

EFFECT OF NEGATIVE PRESSURE WOUND DRESSING IN POST-OPERATIVE CARE OF SPLIT THICKNESS SKIN GRAFTING IN A TERTIARY CARE CENTRE IN SOUTH KERALA

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Abstract

Background: Split skin grafting is used to cover ulcers or wounds of varying area and minimal depth. Different schemes of post-operative wound dressings have been developed over time to secure the precious graft at the recipient site. Traditionally, a splint or bolster dressing is used. Recently, Negative Pressure Wound Therapy which is an air-tight dressing around a wound or ulcer using occlusive film and a suction device embedded in a sponge laid over the graft is also being used. The objective is to compare the mean percentage of skin graft taken between patients who were given NPWT and those who were given conventional wound dressing post operatively. **Materials and Methods:** This was a prospective cohort study of patients who underwent split skin graft in the Department of General Surgery in a tertiary care center, South Kerala from September 2019- October 2021. Sample size was calculated to be 76 in each arm. Convenient sampling was done. The size of the ulcer or wound over which grafting was planned was measured on the preoperative day using a graph paper. Patients undergoing split thickness graft received either the traditional dressing or the NPWT. Postoperatively on day 5, again a measurement of the surface area of graft taken was done and another measurement taken within day 14 when the patient comes for review in OP after being discharged. Other data were collected using an interviewer administered questionnaire. Institutional ethical committee clearance was obtained and informed consent obtained from the participants. Data was entered in MS Excel and mean percentages of 'graft uptake was calculated for both groups. Paired t test was done to find statistically significant difference between the mean graft take percentages of each arm. **Result:** There is a significant difference in the percentage of graft uptake between the two types of post operative dressing techniques when measured on the 5th day and NPWT is better. **Conclusion:** Negative Pressure Wound Therapy in post operative care of split skin grafting patients may increase the percentage of graft uptake in the immediate post operative period (POD-5) and is not superior to traditional dressing by the end of two weeks following surgery.

INTRODUCTION

Various forms of skin grafting, and plastic surgery techniques have been in use from the times of the masterful Indian father of surgery, Sushruta, the scientific legacy which was carried forward through various civilisations. The Split skin grafting is the

simplest plastic surgery technique used to cover ulcers or wounds of varying area and minimal depth.^[1] This is a technique involving the harvesting of all of epidermis and parts of the dermis, leaving behind the rest of the dermis at the donor site. Graft uptake improves with increase in the thickness of an STSG and more durable will be the graft once healed.

The downside is the delay in healing of the donor site with thicker grafts.

The successful uptake of the graft in the recipient site depends on a lot of patient factors like disease, limb, and surgeon factors, among which the post-operative care of the graft site to allow the graft to securely adhere to the graft bed is the most easily modifiable factor. Different schemes of post-operative wound dressings have been developed over time to secure the precious graft at the recipient site. Traditionally, a splint or bolster dressing is used to immobilise the graft on the bed to prevent any unwanted distraction of the tissue. Following the initial Prevention of accumulation of exudates between the graft and its bed and prevention of any infection are also concerns for the surgeon.

NPWT or vacuum assisted closure is a technique of creating an air-tight dressing around a wound or ulcer using occlusive film and a suction device embedded in a sponge within the occlusive dressing.

Several studies have proven the efficacy of NPWT in long standing ulcers and wounds of various aetiologies, and in the dressing of burns patient. The results have been fairly reproduced in studies conducted in India as well.^[2-6]

Several mechanisms that contribute towards better wound healing in negative wound pressure therapy have been proposed, including, better clearance of exudates and excessive edematous fluid from the intercellular matrix and third space, better rates of angiogenesis, overall reduction in the bacterial count per unit gram of ulcer tissue and increase in the doppler measured blood flow to the surrounding tissue based on physiological studies in animal models.^[7] A study conducted in the USA as far back as 1998 had demonstrated the effectiveness of the NPWT as a better alternative for bolster dressing for the purpose of immobilising the graft site and protecting against shearing forces and had proposed better approximation of wound edges by macro-distraction, elimination of fluid collection and decreased bacterial contamination as the main mechanisms behind better outcomes of skin grafting supported by NPWT.^[8] Although both techniques are being independently practised in the tertiary care centres in South Kerala, NPWT is not commonly seen in the post-operative care of Split Thickness Skin Grafting.

