ORIGINAL ARTICLE

# IMPACT OF ADJUVANT FAT GRAFTING ON IMPROVED UPTAKE AND HEALING OF SPLIT THICKNESS SKIN GRAFT AT TERTIARY CARE HOSPITAL

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**Background:** Since the 1980s, autologous fat grafting has been one of the most widely used methods in plastic surgery to treat volume and contour problems. There are many advantages of autologous fat, i.e., it is cheap, biocompatible, and readily available autologous tissue in large quantities, minimal morbidity. Objective was to compare the outcomes of fat grafting combined with STSGs and STSGs alone in patients with chronic non-healing wounds presenting at a tertiary care hospital. **Methods:** It was a prospective cohort study carried out at the Department of plastic surgery, Civil hospital Karachi, Pakistan from 11th April to 12th October 2023. Patients aged 18–60 years with chronic non-healing wounds due to burn, trauma, or infection lasting at least six weeks were included. Group A received fat grafting followed by STSGs, while Group B received STSGs alone. Follow-up for both groups continued for 4–5 weeks, focusing on graft uptake and healing, with successful graft take defined as wound healing upon clinical examination. Data was analyzed by SPSS version 25. **Results:** Overall, the mean age of the patients was 36.47±8.57 years. In Group A, the median width was 8.00 cm, and in Group B, it was 7.00 cm, this difference was statistically significant ($p$=0.005). The proportion of healing in group A was significantly higher as compared to group B (66.7% vs 30%, ($p$=0.001). The odds of wound healing were 0.21 times lower in group B as compared to group A (95% CI=0.07 to 0.63). After adjusting for duration and width of wound, the odds of wound healing in group B remains significantly lower as compared to odds of wound healing in group A (OR=0.13, 95% CI=0.03 to 0.54). **Conclusion:** The combination of fat grafting with split-thickness skin grafts holds promising result for improved wound healing in patients with chronic non-healing wounds.

**Keywords:** Non-healing wounds; Burn; Trauma; Infection; Fat grafting; Split-thickness skin grafts

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## INTRODUCTION

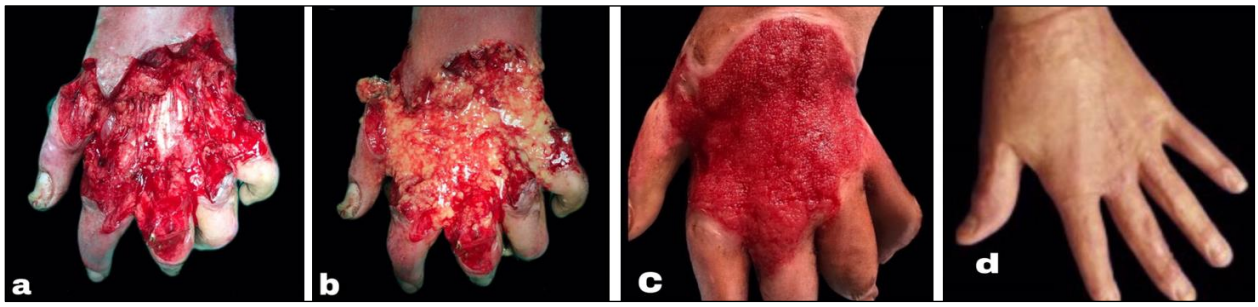
Since the 1980s, autologous fat grafting has been one of the most widely used methods in plastic surgery to treat volume and contour problems.[1,2] There are many advantages of autologous fat, i.e., it is cheap, biocompatible, and readily available autologous tissue in large quantities, minimal morbidity.[3] Various research studies have revealed that use of fat grafting as an adjuvant therapy has favourable outcomes in radiation damage, hand contractures, facial contouring, breast reconstruction and augmentation, burn wounds, diabetic foot ulcers, arterial ulcers, pressure ulcers, burn reconstruction, rejuvenation, chronic wounds and congenital deformities.[4–13] Split-thickness skin grafts (STSGs) are a common procedure for healing burn, traumatic, and chronic wounds which have good granulation tissue. It is a crucial component of the reconstructive ladder, has an epidermis with varying dermal thicknesses, and provides benefits beyond just wound coverage.[14] Their utilization is popular since they are generally simple and expedient, if clean and vascularized donor tissue and recipient sites are available.[15] Literature has also shown STSGs are effective approach in reconstruction of lower limb, but in other body parts, they have higher complication and failure rates.[16]

