

A Study Evaluating the Uptake of Split-Thickness Skin Grafts in Relation to the Initial Postoperative Dressing Applied on Day Third Versus Day Fifth

Abhishek Sharma*

¹ Faculty Medical Superintendent, Senior Consultant, Head, and Director of the Department of Plastic and Cosmetic Surgery, All Is Well Multi-speciality Hospital, Burhanpur, (450331) Madhya Pradesh, India

Corresponding Author: Abhishek Sharma, Faculty Medical Superintendent, Senior Consultant, Head, and Director of the Department of Plastic and Cosmetic Surgery, All Is Well Multi-speciality Hospital, Burhanpur, (450331) Madhya Pradesh, India.

Abstract

Skin grafting is a technique used to restore the continuity of the skin. The primary reasons for the failure of skin grafts include seroma, haematoma, or infection. These issues hinder the adherence of the graft and its revascularization, leading to a higher likelihood of graft rejection, especially in the early postoperative phase. Aim: The goal of the study was to analyse graft acceptance, rejection resulting from infection or seroma, and the timing of the first postoperative dressing on day third compared to day fifth. A comparative and prospective study was carried out at our institution from November 2021 to April 2024, involving 200 patients who received split-thickness skin grafting (STSG) and were divided into two groups. In Group A, the initial postoperative dressing was applied on day 3, while for Group B, it was done on day 5. The second postoperative dressing took place two days after the first. The grafted area was evaluated for the percentage of graft uptake, incidence of seroma, rejection, and infection, both through clinical observation and culture sensitivity testing. Findings revealed that the average graft uptake in group A was 88.5%, compared to 81.93% in group B during the first dressing, while during the second dressing, group A showed 88.24% and group B showed 78.03%, with the data being statistically significant, indicating a lower rate of rejection and infection in group A. Seroma occurred in 82.01% of cases in group A and 74.02% in group B during the first postoperative dressing, decreasing to 6.0% and 12.0%, respectively, by the second dressing. Performing the first postoperative dressing on third day after skin grafting significantly enhances the final graft uptake and decreases the rejection rate by minimizing both seroma and infection.

Keywords: Split-thickness skin graft (STSG) • Graft uptake • Graft failure • Initial postoperative dressing

Introduction

Due to its extensive surface area, the skin is considered the body's largest organ. It interacts directly with the external environment, and its mechanical and biological functions help protect the body and maintain its delicate homeostasis.[1] Skin grafting provides surgeons with a technique for restoring the continuity of the skin. In addressing wound healing challenges, it offers benefits such as shorter healing times and reduced hospital stays, along with minimal complications at the donor site. This method is effective for

treating large ulcers of various causes. Consequently, it ranks among the most frequently performed surgical procedures. Split-thickness skin grafts are obtained by excising the entire epidermis along with a portion of the dermis, allowing the remaining dermis to heal at the donor site.[2] After a skin graft is placed, its survival depends on a series of processes that lead to vascular independence. These processes include initial serum imbibition occurring within the first 24 to 48 hours, followed by inosculation in the subsequent 48 to 72 hours, and angiogenesis, which commences after 72 hours. Factors that disrupt this process, such as mechanical shear forces, can negatively impact the uptake of the graft and lead to fluid accumulation beneath it.[3] A surgical dressing is applied to the grafted or recipient site during the postoperative phase to promote healing and enhance uptake. Epithelialisation occurs from the graft dressings as well as from the wound and granulation tissue itself.[4] Numerous studies have explored the factors that contribute to the uptake of split-thickness skin grafts. The most frequent causes of skin graft failure include seroma, hematoma, movement (shear), and infections at the recipient site. During the initial postoperative period, these factors most significantly affect graft uptake by hindering its adherence to the wound bed and subsequent revascularisation. Dressing stabilises the graft by maintaining a moist, sterile environment that protects against shear forces and prevents fluid build-up beneath the graft. The success of a graft is primarily determined by how quickly and effectively vascular perfusion is restored between the donor and recipient tissues. Consequently, surgical dressing plays a crucial role in ensuring a successful graft take in the postoperative phase.[5] Haematoma and seroma beneath the graft in the early postoperative period of 1 to 3 days can impair adherence and hinder revascularisation, thus affecting graft take. The postoperative dressing is generally kept in place for 5 to 7 days before it is removed, during which time the graft is examined and reapplied if necessary. Therefore, inspections during this initial dressing period can help evacuate seroma and hematoma, allowing for reapplication of the graft if it has shifted, subsequently improving revascularisation and graft survival rates. The risk of infection can also be monitored, and timely intervention can be initiated if the graft is inspected promptly. [6] There is a lack of studies focusing on this matter, particularly regarding the influence of the first postoperative dressing on graft uptake and survival, with few studies suggesting the timing for the initial dressing. Thus, our study aims to assess the relevance of the graft uptake effect from the postoperative check dressing performed on the 3rd and 5th days following surgery, along with the early and late complications related to grafting in patients undergoing split-thickness skin grafting.

