 months. The most common sites on the face were the cheeks and perioral region. Most of the patients were seen with hyper pigmentation with contour irregularities and poor pliability of the scars.

The scar characteristics improved greatly at the six-month follow-up. Before the nanofat grafting, the median Vancouver Scar Scale (VSS) score was 9 (IQR: 7–11) and after, it was 4 (IQR: 3–6). Pigmentation, vascularity, pliability and thickness of scar were improved.

As far as pigmentation results are concerned, 72.7% of patients had seen a significant or complete reduction in hyperpigmentation, and 5.5% had seen minimal or no improvement. Likewise, scar appearance was significantly enhanced, with 76.4% of patients reporting that they had seen significant improvement, or their scar-related aesthetic issues had gone away almost entirely.

The patient was very satisfied after the surgery. The mean satisfaction score was (VAS) 8.3 ± 1.4 out of 10. The majority of patients were pleased with the cosmetic benefit and feel more confident when interacting with others.

Nanofat grafting was well tolerated. A small number of patients (minor complications) had minor problems such as donor site discomfort, bruising, and edema that persisted for a short time. There was no significant event including infection, fat necrosis, allergic reactions, or any procedure-related hospitalization reported.

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants (n = 110)

Variable	Frequency (n)	Percentage (%)
Age Group (Years)		
15–25	32	29.1
26–35	29	26.4
36–45	25	22.7
>45	24	21.8
Gender		
Male	46	41.8
Female	64	58.2
Residence		
Urban	68	61.8
Rural	42	38.2
Type of Burn		
Flame Burn	60	54.5
Scald Burn	31	28.2
Contact Burn	19	17.3
Scar Type		
Hyperpigmented Scar	48	43.6
Atrophic Scar	21	19.1
Contour Deformity	12	10.9
Mixed Scar Pattern	29	26.4

Table 2: Comparison of Scar Characteristics Before and After Nanofat Grafting (n = 110)

Outcome Variable	Pre-treatment	Post-treatment	P-value
Vancouver Scar Scale Score, Median (IQR)	9 (7–11)	4 (3–6)	<0.001
Pigmentation Score	2.8 ± 0.9	1.4 ± 0.7	<0.001
Pliability Score	2.6 ± 0.8	1.2 ± 0.6	<0.001
Vascularity Score	2.1 ± 0.7	1.1 ± 0.5	<0.001
Height/Thickness Score	1.8 ± 0.6	0.9 ± 0.4	<0.001

Table 3: Treatment Outcomes and Patient Satisfaction Following Nanofat Grafting

Outcome Variable	Frequency (n)	Percentage (%)
Improvement in Hyperpigmentation		
No Improvement	2	1.8
Slight Improvement	10	9.1
Moderate Improvement	18	16.4
Significant Improvement	55	50.0
Complete Resolution	25	22.7
Improvement in Scar Appearance		
No Improvement	3	2.7
Slight Improvement	8	7.3

Moderate Improvement	15	13.6
Significant Improvement	58	52.7
Complete Resolution	26	23.7
Overall Patient Satisfaction		
Low (1–4)	7	6.4
Moderate (5–7)	29	26.4
High (8–10)	74	67.3
Complications		
None	101	91.8
Transient Edema	5	4.5
Bruising	3	2.7
Donor Site Pain	1	0.9

Figure 1: Distribution of Hyperpigmentation Improvement Following Nanofat Grafting

