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(RESEARCH ARTICLE)

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A Prospective Randomised Control Study on Split Thickness Vs Full Thickness Skin Grafting for Non-Healing Ulcer

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Abstract

Background: Non-healing ulcers, commonly resulting from diabetes and vascular diseases, pose significant health and economic challenges. When conservative treatments fail, skin grafting becomes necessary. Among grafting techniques, split-thickness skin grafts (STSGs) and full-thickness skin grafts (FTSGs) are widely used; however, comparative outcomes remain uncertain. This study aimed to evaluate the effectiveness of STSG versus FTSG in healing non-healing ulcers.

Materials and Methods: A prospective randomized controlled trial was conducted at Sree Mookambika Institute of Medical Sciences, Kanyakumari, Tamil Nadu from January 2023 to January 2025. Thirty patients with non-healing ulcers (>3 weeks' duration) were enrolled and randomly assigned to either STSG or FTSG groups. Patients with infection, plantar ulcers, uncontrolled diabetes, or significant comorbidities were excluded. Healing outcomes, graft uptake, and predictors of recovery time were analysed.

Results: The mean age of participants was 36.7 ± 13.9 years, with a male predominance (53.3%). Diabetes mellitus was the most common etiology (50%), and lower limbs were the most frequent graft site (73.3%). Complete graft uptake was higher in the STSG group (93.3%) compared to FTSG (73.3%). Larger ulcers (>100 cm^2) had a higher risk of graft failure. Healing was faster in the STSG group (5–6 weeks) than FTSG (7–8 weeks). Ulcer size ($p = 0.008$) and age ($p = 0.042$) were significantly associated with healing time. Regression analysis confirmed ulcer size and graft type as key predictors ($p = 0.000$).

Conclusion: STSGs offer superior healing outcomes and faster recovery, supporting their use as the preferred grafting method in non-healing ulcers.

Keywords: Non-Healing Ulcer; Split-Thickness Skin Graft; Full-Thickness Skin Graft; Graft Uptake; Wound Healing

1. Introduction

An ulcer is defined as a break in the epithelial surface, characterized by persistent tissue damage and granulation tissue formation during healing (1,2). Ulcers that show no improvement after four weeks or fail to heal within eight weeks are termed non-healing ulcers, commonly associated with conditions like chronic venous insufficiency, diabetes mellitus, and peripheral vascular disease (1,2). These ulcers cause pain, restricted mobility, and emotional distress, significantly reducing quality of life and productivity. They also impose a substantial economic burden due to long-term treatment needs and work absenteeism (3).

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Skin grafting is a widely used intervention in dermatology and plastic surgery. Its origins trace back over 3,000 years to India, with modern medical use documented in the early 19th century (4,5). It is especially valuable in managing chronic leg ulcers (CLUs) such as venous, arterial, diabetic, traumatic ulcers, and healing amputation stumps (6). CLUs affect nearly 1% of the adult population in Western countries and are associated with high recurrence and healthcare costs (7). When medical management fails, skin grafting becomes essential to promote healing (8). Grafts are classified by thickness into split-thickness skin grafts (STSGs) and full-thickness skin grafts (FTSGs) (9). STSGs include the epidermis and part of the dermis, while FTSGs include the entire dermis and offer better structural and aesthetic outcomes. However, neovascularization usually begins after five days (10).

Given the variability in healing outcomes and the lack of definitive evidence identifying the superior grafting technique, this study compares the outcomes of full-thickness skin grafts (FTSGs) and split-thickness skin grafts (STSGs) in the management of non-healing ulcers, with the aim of determining the more effective approach for promoting wound healing and improving patient recovery.

2. Materials and Methods

2.1. Study Design and Setting

This prospective randomized controlled trial was conducted at Sree Mookambika Institute of Medical Science from January 2023 to January 2025. The primary objectives of the study were

- To evaluate the rate of graft uptake in patients undergoing full-thickness and split-thickness skin grafting for non-healing ulcers
- To compare the time required for complete wound healing between full-thickness and split-thickness graft recipients
- To assess post-grafting complications such as infection, graft rejection, or ulcer recurrence in both groups.

2.2. Participants and Sampling

A total of 30 patients undergoing skin grafting surgery for non-healing ulcers were enrolled using a consecutive sampling technique. Participants were adults aged 18 years and above with ulcers persisting for more than 3 weeks, measuring between 1 cm × 1 cm and 6 cm × 6 cm, and with adequately prepared ulcer beds (granulation tissue, no active infection). Only patients deemed fit for surgery and who provided written informed consent were included.