Aims and objectives: The goals and objectives of this research were to assess the following regarding the dressings applied for split-thickness skin grafting on the first postoperative day, as well as on days third and fifth. These included the rates of seroma or haematoma development, graft uptake, incidence of infection, and instances of graft rejection.

Methods

This research was a forward-looking, comparative investigation carried out in the plastic surgery department of our institution between November 2021 and April 2024, following the approval of the ethical board. The study involved 200 patients who were receiving split-thickness skin grafts for different underlying causes, all of whom satisfied the established inclusion and exclusion criteria.

Inclusion criteria

In this study, participants of both genders aged over 18 and under 70 years were selected; individuals receiving split-thickness skin grafts to address raw surfaces or ulcers were included; and patients whose pre-surgery wound culture sensitivity tests indicated no growth were part of the study.

Exclusion criteria

Patients who were being grafted for a second time or re-grafting, those with exposed tendons, active infections, visible bones, multiple ulcers, or multiple treatment sites were not included in this study. A thorough physical examination, history collection, preoperative tests, and evaluation and management of coexisting conditions were performed on the patients. The specific preoperative tests included blood tests, serum albumin levels, and wound culture swabs taken during the first postoperative dressing.

Following assessment, standard preoperative wound care was provided; the patients received split-thickness skin grafting until there was healthy granulation tissue and a negative culture swab result. Reporting adhered to STROBE guidelines [7].

Procedure

The recipient site was prepared with rigorous aseptic techniques. After administering appropriate anaesthesia, a split-thickness graft was excised from the thigh using Watson's modified Humby's knife, then tailored, meshed, and applied to the freshly prepared ulcer bed. The graft was secured in place with a skin stapler. Once the graft was positioned, efforts were made to eliminate any accumulation of blood or serum. The grafted area was then covered with sterile, antibiotic-impregnated tulle, followed by the application of sterile dressings and pressure bandages. The donor site was dressed. If the graft was situated near the joints, the limb was immobilised with a POP slab, and antibiotic-impregnated tulle along with pressure bandages were used. Routine postoperative care was implemented.

Postoperative care

Patients were classified into two categories, group A and group B, based on the initial dressing applied, with group A receiving it on day third and group B on day fifth. The grafted area was evaluated for graft uptake percentage by measuring the graft's surface area, checking for seroma presence, noting the colour, assessing graft adherence, slough, and signs of rejection. The percentage of graft uptake was determined using the following formula:

$$\text{Percentage of graft uptake} = \frac{\text{area of graft uptake}}{\text{total area of graft}} \times 100$$

The percentage of graft rejection and acceptance was assessed based on the total area of the graft. The dimensions of the graft that appeared stable were outlined and recorded on graph paper.[8] Any sloughs present were removed, and the seroma was drained in a sterile environment, with samples sent for culture and sensitivity analysis. The grafted area was subsequently covered with sterile, antibiotic-impregnated tulle and dressing. The second dressing was applied on day 5 for group A and on day 7 for group B, with observations noted. The percentages of graft rejection and uptake were calculated during both the first and second postoperative dressings for each group. After discharge, the patients were monitored during follow-up.

Data entry and analysis

The analysis of data entry was conducted using Microsoft Excel and the SPSS (Statistical Package for the Social Sciences) software (version 20). [9] Categorical variables, including group (A and B), slough formation, and infection seroma formation, were reported as proportions. Continuous variables and categorical variables were presented as mean (SD) and count, respectively. The relationship between continuous variables and the groups (A and B) was evaluated using the Mann-Whitney U test and the unpaired T test, depending on the normality of the continuous variables' distribution. The Chi-square test, or Fisher's exact test, was applied to analyse the association between the categorical variables based on the cell values. A value of $p < 0.05$ was considered statistically significant.[10]

Sample size

The minimum sample size needed was 200 patients. These 200 participants were necessary to achieve an 80% probability of identifying a significant relative precision level (5%). In our study, the power was maintained at 80% with a confidence interval of 95%. Our research included a total sample size of 200 participants.

