ORIGINAL ARTICLE

Vacuum-assisted Closure in Integration of Skin Graft Over Scalp Wounds: A Randomised Control Trial

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ABSTRACT

Objective: To compare outcome of split thickness graft with and without vacuum-assisted closure over the scalp soft tissue defects in terms of graft take and complications.

Study Design: Randomised controlled trial.

Place and Duration of Study: Department of Plastic Surgery, Jinnah Burns and Reconstructive Surgery Centre, Lahore, from June 2017 to June 2018.

Methodology: Patients with scalp soft tissue defects were recruited for the study. Patients with history of poly trauma, hypertension and diabetes mellitus were excluded. Patients were randomly divided into two groups by balloting lottery method. In group A, simple dressing were done after split thickness skin graft; and into group B, VAC dressing was applied after split thickness skin graft. Outcome variables (graft take and complications rate at recipient site) were assessed clinically at 2 weeks and analysed by Chi-square test with p-value ≤0.05 was taken as significant.

Results: Mean age of 120 patients was 33.44 ±14.65 years. Graft take was seen in 24 (40.0%) patients in group A and in 56 (93.3%) patients in group B (p = 0.0001). Seroma was recorded in eight (13.3%) in group A (simple dressing) patients and one patient (1.67%) in group B (VAC dressing, p = 0.015), hematoma was seen in 04 (6.67%) *versus* 0 (0.0%), respectively (p = 0.042) and graft edge dehiscence in 03 (5.0%) *versus* 0 (0.0%), respectively (p = 0.079).

Conclusion: Outcome of split skin graft over scalp soft tissue defects with VAC dressing is better than simple dressing in terms of graft take and complications rate.

Key Words: *Split thickness graft, Vacuum-assisted closure, Seroma, Scalp soft tissue defect.*

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INTRODUCTION

Scalp defects may result from trauma, thermal or electrical burns, resection of tumors, infections or congenital lesions. A reconstructive "ladder" is followed for scalp and calvarial reconstruction.[1] A broad armamentarium of reconstructive options exists for the treatment of scalp defects including skin grafts, tissue expansions, local flaps, or free-tissue transfers.[2,3]

Skin grafting is an excellent option, if the defect does not involve the pericranium (periosteal) plane.[4] It is a simple and reliable option with minimum donor site morbidity, provided the wound bed is well vascularised. The integration (adherence) of skin graft is influenced by diverse factors and occurs within 24-72 hours after grafting, is known as the key point for the long-term success of grafting.[5] Therefore, it is important that the graft is immobilised at that stage. Healthy vascularised surface is usually required for adequate skin graft-take. Other factors that can also hinder graft-take at that stage include hematoma or seroma at the recipient site and wound infection.

Modern wound-healing techniques include different types of moist dressings and topical agents, although only a few of these treatments have convincingly been shown to give higher rates of wound healing as compared to traditional wound dressings.[6] Over the past 50 years, clinicians have described how certain wounds respond to sub-atmospheric pressure used within a closed dynamic delivery system.[7] The vacuum-assisted closure device has revolutionised wound care since its first introduction in 1997.[8] This technique, developed by Argenta and Morykwas to expedite wound healing by secondary intention, is based on the principles of controlled negative pressure wound therapy (NPWT) application, often called topical negative pressure (TNP).[8,9] It is effective for treating acute, chronic, and infected wounds. It expedites wound preparation for skin grafting, and promotes subsequent graft adherence. It has been reported to increase local vascularity with formation of granulation tissue, reduction in interstitial edema and bacterial contamination, which eventually enhance the skin graft-take.[10,11]

During the past decade, NPWT has become a common treatment of acute and chronic wounds. It has revolu-

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tionised the management of open wounds. The granulation tissue formed with this technique is high of quality, rich in capillaries, and suitable for skin graft. Many surgeons have adopted the use of NPWT as a bolster dressing for split-thickness skin grafts (STSG) and full-thickness skin grafts.[12] Studies have shown improved graft survival and epithelialisation with NPWT bolster, as well as decreased numbers in repeat STSG procedures. So, there is improvement in graft incorporation particularly in large or irregularly shaped wounds. Although studies have suggested negative pressure settings for wound healing but similar settings may not be optimal when used over skin grafts.[13] NPWT yieldes significantly lower nursing staff costs, reduces risk of cross infection, and more comfortable for the patients than treatment with other wound dressings.[14]

In a study by Saaiq *et al.,* marked differences were found in favour of the VAC therapy group with respect to various wound management outcome measures studied. *i.e*. graft-take (90% of VAC therapy group *vs*. 18% of controls), wound healing time (2 weeks post-grafting in 90% of VAC therapy group *vs*. 18% of controls), need for re-grafting (none among VAC therapy group *vs*. 8% of controls) and duration of hospital stay (less than 3 weeks in 90% of VAC therapy group *vs*. 18% of controls).[15] Graft loss and need for re-grafting was zero% in VAC therapy group *vs.* 8% in traditional gauze dressing group.

