

## A COMPARATIVE STUDY OF SPLIT SKIN GRAFT WITH FIXATION AND WITHOUT FIXATION IN THE MANAGEMENT OF RAW AREA

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### ABSTRACT

**Background:** The skin plays a vital role, and loss of its integrity, particularly in diabetic foot ulcers, predisposes patients to infection and amputation. Split-thickness skin grafting is an effective method for wound reconstruction, with graft uptake influenced by vascularity, fixation technique, and prevention of shear, haematomas, and seromas. This study aimed to compare the efficacy of graft uptake with and without stapler fixation. **Materials and Methods:** This prospective comparative study was conducted on 50 patients (25 with and 25 without stapler fixation) at Government Thoothukudi Medical College and Hospital, Thoothukudi, from June 2022 to December 2023. Baseline demographic and clinical data were recorded preoperatively, and all patients who underwent skin grafting were followed up postoperatively for complications and graft loss. **Result:** The case and control groups were comparable in terms of age, sex, diagnosis, and diabetes status ( $p > 0.05$ ). Surgery duration was significantly shorter in the case group, with all procedures completed within 30 min compared with 80% exceeding 30 min in the control group ( $p < 0.001$ ). Postoperative pain was lower in the case group, with all patients reporting a Visual Analogue Scale (VAS) score of 0, versus higher scores in the control group ( $p < 0.001$ ). The incidence of graft migration was similar between the groups (12% vs. 16%,  $p = 0.684$ ). Hospital stay was significantly shorter in the case group ( $p = 0.002$ ). The mean graft uptake at first look was slightly higher in the case group, but the difference was not significant (94.2% vs. 92.3%,  $p = 0.356$ ). Second-look graft uptake was comparable between the groups (92.6% vs. 89.9%,  $p = 0.601$ ). **Conclusion:** Stapler fixation in split-thickness skin grafting was associated with a shorter operative time and lower postoperative pain, with a shorter hospital stay, whereas graft uptake and graft migration were comparable to grafting without stapler fixation.

## INTRODUCTION

The skin is the largest organ in the body, in terms of surface area. Its biological and mechanical characteristics safeguard and preserve the delicate equilibrium of the human system. Its semipermeable nature prevents fluid loss, and a rich capillary network aids thermoregulation. The presence of Langerhans cells aids the adaptive immune system. Rich nerve endings provide sensation, and the skin plays an essential role in vitamin D synthesis.<sup>[1,2]</sup> Ulceration is the leading cause of non-traumatic amputations of the lower limb, particularly in patients with diabetic foot ulcers. Diabetic foot ulcers develop due to vascular disease, neuropathy, and immunopathy. This triad not only leads to ulcerations

but also increases the risk of infection, potentially resulting in amputation. Restoring an intact skin barrier is crucial for preventing infection. Split-thickness skin grafts are the most effective method for reconstructing skin defects and tissue loss.<sup>[3,4]</sup>

Peripheral neuropathy plays a role in the aetiology of over 80% of diabetic foot lesions, but inadequate perfusion always results in non-healing wounds. This lack of arterial blood flow decreases tissue oxygenation, leading to cell death and impaired wound healing. Skin grafting is a technique that transfers cutaneous tissue from one part of the body to another. The graft is devoid of its blood supply and is revascularized from the recipient bed. Split-thickness skin grafts are harvested by taking all epidermis together with the upper dermis, leaving the

remaining dermis behind to heal the donor site.<sup>[5,6]</sup> Skin grafts are used when wounds are too large for primary closure and when reconstruction by skin flaps or healing by secondary intention is unfavourable. In some cases, skin grafts are used in combination with local, regional, or free flaps to close secondary donor defects. To maximise the chance of survival of skin grafts, a tie-over dressing is usually administered.