As there are many supportive literatures for Negative Pressure Wound Therapy in Split Skin Graft, surgeons have slowly started advocating the use of the same in an effort to maximise the result of skin grafting procedures. NPWT has been shown to improve granulation formation and in improving wound contraction whereby any filling of defects caused by tissue loss become easier with this type of dressing.^[9] Arterial or Venous or even lymphatic insufficiency can cause delays. However, skepticism is rife among many surgeons due to the lack of credible regional studies supporting the safety and efficacy of the practice especially in South Kerala. Hence our study is an attempt to find the

effectiveness of negative pressure wound therapy in split skin grafting when compared with the traditional method.

Objective

To compare the mean proportion of skin graft taken between patients who were given Negative Pressure Wound Dressing and conventional wound dressing post operatively at graft site following Split Thickness Skin Grafting in a tertiary care centre in South Kerala.

MATERIALS AND METHODS

Study Design: Prospective observational study.

Study Setting: The Department of general surgery in a tertiary care centre, south Kerala.

Study period: September 2019- October 2021(2 years).

Data collection period: A period of 18 months from the date of institutional ethical committee clearance.

Study population: Patients undergoing split thickness skin grafting The Department of General Surgery, Dr SMCSI Medical College, Karakonam during the study period.

First group (Exposed group): Patients undergoing NPWT following split thickness skin grafting
Second group (non-exposed group): Patients undergoing conventional dressing following split thickness skin grafting.

Inclusion Criteria

Those underwent Split thickness skin grafting in the institution during the study period and given informed written consent for the same.

Sample Size Calculation: Based on a study conducted in the Department of Plastic Surgery, Christian Medical College, Vellore comparing the mean graft percentage taken between split skin grafts receiving conventional dressing and negative pressure wound therapy¹⁰. This was chosen because the techniques used were like the ones being used in the study setting and the study population closely resembling each other in ethnicity and composition.

Sample size formula: [Figure 1]

Sampling technique: Convenient sampling of all patients who meet the criteria. (Non-Probability sampling)

Data collection tools:

- 1cm x 1cm graph paper for measuring the surface area of wound and graft taken.
- Interviewer administered questionnaire

Data collection method: Patients underwent split thickness skin graft in the institution for various ulcers and wounds as and when decided by the treating surgeon in agreement with patients informed consent. Patients were given anesthesia, donor site and recipient site are painted and draped, and a split thickness skin graft is harvested with Humby's knife. The harvested skin was immediately webbed on a wooden board using surgical blade (No.11) manually by the assistant all the while keeping the harvested pieces moist in saline. After webbing, the skin graft

was transplanted over the recipient site which has been thoroughly debrided and has an evident bed of granulation tissue/clean ulcer floor. The graft was secured in place by synthetic non absorbable monofilament sutures/ stainless steel staplers applied to the margins of the skin graft. On table itself, patients received conventional dressing or a Negative Pressure Wound Dressing. The type of dressing was decided by the treating surgeon and the primary investigator only be measured the treatment outcome. The conventional dressing was done with sterile non adherent material (paraffin gauze with or without chlorhexidine) covered by sterile cotton gauze and pads and immobilised by Plaster of Paris cast when required. Post operatively, the dressings were opened only on day 5 for wound inspection and first assessment of take of graft. Alternatively, patients were given a sterile negative pressure wound dressing, a cheap, indigenous design modification of an otherwise more expensive commercial dressings assembly. It consisted of a suction catheter (16G or 18G) manually fenestrated throughout its length and embedded in autoclaved polyurethane foam/sponge of sufficient size to cover the graft. A sterilised transparent cling film or post-op site transparent occlusive film dressing was given over the sponge and air seal will be ensured by connecting to a suction apparatus. Post operatively, patients were given continuous sub atmospheric pressure maintenance at -100mm Hg suction using electrical vacuum suction apparatus every alternate hour when the patient is awake while in the ICU (during post-operative observation) and during the hospital stay in the ward until the dressing is opened on the POD-5.