The objective of this research was to determine the outcome of STSG with or without VAC in terms of graft-take and complications rate. The rationale was that the outcome of the study would change the clinical practice of the department. Published data in local settings was limited on this aspect, so this study will be a good addition.

METHODOLOGY

A randomised control trial was conducted from 16th June 2017 to 15th June 2018 at the Department of Plastic Surgery, Jinnah Burns & Reconstructive Surgery Center. After the approval from Ethical Committee of Hospital, 120 patients (sample size calculated using win-pepiver 11.15 with 80% power of test, 2.5% level of significance) with scalp soft tissue defects were recruited for study. Patient having soft tissue defect of more than 6 cm over scalp, after trauma, burn or tumor excision, with age between 5 to 65 years of either gender were included in the study. The sampling was non-probability, consecutive sampling. Patients with history of polytrauma, hypertension and diabetes mellitus and wounds more than four weeks were excluded from study.

Subjects were randomly divided into two groups (60 in each group) by using balloting method by researcher; group A without VAC dressing after split thickness skin graft and group B with VAC dressing after split thickness skin graft. Informed consent was obtained from them. All the patients were photographed and baseline assessment was done before starting the treatment. The wound was debrided and washed with normal saline under general anesthesia. After the split-skin graft secured with staplers, the control group received the conventional dressing consisting of a vaseline gauze, cotton pads and cotton bandage. In the study group, VAC dressing was placed on the graft with continuous pressure of 50mm of Hg for 3 days. The dressings were continually observed by the nursing staff and resident doctor and suction was assured by visualising the collapsed foam and absence of gushing sound. The grafts were inspected on fourth postoperative day after which, negative pressure dressing was discontinued in group B. Patients were discharged after second dressing change and were followed up for a total of three weeks.

Outcome variables (graft-take and complications) were assessed clinically at 2 weeks by three consultant plastic surgeons. Data was entered and analysed in S.P.S.S. version 17. Mean and standard deviations were calculated for numerical variables like age, area of scalp injury, and duration of injury. Frequencies and percentages were calculated for nominal/qualitative variables like gender, outcome (graft-take and complications). Both groups were compared by Chi-square test; and p-value <0.05 was taken as significant.

Table I: Demographic and clinical characteristics of subjects.

	Group A (n=60)		Group B (n=60)		Total (n=120)	
	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Age (years)						
5-35	37	61.7	35	58.3	72	60.0
36-65	23	38.3	25	41.7	48	40.0
Mean ±SD	32.53 ±14.61		34.35 ±14.76		33.44 ±14.65	
Duration of injury						
1-2 weeks	39	65.0	38	63.3	77	64.7
3-4 weeks	21	35.0	22	36.7	43	35.3
Mean ±SD	2.68 ±0.77		2.71 ±0.78		2.69 ±0.77	
Size of injury						
7-10 cm	42	70.0	40	66.7	82	68.3
>10 cm	18	30.0	20	33.3	38	31.7
Mean ±SD	9.08 ±2.13		9.12 ±2.18		9.10 ±2.16	

Table II: Frequency of graft take and complications of split thickness graft with and without vacuum-assisted closure in scalp wounds (n=120).

	Group A (n=60)		Group B (n=60)		p-value
	Frequency	Percentage	Frequency	Percentage	
Graft take					
Yes	24	40.0	56	93.3	0.0001
No	36	60.0	04	6.7	
Complications					
Seroma					
Yes	08	13.3	01	1.67	0.015
No	52	86.7	59	98.3	
Hematoma					
Yes	04	6.67	00	0.0	0.042
No	56	93.3	60	100.0	
Graft edges dehiscence					
Yes	03	5.0	00	0.0	0.079
No	57	95.0	60	100.0	

RESULTS

A total 120 patients were included in the study. Subjects' mean age was 33.44 ±14.65 years with mean duration of injury as 2.69 ±0.77 weeks. The mean size of injury was 9.10 ±2.16 cm (Table I). The graft-take in group A (simple dressing) was seen in 24 (40.0%) patients and in group B (VAC dressing) was seen in 56 (93.3%) patients with p-value = 0.0001. The complications, *i.e*. seroma, was recorded in 08 (13.3%) patients in group A (simple dressing) while 01 (1.67%) patients in group B (VAC dressing) (p = 0.015), hematoma was seen in 04 (6.67%) *versus* 0 (0.0%), respectively (p = 0.042) and graft edges dehiscence in 03 (5.0%) *versus* 0 (0.0%), respectively (p-0.079) (Table II).