There are two different techniques for skin grafting: full-thickness skin grafts and split-thickness skin grafts. Full-thickness skin grafts are harvested with the full dermis intact. The advantages of split-thickness skin grafts are that they can be meshed to larger sizes, cover larger defects, and be placed on recipient sites with less vascularity. Skin grafts rely on “plasmatic imbibition” in the first 24 hours and eventually on revascularisation of the graft to survive. Various factors influence graft uptake, such as graft nutrition absorption, vascular ingrowth from the recipient bed, and postoperative immobility. A complication that can occur is partial failure if revascularisation is obstructed by seroma or haematoma formation. Numerous dressings and fixes have been suggested to enhance the successful graft take. They are used to provide equal pressure on the graft surface to prevent friction and improve graft attachment to the wound bed. Techniques for graft fixation are negative pressure therapy, basting sutures, tie-over bolsters (e.g., non-adherent gauze, sometimes drenched in antibacterial solution), fibrin glues, topical phenytoin or platelet-rich plasma (PRP).<sup>[7,8]</sup>

Tie-over dressing modifications and hydrofiber-based fixation methods have also been described to improve graft stability and patient comfort.<sup>[9,10]</sup> Split skin grafts help treat post-infective and post-traumatic raw areas with good granulation tissue. The thigh is the preferred donor site for this procedure. Factors such as seroma formation, vascularisation of the recipient site, general condition of the patient, and shearing of the graft influence graft uptake. Many techniques, either alone or in combination, have been documented in the past for improving the skin graft outcome, like sutures, foam, staplers, pocket staplers, rubber bands, modified syringes, pressure buttons, and stoppers.<sup>[5]</sup>

Initially, sutures (3-0 and 4-0 Ethilon) were used to secure the grafts. Staplers were used instead of sutures because they were less time-consuming. Adhesive, fibrin glues, and sealants are currently used. The glue fixation method is more efficient, consuming less time and effort, and has an excellent cosmetic appearance.<sup>6</sup> Using cyanoacrylate has the added advantage of obviating the need for postoperative suture or staple removal. The disadvantage of this technique is that it is more expensive than the others. Therefore, this study aimed to evaluate whether stapler fixation provides superior graft uptake compared to graft placement without fixation.

Secure fixation is important in split-thickness skin grafting to minimise shearing and prevent haematoma or seroma, which can reduce graft uptake. Stapler fixation is widely used because it is faster; however, it increases the cost and requires staple removal. Evidence comparing graft uptake with stapler fixation versus grafting without fixation remains limited; hence, this study was undertaken.

#### **Aim**

This study aimed to compare the efficacy of graft uptake with and without stapler fixation.

## **MATERIALS AND METHODS**

This prospective comparative study was conducted in 50 patients (25 with and 25 without stapler fixation) at the Department of General Surgery, Government Thoothukudi Medical College and Hospital, Thoothukudi, from June 2022 to December 2023. The study was performed after obtaining clearance from the Institutional Ethics Committee. Informed consent was obtained from all patients before enrolment in the study.

#### **Inclusion criteria**

Patients aged >18 and <80 years with diabetic ulcers, ulcers with healthy granulation tissue, burns, traumatic ulcers, and postmastectomy raw areas were included.

#### **Exclusion criteria**

Patients with immunocompromised status, malnutrition and infections, underlying osteomyelitis, and comorbid illnesses such as anaemia, chronic kidney disease, protein deficiency status, and coagulation disorders were excluded.

**Methods:** After the selection of patients based on predefined inclusion and exclusion criteria, data were collected from all the enrolled participants. Baseline information was obtained through direct patient interviews, and detailed clinical history was obtained before enrolment. Surgery duration was recorded in minutes and categorised as ≤30 min and >30 min. Hospital stay was recorded in days and categorised as ≤5 days and >5 days. The histories of comorbid conditions, including diabetes mellitus and hypertension, were recorded.

All participants who underwent skin grafting for raw areas were postoperatively evaluated for complications, including surgical site infection, postoperative pain, seroma formation, graft migration, graft necrosis, and graft loss. Postoperative pain was assessed using a Visual Analogue Scale (VAS). All findings were systematically recorded and analysed. Graft uptake was assessed at the first and second postoperative dressing inspections and recorded as a percentage of uptake.

**Statistical analysis:** Data were presented as mean, standard deviation, frequency, and percentage. Continuous variables were compared using independent sample t-tests. Categorical variables were compared using Pearson's chi-square test.