It is very crucial to identify the efficacious method for the optimal take of grafted skin. For the survival the grafted skin has to go through three steps i.e. serum imbibition, revascularization, and maturation.[17,18] Wherein, revascularization is the most critical step and is highly affected by external determinants. The determinants of skin-graft take, consist of the coverage technique, graft thickness, and the soft tissue bed. The common reasons of loss of skin graft are formation of hematoma under the graft, shear forces of the interface and infection of the grafted skin. A second surgery is required if the grafted skin is lost to provide wound coverage.[17] Split-thickness skin grafts are a common procedure for healing various types of wounds, but their success rate varies depending on the location and the condition of the wound. Therefore, identifying effective methods to improve the uptake and healing of skin grafts is crucial to improve patient outcomes. Secondly, previous studies have shown that adjuvant fat grafting has favourable outcomes in various reconstructive procedures, including burn reconstruction and chronic wounds. However, there is limited data

available on the efficacy of fat grafting when combined with split-thickness skin grafts. Therefore, our aim is to compare the outcomes of fat grafting combined with STSGs and STSGs alone in patients with chronic non-healing wounds presenting at a tertiary care hospital. The proposed study will fill the gap in knowledge and provide insights into the effectiveness of combining these two procedures. This study will also help to improve the standard of care for patients with chronic non-healing wounds.

## MATERIAL AND METHODS

It was a prospective cohort study carried out at the Department of plastic surgery, Dow University of Health Sciences, Civil hospital Karachi, Pakistan from 11$^{th}$April to 12$^{th}$ October 2023. Using the statistics of wound size as 35-40 cm$^2$ as 0% in fat graft group on 4–5weeks and 20% in controls[4], power of test as 80% and 95% confidence level, the estimated sample size came out as 27≈30 in each group. Sample size was calculated using WHO sample size calculator. Patients of age 18–60 years of either gender with chronic non-healing wounds i.e. a wound due to burn, trauma or infection with at least duration of six weeks were included. Patients on chemotherapy, on immunosuppressive drugs like steroids, patients with bleeding disorders were excluded from study. Non-probability consecutive sampling technique was employed for sample selection. Approval of the research was obtained from ethical review committee of Dow University of Health Sciences, Civil hospital Karachi, Pakistan. Informed consent was obtained from all the eligible participants. Patients and their wound were assessed clinically and optimization of wound was done if needed through debridement or dressings. Data regarding age, gender, location of wound, duration of wound, and uncontrolled diabetes were obtained. Patients were divided into two groups. In group A, patients were treated with fat grafting combined with STSGs, in group B, patients were treated with STSGs only. All patients were treated by same surgical team. Non-healing wounds were undergoing various rounds of debridement prior to operation, necrotic tissue were removed under sterile conditions. The timing of STSG depended on the optimization of wound bed. In group A: fat grafting was performed in first session and after one week in next session STSGs was done. Autologous Fat tissue was harvested using sterile technique. Fat was injected over the wound and dressing was done. Three cases are displayed below:




**Case 1: 30-year female with wound after debridement of burned skin showing exposed soft tissue over dorsum of hand(b)showing autologous fat graft done on wound (c) showing healthy granulation bed at 1 week (d) completely healed Split thickness skin graft with good skin contour at follow-up**


**Case 2: A 25 year male with wound after burn scar release showing exposed soft tissue over dorsum of hand (b) wound after 5 days of Autologous fat grafting with healthy granulation bed over the wound (c) healed split thickness skin graft with good skin contour at 5 weeks follow-up**


**Case 3: 12x6.5 wound distal leg and foot over lateral malleus with bone exposed(b)showing wound with granulation bed covering bone after 1week of autologous fat grafting(c) after 1 week STSG applied, showing completely healed skin graft with better contour after 4 weeks follow-up.**

Patients in both groups were followed for 4–5 weeks and observed for the graft uptake and healing. Optimal graft take was concluded as wound healing assessed on clinical examination. All data were gathered on predesigned proforma by researcher herself.