Results

Our study group consisted of 74% (n = 74) males and 26% (n = 26) females, with group A having 86% (n = 86) males and 14% (n = 14) females. The average age in group A was 43.7 years, while in group B it was 42.9 years. In this study, 22% of the participants had diabetes, and trauma was identified as the most common cause of the raw area, accounting for 57%. The demographic information of our study is displayed in Table 1.

Table 1. Demographic data of our study population

Factors	Group A (N%)	Group B (N%)	Total (N%)
Sex			
Male	74(74)	86(86)	160(80)
Female	26 (26)	14(14)	40 (20)
Cause of ulcer			
Traumatic	66 (66)	48 (48)	114 (57)
Post-infective/debridement raw area	16(16)	30(30)	46(23)
Others	18 (18)	22 (22)	40 (20)
Co-morbidities			
Absent	72 (72)	74 (74)	146 (73)
Diabetes alone	22(22)	22(22)	44(22)
Others (hypertension, venous disease, arterial disease)	6 (6)	4(4)	10 (5)
Recipient sites			
Upper limb	16 (16)	12 (12)	28 (14)
Lower limb	68(68)	66(66)	134 (67)
Other	16 (16)	22 (22)	38(19)

Table 2. The graft uptake values on the first dressing day of the participants in groups A and B.

Variables	Day 3, group A	Day 5, group B	P Value
POD 1 percentage of graft uptake	88.50 (+/- 11.17)	81.93 (+/13.36)	0.02

Table 3. Second dressing day graft uptake values of the participants in group A and group B.

Variables	Day 3	Day 5	P Value
POD 2 percentage of graft uptake	88.24(+/-16.61)	78.03(+/14.04)	0.00

Table 4. Formation of seroma on the first dressing day among the participants in groups A and B.

POD 1 seroma	Day 3 N (%)	Day 5 N (%)	Total	P Value
--------------	-------------	-------------	-------	---------

Absent	18 (18)		44 (22)	
Present	82 (82)		156 (78)	0.335
Total	100 (100)		200(100)	

Table 5. Formation of seroma on the second dressing day among the participants in groups A and B.

POD 2 Seroma	Group A Day 3 N (%)	Group B Day 5 N (%)	Total	P value
Absent	94 (94)	88 (88)	182 (91)	0.296
Present	6 (6)	12 (12)	18 (9)	
Total	100 (100)	100 (100)	200(100)	

Table 6. Comparison of infection rate in group A and group B postoperatively, through positive culture/sensitivity of the graft site.

Groups	Post operative infection rate according to culture and sensitivity N (%)	Clinical evidence of infection (slough) N (%)
A	46 (45)	16 (15)
B	50(50)	20(20)

Table 7. Rejection of graft values in groups A and B on the first postoperative dressing

Variables	Day 3 group A (%)	Day 5, group B (%)	P value independent
POD 1: percentage of graft rejection	5.87	11.25	0.02

Table 8. Rejection of graft values in groups A and B following the second postoperative dressing.

Variables	Day 3 (%)	Day 5 (%)	P-value independent test
POD 2 percentage of graft rejection	11.87	21.99	0.00

Table 9. Uptake of graft in relation to the first and second postoperative dressings done on the 3rd and 5th days, comparing data from different studies.

Name of the study	First postoperative day done following skin grafting	Mean graft uptake (%)
Ünal S et al. [11]	5 th POD	60.46

Younes et al. [12]	3 rd POD	95.63
Maher [13]	3 rd POD	83.35
Rituraj [14]	5 th POD	85.90
Our study	3 rd POD/5 th POD	88.24/78.03

Table 10. Effect of postoperative dressing on graft uptake in relation to local factors.

Groups	Post-operative dressing	Local factors	Local factors	Final percentage of graft uptake
		Seroma N(%)	Infection N(%)	
A	First	82 (82)	46 (45)	88.24
B	First	74(74)	50(50)	78.03



Fig.1. Uptake of skin graft in a group A patient.



Fig. 2. Uptake of a skin graft in a group B patient.