Patients were excluded if they had infected wounds, plantar foot ulcers, were unsuitable for STSG, had a history of excessive bleeding, uncontrolled diabetes (HbA1c ≥ 10%), significant comorbidities (renal, hepatic, hematologic, autoimmune conditions), were on systemic steroids/immunosuppressants, or classified ASA > 4.

2.3. Ethical Considerations

The study was approved by the Institutional Ethics Committee of Sree Mookambika Institute of Medical Science. Informed written consent was obtained from all participants. Confidentiality and anonymity of data were strictly maintained in compliance with ethical standards.

2.4. Randomization and Blinding

Eligible participants were randomly allocated in a 1:1 ratio to either the STSG or FTSG group using a computer-generated randomization sequence. Allocation concealment was ensured using sequentially numbered, opaque, sealed envelopes. This was a single-blinded trial—participants were blinded to group allocation to minimize bias, while the surgical team was necessarily unblinded due to the nature of the procedures.

2.5. Intervention: Split-Thickness Skin Grafting (STSG)

Patients in the STSG group underwent grafting using a partial thickness of skin (epidermis and a portion of the dermis), harvested from the thigh using a dermatome (thickness: 0.012–0.018 inches). Hemostasis was achieved at the donor site, and the graft was immediately placed on the ulcer bed, which was prepared with healthy granulation tissue. The graft was secured using sutures, staples, or adhesive dressings. A non-adherent and pressure dressing was applied. Postoperative follow-up included monitoring for graft adherence, infection, and other complications at both donor and recipient sites.