After obtaining informed written consent in the patient's mother tongue, using an ETO sterilised transparent grid film with 1 cm x 1 cm markings, surface area of the graft attempted, and surface area of graft taken was measured on the 5th post-operative day (when the dressing is removed for first assessment of graft take) and during routine review in Out Patient Department after discharge between post-operative days 7 and 15.

Measurement of outcomes: Primary outcome measured is the mean of the proportion of surface area of graft taken expressed as a percentage of the surface area of graft attempted.

Study variables: Exposure variables: Whether receiving negative pressure wound dressing or conventional dressing.

Outcome Variable: Percentage of graft taken.

Data Analysis: Data was entered into MS Excel and analysis was done using SPSS.

Percentage of graft taken was calculated by the formula: Percentage of surface area taken = Surface area of graft taken / Surface area of graft attempted. Mean and standard deviation of percentage of surface area taken was calculated for each arm then, separately. Test of significance was done using paired t test to compare the mean of percentages of graft taken.

Ethical considerations: Informed written consent was taken from the study participants and their privacy protected throughout the study.

Policy Implications: Study outcome was favourable for the use of NPWT and routine use of the practice may be adopted as standard post-operative care for STSG in the institution.

RESULTS

The study yielded mixed outcome with respect to the research question. Outcome measurement shows significantly better graft uptake on POD-5 with NPWT when compared with traditional dressing (p value 0.022).

However, there was no significant difference between the percentage of graft uptake between the patients receiving the two types of post operative dressings following SSG as measured within POD-14. (p value 0.680).

Anova F test was done for aetiology, and since there were no significant difference between the different groups, further paired tests were not done.

$$n = \frac{(z_{(\alpha/2)} + z_{(1-\beta)})^2 \times \frac{\sigma_1^2 + \sigma_2^2}{(\mu_1 - \mu_2)^2}}{76 \text{ (in each arm)}}$$

$$z_{(\alpha/2)} = Z \text{ value for } \alpha \text{ level} = 1.96$$

$$z_{(1-\beta)} = z \text{ value for } \beta \text{ level} = 0.842$$

σ_1 = Standard deviation of group receiving NPWT (exposed group) = 3.55

σ_1^2 = Variance of first group = 12.6025

σ_2 = Standard deviation of nonexposed group receiving conventional wound dressing = 8.73

σ_2^2 = Variance of second group = 76.21

$(\mu_1 - \mu_2)$ = Difference of means = 9.2

Figure 1:

Table 1: Effect of NPWT in STSG post operatively

	Mean of percentage graft taken on day 5	Mean of percentage graft taken on review
Graft + Traditional dressing	0.846	0.824
Graft + NPWT	0.885	0.836

Table 2: Statistical association of NPWT on post op day 5 and day 14.

	Postoperative day 5	OP Review Day
t value	-2.322	-0.413
p value	0.022 (p < 0.05)	0.680 (p > 0.05)

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Table 3: Effect of Aetiology of Ulcer on Graft Uptake

	F value	P value
Percentage uptake on day 5	0.676	0.568 (>0.05)
Percentage uptake in day 7-14	0.765	0.515 (>0.05)

Anova F test was done for aetiology, and since there were no significant difference between the different groups, further paired tests were not done.

Table 4: Sex and uptake of skin graft: Group characteristics.

	Sex	Number	Mean of percentages	Standard Deviation
Day 5	Male	90	86.87	0.0726
	Female	62	86.12	0.1411
Day 7-14	Male	90	84.65	0.1175
	Female	62	80.66	0.2369

Table 5: Statistical significance between sex and uptake of skin grafting

	t value	P value
Percentage uptake on day 5	0.425	0.671 (>0.05)
Percentage uptake in day 7-14	1.374	0.171 (>0.05)

Table 6: Effect of HbA1c value on graft uptake.