The average graft uptake for the initial dressing on POD 1 in group A was 88.48%, compared to 82.62% in group B. A significant relationship was found between the first dressing day and graft uptake in the two groups ($p < 0.05$), as detailed in Table 2. The average graft uptake for the second dressing on POD 2 in group A was 88.14%, while in group B, it was 78.02%. There was a significant correlation between the groups and the final graft uptake ($p < 0.01$), as presented in (Table 3).

In group A, 82% of the participants experienced seroma, whereas 74% in group B had seroma during the first postoperative dressing. This did not show statistical significance (Table 4). In group A, 5% of patients had seroma on POD 2, while in group B, the rate was 7%. This also lacked statistical significance (Table 5).

Upon further comparison of infection rates through clinical evidence of infection and positive culture/sensitivity at the graft site in groups A and B postoperatively, it was found that group A had 45% of cases with positive wound culture results, the most common

organism being *E. coli*, while only 15% exhibited clinical signs of infection. In group B, 50% of cases were reported. *Staphylococcus aureus* was the most frequently isolated organism in the wound culture results for this group, with only 20% showing clinical evidence of infection (Table 6).

For the first dressing, the mean graft rejection rate was recorded as 5.86% in group A and 11.24% in group B. A significant relationship was identified between the first dressing day and graft uptake ($p < 0.05$) (Table 7). In the second dressing assessment, the mean graft rejection rate for group A was 11.86%, while group B reported 21.98%, indicating a significant association between the second dressing day and graft outcomes ($p < 0.01$) (Table 8).

Discussion

In addition to applying the graft technique, effective postoperative management was equally critical to the successful vascular integration of the graft. Various other factors negatively affected the absorption of the skin graft. The most frequent reasons for graft failure included seroma formation, shearing forces, and infections. Nevertheless, conducting an early examination and changing the first dressing during the immediate postoperative phase can assist in draining haematomas and seromas, allowing for the reapplication of the graft if it becomes compromised, which enhances revascularisation and the chance of graft survival.

The postoperative dressing is generally kept in place for a period of 5 to 7 days before it is removed. Converse et al. noted that the serum beneath a free skin graft nourishes it during the initial two days, after which revascularisation begins to grow into it. Consequently, it is essential to promptly drain any haematomas, clots, or seromas that form under the graft. If this intervention is performed within the first 24 hours, there is a 100% chance of salvaging the graft. It is recommended to carry out this procedure the following day or within two days, depending on the state of the graft during the first dressing assessment. [6]

Research examining the impact of the initial postoperative dressing on the uptake of grafts has been limited. Our study reviewed 200 patients who received split-thickness skin grafts for ulcers of various origins to gather insights and understanding regarding graft uptake and its relationship with postoperative dressings.

Graft Uptake

On the first day after the operation, the graft uptake in group A varied between 70% and 98%, averaging at 88.48%, while in group B, it ranged from 50% to 95%, with a mean of 82.2%. The average graft uptake was notably higher in group A compared to group B, which was statistically significant with a p-value of 0.02.

For the second postoperative day, group A showed graft uptake between 80% and 100%, with a mean of 88.14%, whereas group B had a range from 3% to 94%, averaging at 78.02%, and this difference was statistically significant with a p-value of < 0.001 .

Therefore, we concluded that patients who received early postoperative dressing demonstrated significantly better graft uptake. Various studies were reviewed, highlighting graft uptake concerning the first and second postoperative dressings performed on the 3rd and 5th days (refer to Table 9).

In a study conducted by Ünal S et al. from 2003 to 2005, after split-thickness skin grafting, the wounds were evaluated at the end of the 5th postoperative day. They found a mean graft uptake of 60.46 ± 19.34 in the cohort that received traditional moist wound dressings [11].

A study by Younes et al. in 2006, published at the University of Jordan, stated that the first dressing change after split-thickness skin grafting was conducted on the 3rd postoperative day. The graft was considered successfully taken when the grafted skin was

fully attached, and epithelization was evident at the edges. Of the sixteen patients, twelve achieved a 100% graft take, three had a 90% take, and one had a 60% take, resulting in a mean uptake of 95.62%. Nearly complete graft take (90% or higher) was observed in 90% of the cases after a preparation period ranging from 2 to 8 weeks [12].

In our investigation, the mean graft uptake on the 3rd day was 88.14%, while the group that had their dressing changed on the 5th day saw an uptake of 78.02%, with statistically significant results that aligned with the aforementioned studies.