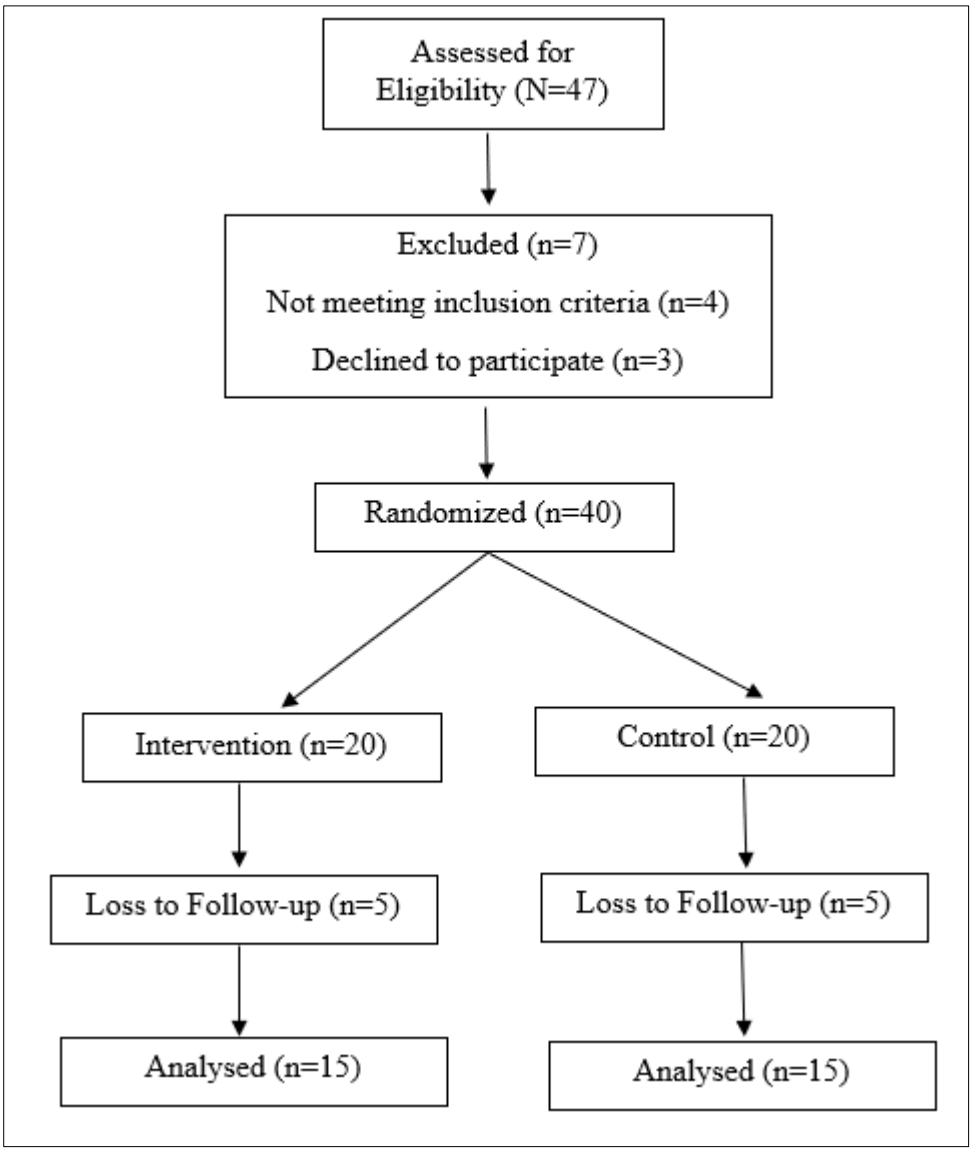

Figure 1 Consort Flowchart

2.6. Statistical Analysis

Data were analysed using SPSS version 21.0 (IBM Corp., Armonk, NY). Descriptive statistics (mean, standard deviation, frequency, and percentage) were used to summarize demographic and clinical variables. Chi-square tests assessed associations between categorical variables. Multiple linear regression analysis was performed to identify predictors of healing time and graft success. A p-value < 0.05 was considered statistically significant.

3. Results

Table 1 Demographic Distribution among Study Participants

STSG (Intervention)		**FTSG (Control)**	
Age			
<30 years	4(26.6%)	7(46.6%)	0.234
31-50 years	5(33.3%)	6(40%)	
>51 years	6(40%)	2(13.3%)	
Gender			
Male	11 (73.3%)	10(66.6%)	0.033
Female	4(26.6%)	5(33.3%)	
Ulcer Aetiology			
Diabetes Mellitus	7(46.6%)	8(53.3%)	0.901
Traumatic	4(26.6%)	4(26.6%)	
Venous	4(26.6%)	3(20%)	
Ulcer Size			
<3 cm	5(33.3%)	2(13.3%)	0.415
4-6 cm	8(53.3%)	11(73.3%)	
>6 cm	2(13.3%)	2(13.3%)	
Recipient Site			
Lower Limb	13(86.6%)	9(60%)	0.183
Upper Limb	2(13.3%)	4(26.6%)	
Trunk	0	2(13.3%)	

Table 1 presents the demographic and clinical profile of participants in both the STSG (Intervention) and FTSG (Control) groups. The age distribution did not show a statistically significant difference between the groups ($p = 0.234$). A higher proportion of younger participants (<30 years) were found in the FTSG group (46.6%) compared to the STSG group (26.6%), whereas a greater proportion of participants aged above 51 years were noted in the STSG group (40%) compared to FTSG (13.3%). A statistically significant difference was observed in gender distribution between the groups ($p = 0.033$), with the STSG group having a higher proportion of male participants (73.3%) than the FTSG group (66.6%). Regarding ulcer aetiology, the most common cause was diabetes mellitus in both groups (46.6% in STSG and 53.3% in FTSG), followed by traumatic and venous ulcers. However, no significant difference was noted in ulcer aetiology between the groups ($p = 0.901$). Ulcer size distribution was comparable between groups, with the majority of ulcers measuring 4–6 cm (53.3% in STSG and 73.3% in FTSG), and this difference was not statistically significant ($p = 0.415$). In terms of recipient site, lower limb ulcers predominated in both groups, particularly in the STSG group (86.6% vs. 60%). While the upper limb and trunk were involved in the FTSG group to a greater extent, this difference did not reach statistical significance ($p = 0.183$).

Table 2 Graft Uptake among SGST (Intervention) FSTG (Control) Groups

Type of Intervention	Graft Uptake		
	Complete	Partial	Rejected
STSG (n=15)	14(93.3%)	1(6.6%)	0
FTSG (n=15)	11(73.3%)	2(13.3%)	2(13.3%)

In Table 2, complete graft uptake was higher in the STSG group 14 (93.3%) compared to the FTSG group 11 (73.3%). Partial uptake and graft rejection were more common in the FTSG group, with 2 (13.3%) cases each, while no grafts were rejected in the STSG group.