DISCUSSION

Negative pressure wound therapy is a popular treatment for the management of acute and chronic wounds. It is an established option in the bolstering of STSG at a pressure setting as low as 50 mmHg without compromise to STSG incorporation.[13] Lower pressure settings may create potential benefits to patients with less pain and less secondary skin reaction at the STSG cutaneous borders. These findings follow the physiologic rationale that any pressure above normal capillary pressure, approximately 25 mmHg, should improve angiogenesis and epithelialisation.[13]

Several postulates suggest that negative-pressure dressings may improve graft survival. First, an important aspect to successful graft-take is maintaining good apposition between the graft and the wound surface. Continuous negative-pressure dressings provide a uniform distribution of pressure and apposition between the graft and the wound bed in most cases. Second, the negative-pressure dressing provides continuous removal of wound fluid, which prevents the accumulation of hematoma or seroma while maintaining graft-to-wound apposition. Third, desiccation is detrimental to wound healing and is reduced with the occlusive nature of the VAC dressing, in which a moist environment is maintained. Last, the VAC has been associated with lower bacterial counts at wound sites and this reduction in the local bacterial flora may enhance graft survival.[16]

Compared to the existing dressing treatment, NPWT can decrease the loss of graft due to better fixation of the graft because exudation and hematoma are easily absorbed and it is more comfortable than tie over bolster dressing because of its easiness to apply on wound. As a result, the length of treatment on operating room can be reduced. The patient satisfaction rate increases because of increased patient mobility with portable NPWT device. If the skin graft is dressed with conventional bolster dressing, the failure rate is generally reported to range from 15% to 30% compared with 2% with negative pressure wound therapy.[17]

Encouraging results in terms of rates of healing have been reported in the literature but there is a relative paucity of randomised controlled trials with significant numbers to substantiate the findings. Mullner *et al.* prospectively studied 45 patients with various wounds to which the VAC was applied. There was no control group and again the recommendations on settings for the VAC were based on anecdotal evidence but 80% reduction in size was found during the period of study in 12 of the 17 pressure sores.[18] In a study, a total of 40 split-skin grafts were put on 30 patients. Twenty-one of them received negative pressure dressing (NPD) and 19 served as controls. Final graft-take at nine days in the study group ranged from 90 to 100 per cent with an average of 96.7 ±3.55%. The control group showed a graft-take ranging between 70 and 100 percent with an average graft-take of 87.5 ±8.73%. Each of these differences was found to be statistically significant (p<0.001).[19]

In another study, the authors reported a randomised controlled trial comparing the efficacy of the standard gauze sealed with an occlusive dressing and wall suction (GSUC) *vs.* the VAC in securing STSG. A prospective, randomised, controlled trial was conducted in

157 wounds in 104 patients requiring STSG from August 2009 to July 2012. All wounds were randomised to VAC or GSUC treatment and assessed for skin graft adherence/take. At postoperative day 4 or 5, NPWT was discontinued, and the size of the graft and any non-adherent areas were measured and recorded. Concomitant comorbidities, wound location, etiology, study failures, and re-operation rates were also reviewed. Out of 157 wounds, 77 and 80 wounds were randomised to the GSUC and VAC study arms, respectively. Patient demographics were similar in both groups in terms of age, sex, comorbidities, etiology, and wound location. In 157 wounds, 64 of 80 wounds in the GSUC group, and 60 of 77 wounds in the VAC group had full take of the skin graft by postoperative day 4 or 5 (p = 0.80). The mean percent graft-take in the GSUC group was 96.12% vs. 96.21% in the VAC arm (p = 0.98).[20] This study signifies a good skin graft-take with negative pressure-assisted dressings, which similar to the VAC dressing group (96.21% vs. 93.33%).

This study was conducted and the results were compared to the study by Saaiq *et al.,* that showed marked differences in favour of the VAC therapy group with respect to the various wound management outcome measures studied, *i.e.* graft-take (greater than 95% graft-take in 90% of VAC therapy group vs. 18% of controls). In this study, the graft-take in group A (simple dressing) was seen in 16 (26.67%) patients and in group B (VAC dressing) was seen in 56 (93.33%) patients (p = 0.0001. The complications, *i.e*. seroma, was recorded in 08 (13.3%) in group A (simple dressing) patients while 01 (1.67%) in group B (VAC dressing) patients (p = 0.0001), hematoma was seen in 04 (6.67%) *versus* 0 (0.0%), respectively (p = 0.015) and graft edges dehiscence in 03 (96.67%) *versus* 0 (0.0%), respectively (p = 0.079).

CONCLUSION

Outcome of split skin graft over scalp wounds with VAC dressing was better than without VAC in terms of graft take and low complication rate. So, VAC dressing with split thickness skin graft in scalp wounds may be opted to promote better outcome and reducing the morbidity of particular patients.

ETHICAL APPROVAL:

The study was approved by Ethical Committee of Jinnah Burns & Reconstructive Surgery Centre, Lahore.

PATIENTS' CONSENTS:

Informed consent were obtained from all patients.

CONFLICT OF INTEREST:

Authors have no financial or personal interests with any people or organisation that would influence this work.

AUTHORS' CONTRIBUTION:

AMM, FAK, NA. Contributed in design of work and data collection.

YS, HK: Contributed in the data analysis, results, discussion and drafting of work.

MNT: Contributed in final review and approval of article.

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