Original

Infection Rates in Split-Thickness Skin Graft Donor Sites in Early Versus Late Exposure Wound Dressing Methods in a Centre, Southeast, Nigeria

Ugbala Amaechi[1,2], Nnadozie Ugochukwu Uzodimma [1,2,3,4], Okwara Blasius Okechukwu[5,6], Maduba Charles Chidiebele[1,2,3], Eze Chinonso Blessing[7], Jacob Joy Nkeiruka[8]

[1]*Division of Plastic Surgery, Department of Surgery, Alex Ekwueme Federal University Teaching Hospital Abakaliki, Ebonyi State, Nigeria.*
[2]*Department of Surgery, Alex Ekwueme Federal University Ndufu Alike Ikwo, Ebonyi State, Nigeria.*
[3]*David Umahi Federal University Teaching Hospital Uburu, Ebonyi State, Nigeria.*
[4]*Ebonyi State University Teaching Hospital Abakaliki, Ebonyi State, Nigeria.*
[5]*Department of Orthopaedics and Trauma, University of Nigeria Teaching Hospital Ituku-Ozalla Enugu, Nigeria.*
[6]*Department of Surgery, Godfrey Okoye University, Enugu, Nigeria.*
[7]*Department of Plastic Surgery, National Orthopaedic Hospital, Enugu, Nigeria.*
[8] *Department of Nursing Sciences, Southern Delta University Ozoro, Delta State, Nigeria*
Corresponding author: *Blasius Okechukwu Okwara.*, Department of Orthopaedics and Trauma, University of Nigeria Teaching Hospital Ituku-Ozalla, Enugu, Nigeria/Department of Surgery, Godfrey Okoye University, Enugu, Nigeria.blasiusokwara@gmail.com;+2348035460636

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ABSTRACT

Background: Split-thickness skin graft (STSG) donor site wounds are associated with morbidities, including pain, delayed healing, infection, and scaring. In tropical environments, prolonged occlusion with delayed exposure may increase infection risk. This study compared infection rates and healing outcomes between early and late exposure dressing methods for STSG donor sites.

Methods: This prospective comparative study was conducted at Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Nigeria, from July 2020 to June 2021. One hundred adult patients requiring STSG were recruited and allocated randomly into two groups of 50 each. Group A had late exposure dressing, while Group B had early exposure and managed with daily application of a mixture of KY jelly and 5% povidone-iodine ointment. Donor site infection, healing rate, and time to complete re-epithelialization, were assessed and compared.

Results: Baseline characteristics were comparable between groups. Mean age was 39 years in Group A and 33 years in Group B. Mean donor site sizes were 111cm^2 and 107 cm^2, respectively. By postoperative day 14, 70.9% of Group A and 98.2% of Group B achieved complete healing of donor sites. Mean time to complete re-epithelialization was longer in Group A (29.4 days) than in Group B (13.8 days). Donor site infection was 22% in the late exposure group compared to 5% in the early exposure group.

Conclusion: Early exposure dressing significantly reduced donor site infection rates and accelerated healing compared with late exposure dressing, making it preferable donor site management techniques in tropical settings.

Keywords: Split-thickness skin graft, donor site, infection, early exposure dressing, late exposure dressing, re-epithelialization

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INTRODUCTION

Venous ulcers, diabetic foot ulcers, traumatic injuries (split skin grafts), defects after tumour removal, scar contracture release and burns are among the conditions where a biological covering of large wounds with a well vascularised bed is achieved with the use of venous ulcers[1,2,3]. The iatrogenic wound is more painful for the patient than the original wound[2,3] and is created during skin harvesting and must be controlled to allow for simple and rapid healing.

The donor site wound and the care of the wound, as well as any associated morbidities, can exacerbate the effect of illness on a person's quality of life, self-esteem and productivity at work. Although moist wound healing products have been shown to promote rapid healing and pain reduction[3,4,5], there is currently no universally recognised standard method or dressing agent for donor site care; however, many different agents and methods have been used to dress the site in an effort to encourage rapid re-epithelialization and decrease pain. Other problems are exacerbated by pain, itching, hypertrophic scar and infection, each of which contributes to increased morbidity, hospitalizations and treatment expenses[4,6]. A partial thickness incision may progress to a full thickness skin loss at the donor site, hampering healing and creating an aesthetically displeasing scar from abnormal healing[4,6].