	HbA1c	Number	Mean	Standard Error of mean
Day 5	< 6.5	27	0.8657	0.01389
	>6.5	51	0.8717	0.01221
Day 7-14	< 6.5	27	0.07386	0.01421
	>6.5	51	0.20001	0.02801

Table 7: Test of significance with respect to HbA1c levels

	t value	P value
Percentage uptake on day 5	- 0.449	-0.0087 (<-0.05)
Percentage uptake in day 7-14	0.581	0.02215 (<0.05)

Table 8: Effect of duration of ulcer and uptake percentage

	F value	P value
Percentage uptake on day 5	1.147	0.320 (>0.05)
Percentage uptake in day 7-14	0.758	0.470 (>0.05)

Anova F test was done for duration of ulcer, and since there were no significant difference between the different groups, further paired tests were not done.

Table 9: Student t test Antibiotics and uptake

	Antibiotics	Number	Mean of percentages	Standard Deviation
Day 5	Pre + postop	90	86.87	0.0726
	Post op only	62	86.12	0.1411
Day 7-14	Pre + postop	90	84.65	0.1175
	Postop only	62	80.66	0.2369

Table 10: Test of significance with respect to antibiotics therapy

	t value	P value
Percentage uptake on day 5	- 0.449	-0.0087 (<-0.05)
Percentage uptake in day 7-14	0.581	0.02215 (<0.05)

DISCUSSION

A statistically significant improvement in the immediate post operative period with respect to percentage graft uptake could be established which can encourage surgeons to attempt this newer method of post operative dressing for split skin grafts. P value is 0.022 which is less than 0.05 in the test of significance as obtained from the results on POD-5.

This is in line with the findings of the meta-analysis done by Dr Ying Chao et al and published in 2018.^[11] But when we look at the statistics, there appears to be no significant difference by the second week (P=0.680). The positive impact of the NPWT could not be seen in the second post operative week may be due to the short period through which the patients received the vacuum dressing.^[12] Prolonging the duration of NPWT for three weeks may further

improve graft uptake but that needs further evaluation through a larger scale study.

The etiology of the ulcer, whether it was an arterial insufficiency of the limb or problems with the venous drainage of the limb or complicated by diabetes mellitus or by recent trauma or burns did not make much difference in the outcome of the split thickness skin graft uptake as observed in the study. ($p = 0.568$ on day 5 and $p = 0.515$ in the second week). This could have been due to an overlap of etiologies among the patients. Patients with long standing diabetes mellitus for instance might have peripheral occlusive vascular disorders due to diffuse atherosclerotic changes in the arteries. Being an observational study, the investigator has had to classify each patient into the most dominant aetiology that was complicating an ulcer with the limited amount of data.

HbA1c value has shown consistent significance statistically, during both measurements. ($p = -0.0087$ and $p < 0.02$ on POD-5 and on POD 7-14.) but this finding is inconsistent with similar studies done across the globe, which have found that split skin graft survival is not dependent on HbA1c value unlike the case of free flaps.^[13-15] But such studies have found a significant association with wound infection and graft rejection. May be in the Indian scenario, a higher HbA1c is associated with greater chances of wound infection or itself could be a sign of recurrent, frequent wound infections.

And in our current study, we have found that use of preoperative and post operative antibiotics gave superior results compared to post operative antibiotics alone. This may also be indirectly linked to occult infections or bacterial colonisations adversely affecting the outcome.

CONCLUSION

The current hospital based prospective observational cohort study conducted over a period of two years in a total of 152 participants who underwent STSG in a tertiary care centre in South Kerala and received either Negative Pressure Wound Therapy or conventional dressing showed significantly better graft uptake on post operative day 5 and no significant difference between graft uptake in the second week post operatively.

Further investigation from a larger scale study, preferably an RCT is needed to generalise the results in the population.

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