Data was analyzed by SPSS version 25. Mean and SD were computed for age and duration of wound. Frequency and percentage were computed for gender, location of wound, size of wound, uncontrolled diabetes and healing. Comparison between both groups for healing was done using Chi-square or Fischer exact test. Data was stratified with respect to age, gender, duration of wound, size of wound, and uncontrolled diabetes. Post-stratification, Chi-square or Fischer exact test was be applied. Level of significance was considered as 5%.

## RESULTS

Overall, the mean age of the patients was 36.47±8.57 years. The gender distribution among the patients revealed that 53.3% were females, while 46.7% were males. The median duration of wounds was 6 weeks, with an interquartile range of 4–6 weeks, indicating that most patients presented with chronic wounds. Among the causes of non-healing wounds, trauma was the most frequent, accounting for 56.7% of cases, followed by third-degree burns (23.3%) and infection (20%). Notably, the distal leg was the most common location for these wounds (61.7%). Only 9 patients had uncontrolled diabetes (15%). A comparison between two groups, Group A and Group B, showed a statistically significant difference in the duration of wounds (*p*-value=0.001), indicating a variation between these groups. Moreover, Table 1 provides a detailed breakdown of the baseline characteristics of the study samples in both Group A and Group B.

In Group A, the median width was 8.00 cm, and in Group B, it was 7.00 cm. A statistically significant difference was observed in wound width between the two groups, with a p-value of 0.005. However, the difference in wound length between groups was statistically insignificant (*p*=0.288). (Table 2)

The proportion of healing in group A was significantly higher as compared to group B (66.7% vs 30%, p=0.001). The odds of wound healing were 0.21 times lower in group B as compared to group A (95% CI=0.07 to 0.63). (Figure 1)

In multivariate logistic regression model, the odds of wound healing in group B remains significantly lower as compared to odds of wound healing in group A (OR=0.13, 95% CI=0.03 to 0.54) even after adjusting the model for duration and width of wound. (Table 3)

**Table-1: Baseline characteristics of study samples in both groups (n=60)**

| **Characteristics** | **Overall (n=60)** | **Group A (n=30)** | **Group B (n=30)** | ***p*-value** |
|---|---|---|---|---|
| **Age (years)** | 36.47±8.57 | 36.97±8.80 | 35.97±8.43 | 0.655 |
| **Gender** | | | | |
| Male | 28 (46.7) | 16 (53.3) | 12 (40) | |
| Female | 32 (53.3) | 14 (46.7) | 18 (60) | 0.301 |
| **Duration of wounds (weeks)** | 6 (4-6) | 4.50 (3.75-6.00) | 6 (5.75-6.25) | 0.001* |
| **Cause** | | | | |
| Infection | 12 (20) | 7 (23.3) | 5 (16.7) | |
| Third degree burn | 14 (23.3) | 7 (23.3) | 7 (23.3) | |
| Trauma | 34 (56.7) | 16 (53.4) | 18 (60) | 0.798 |
| **Location** | | | | |
| Distal leg | 37 (61.7) | 17 (56.7) | 20 (66.7) | |
| Dorsum forearm | 11 (18.3) | 5 (16.7) | 6 (20) | |
| Dorsum of hand | 9 (15) | 5 (16.7) | 4 (13.3) | |
| Foot dorsum | 1 (1.7) | 1 (3.3) | 0 | |
| Rolar surface of forearm | 1 (1.7) | 1 (3.3) | 0 | |
| Volar forearm | 1 (1.7) | 1 (3.3) | 0 | 0.632 |
| **Uncontrolled diabetes** | | | | |
| Yes | 9 (15) | 7 (23.3) | 2 (6.7) | |
| No | 51 (85) | 23 (76.7) | 28 (93.3) | 0.145 |
| Data presented as mean± SD or median (IQR) or n (%). *Significant at 5% level of significance | | | | |