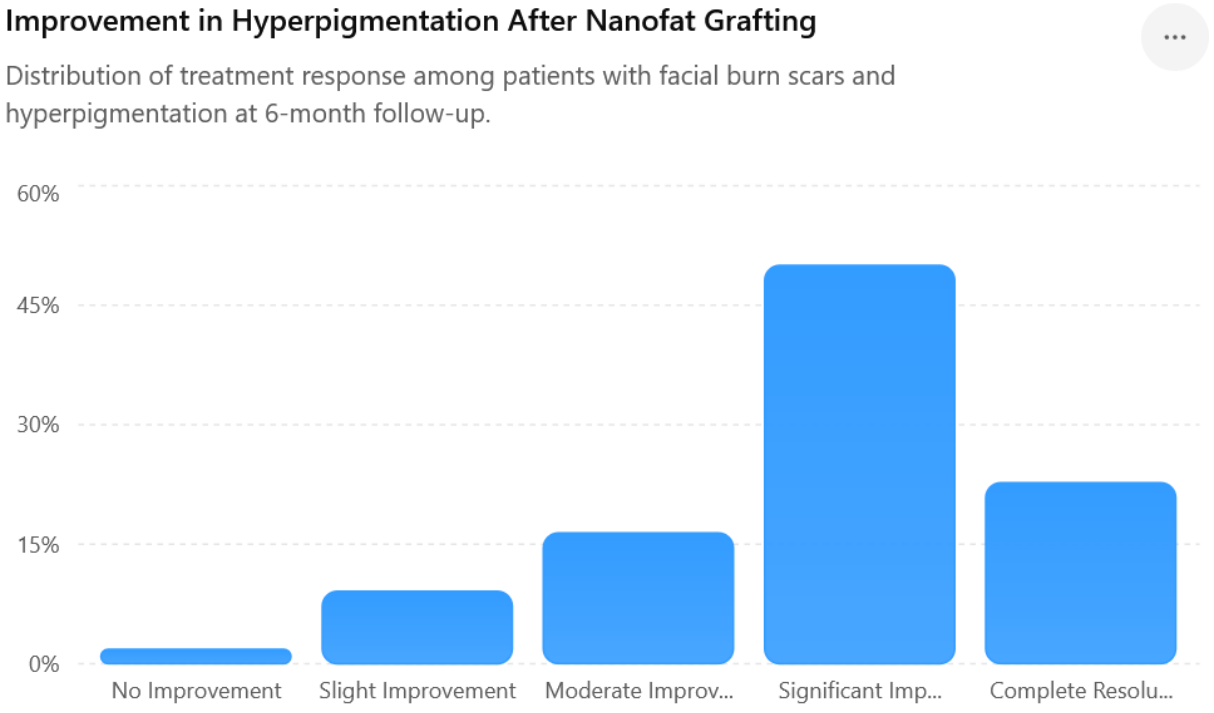


Figure 1 demonstrates that the majority of patients experienced significant improvement (50.0%) or complete resolution (22.7%) of facial burn-associated hyperpigmentation following nanofat grafting, highlighting the potential effectiveness of this regenerative treatment modality.

DISCUSSION

In the present study, the results of applying nanofat in patients with facial hyper pigmentation and scars were analyzed and it was found that there was a significant improvement in scar quality, hyper pigmentation, irregularities in contour and the satisfaction of the patients. Treatment resulted in a significant decrease in Vancouver Scar Scale (VSS) scores, which reflect the improvement in vascularity, pigmentation, pliability and thickness of the scar. In addition, a large majority of the patients reported that they were quite pleased with the procedure and that their cosmetic appearance was improved. The results corroborate the increasing body of evidence suggesting nanofat grafting is a promising approach for scar management and

pigmentary abnormalities in the post burn period of facial rejuvenation.

The current study showed that scarring severity was significantly decreased after the nanofat grafting, as determined by VSS scores. These results are consistent with other studies that have tested the rejuvenating effect of nanofat on post-burn scars. Investigators have showed that nanofat can help in scar remodeling by its adipose-derived stem cells as well as stromal vascular fraction, which leads to improvement in scar texture, elasticity and appearance [9,10]. These findings are consistent with our observations of the decreased severity of scars, and the applicability of nanofat to improve tissue regeneration and remodeling.