Fisher's exact test was used when the expected cell counts were <5. Statistical significance was set at  $p < 0.05$  using a two-tailed test. Data analysis was performed using IBM SPSS version 29.0.

## RESULTS

The case and control groups were comparable in age distribution, sex, diagnosis, and diabetes status, with no significant differences ( $p > 0.05$ ). Surgery duration was significantly shorter in the case group, with all patients operated within  $\leq 30$  min compared with 80% of controls requiring  $> 30$  min ( $p < 0.001$ ). Hospital stay was shorter in the case group, with more patients discharged within 5 days (92% vs. 52%,  $p = 0.002$ ) [Table 1].

**Table 1: Comparison of baseline characteristics and perioperative outcomes between the groups**

Variable	Category	Case n (%)	Control n (%)	P value
Age (years)	< 40	4 (16.0%)	3 (12.0%)	0.559
	41–50	4 (16.0%)	3 (12.0%)	
	51–60	8 (32.0%)	5 (20.0%)	
	> 61	9 (36.0%)	14 (56.0%)	
Sex	Male	16 (64.0%)	16 (64.0%)	1
	Female	9 (36.0%)	9 (36.0%)	
Diagnosis	Infective	18 (72.0%)	20 (80.0%)	0.508
	Traumatic	7 (28.0%)	5 (20.0%)	
Comorbidity	Diabetes mellitus	17 (68.0%)	17 (68.0%)	1
	Non-diabetic	8 (32.0%)	8 (32.0%)	
Surgery duration (minutes)	$\leq 30$	25 (100.0%)	5 (20.0%)	<0.001
	$> 30$	0 (0.0%)	20 (80.0%)	
Hospital stay (days)	$\leq 5$	23 (92.0%)	13 (52.0%)	0.002
	$> 5$	2 (8.0%)	12 (48.0%)	

Postoperative pain (VAS) was significantly lower in the case group ( $p < 0.001$ ). Graft migration was

comparable between the groups (12% vs. 16%,  $p = 0.684$ ) [Table 2].

**Table 2: Postoperative pain scores and graft migration outcomes between the groups**

Variable	Category	Case n (%)	Control n (%)	P value
VAS score	0	25 (100.0%)	0 (0.0%)	<0.001
	3	0 (0.0%)	5 (20.0%)	
	4	0 (0.0%)	16 (64.0%)	
	5	0 (0.0%)	4 (16.0%)	
Graft migration	No	22 (88.0%)	21 (84.0%)	0.684
	Yes	3 (12.0%)	4 (16.0%)	

Mean graft uptake at the first and second postoperative assessments was higher in the case

group, but the difference was not statistically significant ( $p > 0.05$ ) [Table 3].

**Table 3: Comparison of graft uptake between case and control groups at first and second postoperative assessment**

Graft uptake	Case (Mean $\pm$ SD)	Control (Mean $\pm$ SD)	P value
1st look (%)	94.20 $\pm$ 5.85	92.28 $\pm$ 8.47	0.356
2nd look (%)	92.64 $\pm$ 17.44	89.88 $\pm$ 19.55	0.601

## DISCUSSION

In the present study, the case and control groups were comparable with respect to age, sex distribution, diagnosis, and diabetic status, which reduced baseline confounding. Stapler fixation was associated with significantly shorter operative and hospital stay durations. Postoperative pain scores were significantly lower in the stapler fixation group, whereas graft migration rates were comparable between the groups. Graft uptake at both the first and second postoperative assessments showed no significant difference between the stapler fixation and non-fixation techniques.