Dressings at the donor site should be easy to apply, inexpensive and effective at promoting healing and decreasing pain and scar formation, while not increasing the risk of local or systemic infection. The traditional method of applying occlusive dressings is to use petroleum gauze, which lets germs in and exudate through. The donor site may get infected as a result of this. In temperate climates, the traditional donor site treatment is occlusive dressing and delayed exposure. Although prolonged occlusive dressing is widely practiced, it may promote bacterial growth and increase the risk of infection in tropical environments with high humidity and early exposure of the donor site after haemostasis is a possible alternative[2,8,9]. Early exposure of donor site may improve aeration, facilitate wound surveillance, reduce bacterial colonization, and improve healing, but evidence from Sub-Saharan Africa is limited. At our institution, donor sites managed with late exposure method (14th day) appeared to experience frequent infections and delayed healing, necessitating a change in practice towards earlier exposure (5th day). However, there were no objective data to support or refute these observations.

The late exposure method (14th day) was used in our facility, but noticed that most of the patients had infection at the donor site as well as a higher morbidity. The re-epithelialization was faster and the incidence of infection at the donor site was reduced when the donor site dressing was exposed on the day of the graft inspection (which was the fifth day). From this observation, the study was conducted to compare the healing outcomes and infection rates of early versus late dressings of the skin graft donor site.

METHODOLOGY

Study Setting: The authors of this study gathered their data from patients at the Plastic and Reconstructive Unit of Alex Ekwueme Federal University Teaching Hospital in Abakaliki, a tertiary referral centre in Southeast Nigeria. The hospital provides specialized surgical services, including skin grafting for burns, traumatic wounds, chronic ulcers, and post-tumour excision defects. The study was carried out over a 12-month period from July 2020 to June 2021.

Study Design: This was a prospective randomized comparative clinical study conducted to compare infection rates and healing outcomes of split-thickness skin graft donor sites managed with early versus late exposure dressing methods. Participants who met the eligibility criteria were allocated randomly into two equal groups and followed until the donor site completely re-epithelialized.

Study population: The study was comprised of adult patients (≥18 years) who had split-thickness skin graft at the Plastic and Reconstructive Surgery Unit of Alex Ekwueme Federal University Teaching Hospital, Abakaliki, and who met the study inclusion criteria during the period of the study.

Eligibility Criteria: **Inclusion criteria:** All patients >18 years of all gender, with benign ulcers and surgically created defects; donor site requirement not more than the anterior and lateral thigh of the chosen limb.

***Exclusion criteria*:** All patients <18 years, patients with cognitive impairment who may be unable to obey instruction, all immunocompromised patients or those with any identifiable condition that may impair wound healing, those who declined consent and patient with previously used donor sites for split-thickness skin grafts were all excluded.

Sample size Determination: The sample size was estimated using the formula provided in 1967 by Yamane

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$n = N/ [1+N (e)^2]$
Where:
n = sample size
N= Total population
e = Error limit (5% degree of accuracy)
1 = A constant
With the population of 92 consisting of the average yearly split thickness skin graft, the formula was applied below at 5% degree of accuracy (Error limit)
$n = 92/ [1+ 92(0.05)^2]$
$n = 92/ [1+ 92 (0.0025)$
$n = 92/1.23$
n = 74.8, approx., 75.
Thus, the minimum sample size required for the study was 75 participants. To increase the study power and compensate for possible attrition, 100 participants were recruited and randomized equally into two groups of 50 participants each.

Sampling methodology: A consecutive sampling technique was adopted. All eligible patients who presented during the study period and met the inclusion criteria were recruited consecutively until the required sample size was attained. Participants were then randomly allocated into either the late exposure dressing group (Group A) or the early exposure dressing group (Group B) using a simple randomization method.