Local factors and percentage of graft uptake

In this research, it was observed that the rates of infection and seroma development were lower in group A when compared to group B, due to significantly improved graft uptake in group A (Table 10).

McGrath et al. indicated that haematoma formation beneath the graft was the most common reason for skin graft failure, with the blood clot acting as an obstacle to the necessary contact between the graft and the bed for revascularisation. [3]

Another frequent issue that hindered revascularisation and led to graft loss was the shearing or movement of the graft on the bed. Reflecting on these studies, our findings also indicated the presence of seromas in both groups. It was observed that the evacuation of seromas in group A enhanced the final graft uptake, reduced the rejection rate, and resulted in comparatively better outcomes. Timely evacuation of seromas or any infection focus, along with appropriate treatment addressing local factors, led to improved results. It was noted that confounding factors in this study included the varying patient profiles, such as multiple comorbidities that affected graft uptake, including nutritional status, diabetes, and the differing vascularity of recipient sites.

Conclusion

In this research, the author observed that performing an early postoperative dressing on the third day after a split-thickness skin graft (STSG) helped to clear any excess seroma or haematoma that might have formed, thereby significantly enhancing the likelihood of the graft being successfully absorbed. The findings of this study suggested that the effectiveness of skin grafting is reliant on how quickly and thoroughly the blood flow is restored to the tissue receiving the graft. By promptly evacuating haematomas, seromas, or infections when present, vascular perfusion is re-established, allowing for the potential preservation of grafts and improved graft absorption.

Statement and declarations

Ethical approval: The study was approved by the Institutional Ethics Committee.

Funding: No funding sources

Conflict of interest: None to be declared

References

1. Gibson T, Rudolph R, Ballantyne D. *Physical properties of skin and skin grafts. McCarty Phys Propert.* 1990;1(1):207-75.
2. Shenaq SM, Bienstock A, Kim JYS. *Plastic and reconstructive surgery. Schwartz's principles of surgery. 8th ed. New York: 2005: 1792.*
3. McGrath MH, Pomerantz J. *Plastic surgery. Sabiston textbook of surgery. 19th ed. Philadelphia: Elsevier Saunders; 2012: 1917. .*
4. Herskovitz I, Hughes OB, Macquhae F, Rakosi A, Kirsner R. *Epidermal skin grafting. Int Wound J.* 2016 Sep;13 Suppl 3(Suppl 3):52-6.

5. Converse JM, McCarthy JG, Brauer RO, Ballantyne DL. Transplantation of skin: grafts and flaps. *Reconstruc Plast Surg.* 1977;1:152-239.
6. Unal S, Ersoz G, Demirkan F, Arslan E, Tütüncü N, Sari A. Analysis of skin-graft loss due to infection: infection-related graft loss. *Ann Plast Surg.* 2005 Jul;55(1):102-6.
7. Cuschieri S. The STROBE guidelines. *Saudi J Anaesth.* 2019 Apr;13(Suppl 1):S31-S34.
8. Arif T, Sami M. Calculating area of graft required for vitiliginous areas during split-thickness skin grafting: A simple, accurate, and cost-effective technique. *J Cutan Aesthet Surg.* 2017;10(3):160.
9. Sheridan J. Coakes. *SPSS Version 20.0 for Windows: Analysis without Anguish.* Wiley online library October 2017
10. Slobodan Jankovic .*Tests for Comparison of Two Groups: Student's T-test, Mann-Whitney U-test and Chi-square Test.*
11. Ünal S, Ersoz G, Demirkan F, Arslan E, Tütüncü N, Sari A. Analysis of skin-graft loss due to infection: infection-related graft loss. *Ann Plast Surg.* 2005;55(1):102-6.
12. Younes N, Albsoul A, Badran D, Obedi S. Wound bed preparation with 10 percent phenytoin ointment increases the take of split-thickness skin graft in large diabetic ulcers. *Dermatol Online J.* 2006;12(6):5.
13. Maher A. Establishing a consensus for the surgical management of chronic burn wounds: A randomised prospective comparative study. *Egypt, J Plast Reconstr Surg.* 2009;33(1):31-7.
14. Rituraj AS, Chatterjee S. Topical phenytoin: role in diabetic ulcer care. *IJIMS.* 2015;2(6):93-7.