One of our results was noteworthy: hyperpigmentation improvement. Over two-thirds of the patients had marked improvement or total resolution of pigmentation abnormalities. This is consistent with previous clinical studies that suggest that nanofat grafting improves skin quality and dyschromia. The regenerative properties found in nanofat are thought to act on melanocytes, increase microcirculation and stimulate the regeneration of the dermis, resulting in a progressive normalization of pigmentation [11,12]. The results confirm the increasing body of evidence that nanofat grafting could potentially be especially beneficial in treating pigmentary issues that sometimes remain after treating scars with other methods.

The results of the scar contour and texture improvement that we found in our subjects also similar to the results reported in the literature. That nanofat grafting has the capacity to restore tissue pliability and correct contour deformities by collagen remodeling and neoangiogenesis has been shown in several studies. These biological effects not only enhance the appearance of the skin but also promote better skin health and function [13,14]. The patients with depressed and irregular scars exhibited a remarkable enhancement in contour, highlighting the potential of nanofat as an effective regenerative therapy for challenging post-burn facial deformities.

In aesthetic and reconstructive surgery, patient satisfaction is a crucial parameter to measure the success of the treatment. In this current study, the majority of the patients were satisfied with the treatment outcome with high satisfaction scores. Previously, patient satisfaction was found to be similar with study done on using nanofat for scar treatment and facial rejuvenation [15, 16]. The positive patient perception that we saw in our cohort was probably partly due to improved pigmentation, texture, contour and overall facial appearance. Facial scars can have a significant socio-emotional impact; as such, even relatively small improvements in their appearance can lead to a significantly improved sense of self and quality of life.

The safety profile found in this study is in line with those previously reported. Minor complications were experienced including transient swelling, bruising and discomfort at the donor site but no serious adverse events were reported. A previous study has also shown low complication rates in nanofat grafting, which is a minimally invasive technique and is a natural procedure [17,18]. Our research did not report any serious complications, which further reinforced the safety and feasibility of using nanofat grafting in the standard scar management procedure.

Adipose derived stem cells, growth factors, cytokines and the stromal vascular fraction components are believed to play a central role in the action of the regenerative potential of nanofat grafting. These cells and molecules initiate angiogenesis, ECM remodeling, collagen rearrangements, and tissue regeneration. Experimental and clinical evidence has shown that these mechanisms enable the skin to become more elastic, less scarring, better pigmentation, and better overall skin quality [19]. The positive findings we found in our study could be attributed to these known biological effects.

While standard treatments including laser therapy, silicone-based products, corticosteroid injections and surgical scar revision are still key aspects to the management of burn scars, many patients still have some cosmetic issues. Nanofat grafting is a truly innovative approach that treats several characteristics of scars all in one, like pigmentation, texture, pliability and contour abnormalities. Based on the findings of the present study, nanofat grafting could be a

beneficial complementary procedure in whole face burn scar rehabilitation [20] programs.

Limitations: There are a number of limitations to this study. The lack of a control group in the descriptive study design makes it difficult to draw causal inferences about the improvements that were observed due to nanofat grafting. Secondly, the study was undertaken in one centre and the results might not be applicable to other centres. Third, the follow-up, in the form of outcomes assessment, was relatively short, at six months; it is not possible to measure long-term treatment durability. Fourthly, subjective measures as patient satisfaction and photographic assessment could be affected by observer and patient-related biases. Lastly, objective instrumental pigmentation and scar quality assessments were not used. In order to better validate the efficacy and safety of nanofat grafting on facial burns hyperpigmentation and scars, further studies with larger sample sizes, extended follow-up periods, control groups, and objective assessment methods are recommended in the future, and multicenter studies are encouraged.

CONCLUSION

Nanofat grafting seems to be a safe and effective treatment option in patients with facial burn hyper pigmentation and scars. The operation was correlated with substantial improvement in scar appearance, pigmentation, contour irregularities and overall aesthetic appearance leading to high satisfaction level and minimal complications. Considering its regenerative properties and good safety profile, nanofat grafting could be a valuable addition in the treatment of post-burn facial scars. Larger controlled studies with longer follow-up are warranted to obtain long term efficacy and fine tune treatment protocols.

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