Study variables

Independent variables: Donor site dressing methods (Early exposure dressing, Late exposure dressing).
Dependent Variables: Donor site infection rate, Time to complete re-epithelialization, Day 14 healing rate
Baseline/Covariables: Age, Sex, Packed cell volume, Serum albumin level, Donor site size (cm^2). These variables were assessed to compare the effectiveness of early versus late exposure dressing on donor site outcomes after split-thickness skin grafting.

Study instrument

Data were collected using a structured researcher-designed proforma which was used to record patients' socio-demographics characteristics, clinical parameters (age, sex packed cell volume, serum albumin level, and donor site size), dressing method, donor site infection status, healing rate, and time to complete re-epithelialization). Clinical assessment of donor site and wound swab culture results were used to determine the presence of infection.

Data collection: Data were collected prospectively using a structured proforma. Baseline demographics and clinical data were recorded, and donor sites monitored for infection and healing outcomes. Donor site infection, day-14 healing rate, and time to complete re-epithelialization were documented for analysis.

Data Analysis: Data were entered and analyzed using IBM SPSS Statistics version 26. Results were summarized using descriptive statistics and presented in tables. Comparisons between the two groups were made, with statistical significance set at $p<0.05$

Ethical Consideration; Ethical approval was obtained from the Research and Ethics Committee of Alex Ekwueme Federal University Teaching Hospital (Approval No. FETHA/REC/VOL2/2019/247). Written informed consent was obtained from all participants before enrollment, and confidentiality of patient information was maintained throughout the study.

The study included 100 patients who fulfilled the inclusion criteria; they were then randomly assigned to one of two groups, A or B. Fifty people made up each of the groups. Donor site dressing was applied late in Group A and applied early in Group B. All of the subjects underwent split-thickness skin graft harvesting using a Watson adaptation of the Humby knife, with the knob adjusted to the first mark. Before and after surgery, patients were instructed to take a bath. Cleaning the selected thigh twice with gauze soaked in chlorhexidine, drying it, and then applying a 70% alcohol-based solution were all steps in preparing the donor site. After the prepped thigh, often the opposite leg, was numbed with an abdominal mop to establish haemostasis, split-thickness skin grafts could be collected. The donor site was covered with petrolatum gauze when haemostasis was achieved. On top of that, a thin cushioned dressing was put. The intravenous antibiotics Ceftriaxone 1g 12 hours and Metronidazole 500 mg 8 hours were administered to the patients in both groups for a duration of 72 hours. After one day, the donor site dressings were checked for any signs of blood or serous discharge. When the strike through was observed, more cushioning was applied using sterile cotton wool and crepe bandage.

Group A: On the fourteenth day after surgery, the dressings are removed to the non-adherent layer. Until then, they are kept undisturbed. In cases where the petrolatum gauze remains stuck to the wound bed, it can be removed as long as there is no sign of infection, such redness, smell, or pus, and a new dressing is applied every day until the epithelium has fully returned. On the other hand, dressings were changed and a wound sample

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was collected for culture and sensitivity testing when the patient complained of excessive discomfort, fever, foul odour, or unusual staining on the dressing between days 5 and 14. We started the patient on the right antibiotics and put them on an occlusive dressing that they would change every day until they were fully re-epithelialized. We documented the time of full re-epithelialization and hospital stay for patients with donor site infection.

Group B: On the fifth day after surgery, the wound was cleaned and the petrolatum gauze was removed. We opted for the fifth day since the donor site wound produces moderate to high volumes of exudate in the first three to four days following skin transplant harvest. It is more convenient for the patient and the management team if the recipient site examination occurs on the fifth day at our center. While wearing sterile surgical gloves, a mixture of KY jelly (Johanna Johnson) and 5% povidone iodine ointment (JAWA product) was liberally but delicately administered to the exposed donor areas in order to maintain their moisture. Until the petrolatum gauze slips off spontaneously, which corresponds to complete re-epithelialization, the application was continued daily while watching for any symptom of infection, such as discharge, bad smell, erythema around the incision borders, or unusual discomfort. The presence of any of these symptoms warrants the collection of a wound swab for the purpose of confirming the presence of infection at the donor site. The time it took for the epithelium to fully regenerate was also documented. We used IBM SPSS statistics for Windows version 26 to analyse the data, and we presented them in tables.