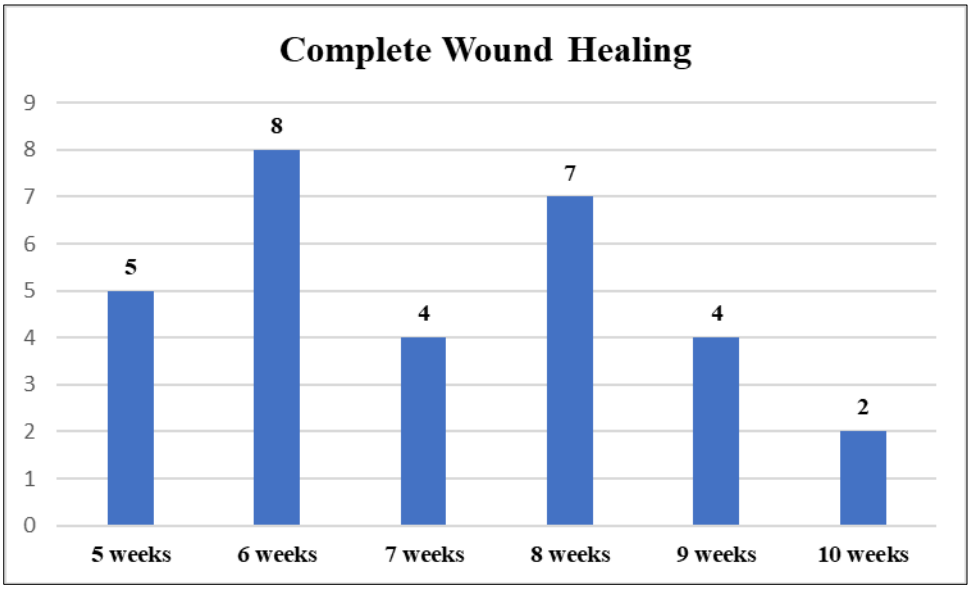

Figure 2 Complete Wound Healing among Study Participants

Figure 2, complete wound healing was observed in 5(16.6%) patients at 5 weeks, 8(26.6%) at 6 weeks, 4(13.3%) at 7 weeks, 7(23.3%) at 8 weeks, 4(13.3%) at 9 weeks, and 2(6.6%) at 10 weeks post-intervention, with the most cases healing by 6 weeks.

Table 3 Association between Demographic characteristics and Total Healing Time among Study participants

Group	Demographic Characteristics	Total Healing Time			P Value
		6-7 weeks	7-8 weeks	9-10 weeks	
Age					
STSG	<30 years	2	5	6	0.042
	31-50 years	2	0	0	
	>50 years	0	0	0	
FTSG	<30 years	0	0	2	
	31-50 years	5	3	3	
	>50 years	0	1	1	
Gender					
STSG	Male	10	1	0	0.476
	Female	3	1	0	
FTSG	Male	0	3	2	
	Female	0	6	4	
Ulcer Aetiology					
STSG	DM	6	4	3	0.579
	Traumatic	1	0	1	
	Venous	0	0	0	
FTSG	DM	0	0	0	
	Traumatic	6	2	1	
	Venous	2	2	2	
Ulcer Size					
STSG	0-25 Cm^2	5	0	0	0.001
	25-100 Cm^2	8	0	0	
	>100 Cm^2	0	2	0	
FTSG	0-25 Cm^2	0	0	0	
	25-100 Cm^2	2	7	0	
	>100 Cm^2	0	4	2	

Table 3 highlights the association between demographic and clinical variables and total healing time among participants in both STSG and FTSG groups. Age showed a statistically significant association with healing time ($p = 0.042$). In the STSG group, participants aged <30 years had healing durations extending up to 9–10 weeks, while those aged 31–50 years healed within 6–7 weeks. In contrast, in the FTSG group, participants aged <30 years had the longest healing times (9–10 weeks), while those aged 31–50 years showed more varied healing durations. Gender did not show a significant association with healing time ($p = 0.476$). In the STSG group, most male and female participants healed within 6–7 weeks. In the FTSG group, females tended to have longer healing times compared to males. Ulcer aetiology was not significantly associated with healing time ($p = 0.579$). In the STSG group, most diabetic ulcers healed within 6–8 weeks, while traumatic and venous ulcers were few. In the FTSG group, traumatic and venous ulcers were more common, with healing times extending up to 10 weeks. Ulcer size showed a statistically significant association with healing duration ($p = 0.001$). In the STSG group, ulcers ≤100 cm^2 healed faster (6–7 weeks), while larger ulcers (>100 cm^2) required 8

weeks. In the FTSG group, ulcers >100 cm^2 were associated with delayed healing (up to 10 weeks), while medium-sized ulcers (25–100 cm^2) commonly took 7–8 weeks to heal.