Zuo et al. assessed scar quality at skin graft borders and reported that fixation methods did not

significantly influence long-term scar outcomes, with Vancouver Scar Scale scores being comparable between fixation techniques.<sup>[11]</sup> This suggests that the choice of fixation may have a limited impact on cosmetic and functional outcomes. Kattan et al. studied 36 patients undergoing split-thickness skin grafting stabilised with cyanoacrylate glue, of whom 66.7% received non-meshed grafts and 33.3% meshed grafts, with 13.9% being diabetic. Complete graft uptake was achieved in 32 patients (88.9%), whereas partial graft loss occurred mainly in burn wounds, accounting for 47.2% of the indications. The graft take was high and comparable to conventional fixation techniques.<sup>[12]</sup>

Pawar et al. evaluated a sutureless technique of split-thickness skin graft fixation in 20 patients and

reported that all patients achieved greater than 90% graft uptake. The study concluded that this method was safe, viable, faster, and more cost-effective than conventional fixation techniques such as sutures, staples, or fibrin glue, while providing comparable graft survival.<sup>[13]</sup> Samal et al. compared tie-over sutures, skin staplers, and cyanoacrylate glue for skin graft fixation and found mean fixation times of 34, 7, and 12 minutes, respectively. The mean pain score on dressing removal was lowest with cyanoacrylate glue (VAS 1.8) compared with tie-over (3) and staplers (2.9), while mean graft take was comparable across groups at 90.1%, 94.1%, and 93.8%, respectively, despite higher material cost for cyanoacrylate fixation.<sup>[14]</sup>

Muthukumar et al. evaluated 40 post-burn patients undergoing split-thickness skin graft fixation using either fibrin sealant (Group 1, n=20) or cyanoacrylate glue (Group 2, n=20). On the 15th postoperative day, the mean graft take was higher in the fibrin sealant group (95%) than in the cyanoacrylate group (90.2%). Graft failure occurred in two patients in Group 1 (mean loss 26.75%) and five patients in Group 2 (mean loss 38.16%). At six months, the modified Vancouver Scar Scale scores for pigmentation, vascularity, thickness, and pliability were superior in the fibrin sealant group. Histopathological and immunohistochemical analysis further confirmed better scar characteristics with fibrin sealant, suggesting a potential role in scar modulation.<sup>[15]</sup>

Barnea et al. studied 23 adult patients with split-thickness skin graft donor sites on the proximal thigh, half of whom were dressed with paraffin gauze and half with Aquacel. They found that Aquacel dressings were associated with significantly less pain, faster epithelialisation, and superior final scar quality at one-year follow-up compared with paraffin gauze. They concluded that Aquacel is superior to standard paraffin gauze for donor site management in terms of pain relief, ease of care, epithelialisation, and long-term scarring.<sup>[16]</sup>

Waiker et al. included 200 patients with wounds, comparing autologous PRP application with conventional fixation methods such as staples or sutures. The PRP group demonstrated significantly better instant graft adherence to the wound bed, delayed first post-graft inspection, lower rates of haematoma, graft oedema, discharge, frequency of dressings, and shorter hospital stay in the plastic surgery unit. The study concluded that autologous PRP promotes early graft adherence and wound healing, recommending its routine use before grafting to optimise clinical outcomes.<sup>[17]</sup> Although the fixation strategies and wound types differ across studies, the common goal remains improving graft stability, comfort, and graft uptake.

Alternative fixation methods for skin grafts, including cyanoacrylate glue, fibrin sealant, sutureless techniques, Aquacel dressings, and autologous PRP, have been reported to provide graft uptake comparable to conventional methods in

selected settings. In the present study, stapler fixation demonstrated advantages in terms of operative time, postoperative pain, and hospital stay, whereas graft uptake and migration were comparable between the stapler fixation and non-fixation techniques. Therefore, the choice of fixation technique should be guided by the wound characteristics, feasibility, patient comfort, and resource availability.

**Strengths:** An equal number of patients were compared between the groups with comparable baseline characteristics. Graft fixation is performed at various sites due to different factors such as trauma, infection, and post-amputation locations.

**Limitations:** The study was limited by its small sample size, single-centre design, and short-term follow-up. Future studies with larger sample sizes and longer follow-ups are required to confirm the clinical benefits of stapler fixation and evaluate long-term outcomes.

## CONCLUSION

Stapler fixation in split-thickness skin grafting was associated with a shorter operative time and lower postoperative pain, with a reduced hospital stay compared to grafting without stapler fixation. Graft uptake and migration were comparable between the two techniques.

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