RESULTS

Table 1: showing the comparison of the parameters used in the study

	Group A	**Group B**
	Late exposure	Early exposure
Mean age (years)	39	33
Males	30	35
Females	20	15
Packed cell volume (%)	33	36
Serum albumin (mg/dl)	2.9	3.0
Mean donor site size (cm^2)	111	107
Day-14 healing rate (%)	70.9	98.2
Mean duration of complete healing (days)	29.4	13.8
Infection rate (%)	22	5

This study compared infection rates and healing outcomes of split-thickness skin graft donor sites managed with early exposure dressing (Group B) versus the late exposure dressing (Group A). A total of One hundred (100) patients were recruited for the study, comprising fifty (50) participants in each group. The demographic characteristics of both groups were comparable, with Group A having a mean age of 39 years and Group B 33 years. The sex distribution was slightly different with more males in Group B (35) compared to Group A (30), but is unlikely to have influenced infectious or healing outcome significantly. The physiological parameters such as the mean packed cell volume (35% vs. 36%) and the serum albumin levels (2.9mg/dl vs. 3.0mg/dl) were not statistically significant suggesting that systemic factors were balanced between the two groups. Also, the mean donor site sizes were similar across both groups (111cm^2 vs. 107cm^2) and did not significantly affect the outcome of the study.

Early exposure was associated with superior parameters. By the 14th day, 98.2% of donor sites in Group B had achieved complete healing, compared to 70.9% in Group A, showing a faster re-epithelialization in early exposure group. Again, the mean duration for complete re-epithelialization was significantly longer in Group A (29.4 days) compared to Group B (13.8 days).

The infection rate was markedly higher in the late exposure group (22%) compared to 5% in the early exposure group. These differences are clinically significant.

DISCUSSION

The donor site of an STSG is a purposeful partial thickness wound made by the surgeon. Split-thickness skin graft donor site infection is variably reported, in parts because trials focus on pain and time-to-complete re-epithelialization rather than the infection rates. A large systemic review of split-thickness skin graft donor site infections showed a range of infection rates from 0 to 56% in the various studies included10. The results of this study show that the use of early exposure dressing on the donor site of split-thickness skin grafts resulted in a significantly lower infection rate than late exposure dressing as shown in table I above. All donor sites are colonized; infection is a transition to invasive growth, facilitated by high bioburden and biofilm, local ischaemia, excess exudate and impaired host defenses. The higher the bacteria burden, the slower the migration of keratinocytes and re-epithelialization.

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The infection rate in Group B (5%) is lower than that in Group A (22%) and may be due to several factors. Early exposure allows for aeration and speedy drying of the donor site, thus decreasing the moist environment that allows for bacterial colonization[11]. Late exposure is the other exposure, however, characterized by prolonged occlusive dressing that can lead to a warm, moist environment conducive to greater bacterial growth and biofilm formation[12]. Additionally, early exposure enables frequent wound bed assessment which can help identify contamination or early signs of infection and prompt intervention. Better wound bed recovery, as seen in the early exposure groups, is indirectly associated with a decrease in the window of vulnerability for microbial invasion and infection[12]. Of note, both groups had similar physiological parameters at baseline (packed cell volume and serum albumin) reducing the effects of systemic factors on infection outcome. Previous studies have shown that early exposure protocols are superior to prolonged occlusive dressings in many ways including faster healing, lower infection rates and less patient discomfort[11,13].

Factors such as diabetes, peripheral vascular disease, smoking, malnutrition, immunosuppression and prolonged steroid or cytotoxic therapy which may diminish patient immunity and delay re-epithelialization were all excluded from the study. The differences in the infection rates and healing times observed are not due to donor site size, which was comparable in both groups (111cm2 vs. 107cm2). So, it is likely that the difference is because of the method of dressing. Early application of a mixture of KY jelly and wosan ointment may have contributed significantly to both faster healing and reduced infection rate observed in the early exposure group because while providing moist environment for keratinocyte migration by the KY jelly, the wosan ointment contains povidone-iodine which has broad-spectrum antimicrobial activity against a wide range of pathogens including, bacteria (Gram-positive and Gram-negative), fungi, viruses and spores. The wide range of antimicrobial activity helps to lower the bioburden in wounds, which is crucial for optimal healing conditions[14]. Povidone works by releasing free iodine that enters the cell walls of microorganisms and interferes with the structure of proteins and nucleic acids, causing cell death. It inhibits the formation of biofilm, does not encourage microbial resistance and lowers bacterial colonization and infection rates[15,16,17].