Table 4 Factors affecting Total Wound Healing among Study participants

Characteristics	B	Std. Error	Beta	t	Sig.
Age	0.001	0.006	0.008	0.162	0.873
Gender	0.67	0.165	0.022	0.405	0.689
Ulcer Aetiology	0.78	0.084	0.042	0.928	0.363
Ulcer Size	1.184	0.118	0.467	10.050	0.000
Recipient Site	0.065	0.120	0.026	0.544	0.592
Type of Intervention	2.367	0.153	0.782	15.447	0.000

In Table 4, multiple linear regression analysis was used to identify factors influencing total wound healing time. Among the variables studied, ulcer size and type of intervention were found to have a statistically significant impact. Larger ulcer size was associated with a longer healing time ($p = 0.000$). Similarly, the type of graft used significantly affected healing time, with the STSG group showing faster recovery compared to the FTSG group ($p = 0.000$). Other variables such as age, gender, ulcer aetiology, and recipient site did not show any significant association with wound healing time.

4. Discussion

This study compared the effectiveness of split-thickness skin grafts (STSGs) and full-thickness skin grafts (FTSGs) in patients with non-healing ulcers, focusing on graft uptake and healing time. The mean age of the participants was 36.7 ± 13.9 years, with the majority falling in the <30 and 31–50-year age groups. These demographics are comparable to those reported by Rama Mani Lam, where the mean age was 35.67 years with most participants between 31–40 years [11]. The gender distribution in this study showed a slight male predominance (53.3%), which also aligns with Lam's findings (57.5% male) [11].

Diabetes mellitus was the most common ulcer etiology (50%) in both STSG and FTSG groups, which supports its known role in chronic wound development. No statistically significant difference was observed between groups in ulcer etiology ($p = 0.901$), suggesting that both graft types are applied across similar clinical profiles. Ulcers sized 25–100 cm^2 were the most prevalent, and a significant association was found between ulcer size and graft uptake ($p = 0.008$), with all graft rejections occurring in ulcers >100 cm^2. This reinforces ulcer size as a key determinant of graft success, particularly in FTSG, which has higher metabolic demands [12].

Graft uptake was notably higher in the STSG group (93.3%) compared to the FTSG group (73.3%). Partial uptake and complete rejection occurred only in the FTSG group (13.3% each), whereas no rejection was observed in the STSG group. These findings align with the results of Lam [11], who reported 95% complete uptake for STSG and 75% for FTSG, and with studies by Sinha et al. [13] and John et al. [14], which emphasize the revascularization advantage of thinner STSGs. Kumar et al. also reported lower rejection rates in STSG and highlighted the importance of well-prepared, vascularized beds for FTSG success [12].

Healing time was significantly shorter in the STSG group, with most participants healing within 5–6 weeks, while the FTSG group predominantly healed in 7–8 weeks. A significant association was found between age and healing time ($p = 0.042$), supporting Rajavelu et al.'s findings ($p < 0.0001$) (3) and those of Jankunas et al., who reported slower healing with increasing age (15). However, this contrasts with Oyibo et al. (16), who found no significant association between age and healing time. Gender was not significantly associated with healing time ($p = 0.476$), consistent with studies by Rajavelu et al. (3), Oyibo (16), and Marston et al. (17), though the latter reported improved healing in females.

Multiple linear regression identified ulcer size and graft type as statistically significant predictors of healing time ($p = 0.000$ for both), while age, gender, ulcer etiology, and recipient site were not significant contributors. These findings are supported by Rose et al. (18), who also found that age and wound size were not independent predictors of healing time, highlighting the importance of wound and graft characteristics over demographic factors.

5. Conclusion

This study demonstrates that STSGs offer better clinical outcomes in terms of both graft uptake and faster healing compared to FTSGs, especially in ulcers sized 25–100 cm^2. Ulcer size and graft type were the most critical factors influencing wound healing, while demographic variables had limited impact. The consistent performance of STSGs suggests they are the preferred option for managing non-healing ulcers, particularly in resource-constrained settings or where vascular compromise is a concern. Further multi-center studies with larger samples and long-term follow-up are recommended to validate these findings and inform evidence-based graft selection protocols.

Compliance with ethical standards

Disclosure of conflict of interest

The authors confirm that there is no conflict of interest related to the manuscript.

Statement of ethical approval

Institutional Ethical Clearance was obtained.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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