**Table-2: Comparison of wound length and width between both groups (n=60)**

| Characteristics | Overall | Group A | Group B | p-value |
|---|---|---|---|---|
| Wound length (cm) | 16.97±4.24 | 15.80±4.18 | 16.97±4.24 | 0.288 |
| Wound width (cm) | 7.75 (7.00-9.00) | 8.00 (7.00-9.50) | 7.00 (6.50-8.00) | 0.005* |
| Data presented as mean± SD or median (IQR). *Significant at 5% level of significance | | | | |

**Table 3: Multivariate logistic regression model for wound healing (n=60)**

| | *p*-value | OR (95% CI) |
|---|---|---|
| Duration of wound | 0.999 | 1.00 (0.64–1.57) |
| Width | 0.061 | 0.70 (0.48–1.01) |
| Group(B) | 0.004 | 0.13 (0.03–0.54) |

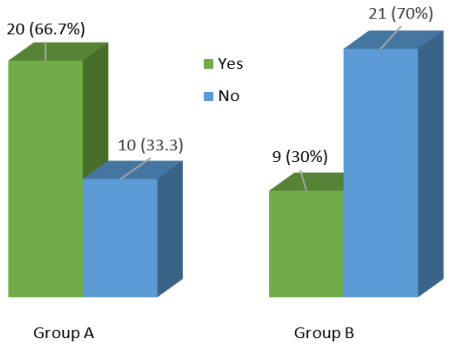



**Figure 1: Comparison of wound healing between both groups (n=60)**

## DISCUSSION

STSG is one of the most utilized techniques for skin loss because of several reasons.[15] Non-healing wounds due to trauma, infection and injury are considered as some of the common reasons.[19] In the recent decades, fat grafting has gained increasing popularity in contouring procedures. However, more recently, there has been a growing focus on its regenerative potential.[20] Literature showed that adipose-derived stem cells or MSCs, which are found in fat, play a role in facilitating healing by differentiating into various cell types that are involved in wound healing, such as fibroblasts and keratinocytes. Additionally, these cells release growth factors that promote healing and anti-inflammatory cytokines. Furthermore, they produce healing-related peptides, including leptin and adiponectin, which, when combined, can potentially enhance the wound healing process.[21–23] Some small-scale studies have indicated that autologous fat grafting may exhibit significant healing properties in cases of chronically scarred tissue after radiotherapy, chronic wounds, arterial ulcers, pressure ulcers, and diabetic foot ulcers.[5,7,8,22] Nevertheless, it's important to note that the available evidence is limited, and there have been no reported comparative study on this topic. Therefore, the current study aimed to compare the outcomes of fat grafting combined with STSGs and STSGs alone for non-healing wounds. In the current study, we found significant differences in the duration of wound healing and width of wounds, with group A having shorter duration ($p$=0.001) and narrower wounds ($p$=0.005) as compared to group B. Moreover, the healing was significantly higher in group A as compared to group B ($p$=0.001), indicating a clear benefit of adding fat grafting to the STSG procedure. Even after adjusting for the duration of wound healing and width of wounds, the odds of wound healing in Group B remained significantly lower than in Group A. Previous studies also revealed that fat grafting may improve healing outcomes.[5,7,8,22,24,25] These results suggest that combining fat grafting with STSGs can lead to improved wound healing outcomes, particularly in patients with non-healing wounds of extended duration and larger wound size. This approach may prove valuable in addressing a wide range of clinical scenarios, potentially reducing the need for repeated surgeries and improving patient outcomes.

This study's strengths lie in its prospective cohort design, ensuring real-time, clinically relevant data collection, along with robust ethical and sample size considerations. However, the study's limitations include its single-center focus and potential selection bias. The short follow-up duration and specific patient population studied also restrict the generalizability of findings. Nevertheless, the study's implications are significant, suggesting that combining fat grafting with STSGs can notably improve wound healing in patients with longer-duration, larger non-healing wounds, potentially impacting clinical practice, patient care, medical education, future research, and health policy considerations.

## CONCLUSION

The combination of fat grafting with split-thickness skin grafts holds promising result for improving wound healing in patients with chronic non-healing wounds.

## AUTHORS' CONTRIBUTION

SAB: Literature search, conceptualization of the study design. SAB, MN, SK, RF: Data collection. SAB, WS: Data analysis, data interpretation, write-up. SB, WS: Proof reading.

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