Clinically, early exposure dressing not only reduces infection risk but also accelerates healing and shortens recovery time leading to improved patient outcomes. Based on these findings, early exposure dressing should be adopted as a preferred method for managing skin graft donor sites to optimize healing and minimize postoperative complications.

Strengths of the study

The study is a prospective randomized comparative design, thus minimized selection bias and improved the validity of the study. Both groups had comparable baseline characteristics reducing the influence of confounding factors. Factors that affect wound healing such as uncontrolled or poorly controlled diabetes, immunosuppression, malnutrition, peripheral vascular disease and prolonged steroid use, were excluded, ensuring a clearer assessment of the effects of dressing methods. Relevant outcomes such as donor site infection rate, re-epithelialization rate, and time to complete re-epithelialization were evaluated. The findings from this study provide evidence from a tropical, resource-poor setting, where data on donor site management are limited.

Limitations of the study

The study was a single centre study which may limit the generalizability of the results to other settings. Blinding of the patients and investigators was not feasible due to obvious differences between the dressing protocols, introducing the possibility of observer bias. The study did not assess other donor site outcomes including pain, patient satisfaction, scar quality, pruritus and cost effectiveness. Cultures were obtained only when infection was suspected, potentially underestimating bacterial colonization patterns. Long-term follow-up was not done, limiting assessment of late complications such as hypertrophic scarring and pigmentary changes.

Implications of the findings of the study for Research, Practice, and Policy

The study adds to the limited body of knowledge on donor site care in tropical and resource-limited settings. Future multicenter randomized controlled trials with larger sample sizes are required to validate these findings and improve their universality. Further research should evaluate outcomes such as pain, scar quality, cost-effectiveness, and patient satisfaction. Research comparing different topical agents used during early

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exposure method protocols may be useful in identifying the most effective and affordable interventions.

Clinically, the lower infection rate and faster healing associated with early exposure dressing suggests reduced morbidity, faster recovery with shorter hospital stay, lower treatment cost, and overall improved outcome. Early exposure allows frequent assessment, facilitating early detection and management of complications. Plastic and Reconstructive Surgeons in tropical regions may consider adopting early exposure of donor site dressing as a preferred management strategy.

The findings support the adoption of evidence-based institutional guidelines favouring early exposure dressing for split-thickness skin graft donor sites, which may improve postoperative outcomes, reduce treatment costs, and enhance wound care quality.

CONCLUSION

The results of this study showed that there was a significant difference between the infection rates of the two dressing techniques for split thickness skin graft donor sites: early and late. The infection rate was significantly lower in the early group 5% compared to the late exposure group 22%. The baseline nutritional and hematologic parameters were similar between both groups, indicating that the difference was not due to patient-related factors. Results showed that early exposure dressing leads to better aeration of wounds, decreases the moisture level and decreases the conditions conducive to bacterial growth, thus decreasing the risk of infection at the donor site. Long-term occlusive dressings in the late exposure approach, on the other hand, seem to promote bacterial growth and delay the epithelialization process.

Declarations

Declaration of Helsinki: This work was done in accordance to the principles of Helsinki declaration.

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Conflict of Interest: The authors have no conflict of interest to declare.

Authors' contribution: AU, UUN, and CCM conceptualized and designed the work. AU, UUN and CCM were involved in data collection and analysis. All the authors (AU, UUN, CCM, BOO, CBE and JNJ) were involved in writing and revising the manuscript. The authors (AU, UUN, CCM, BOO, CBE and JNJ) read and approved the final manuscript and also agreed to be accountable for all aspects of this study.

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