



**EVALUATING THE EFFICACY OF NEGATIVE-PRESSURE WOUND THERAPY WITH DAKIN'S SOLUTION INSTILLATION VERSUS CONTINUOUS NEGATIVE-PRESSURE WOUND THERAPY: A FOCUS ON WOUND SITE INFECTION AND SPLIT SKIN GRAFT OUTCOMES**

\*<sup>1</sup>Dr. Amira Al-Saad, <sup>2</sup>Dr. Tariq Al-Majid, <sup>3</sup>Dr. Laila Nasser and <sup>4</sup>Dr. Rohan Deshpande

<sup>1</sup>MD, Plastic Surgeon, Shifa Al Jazeera Hospital, Department of Plastic Surgery.

<sup>2</sup>MD, Senior Plastic Surgeon, Shifa Al Jazeera Hospital, Department of Plastic Surgery.

<sup>3</sup>MD, Consultant Plastic Surgeon, Shifa Al Jazeera Hospital, Department of Plastic Surgery.

<sup>4</sup>MD, Associate Plastic Surgeon, Shifa Al Jazeera Hospital, Department of Plastic Surgery.



\*Corresponding Author: Dr. Amira Al-Saad

MD, Plastic Surgeon, Shifa Al Jazeera Hospital, Department of Plastic Surgery.

Article Received on 21/10/2022

Article Revised on 11/11/2022

Article Accepted on 01/12/2022

**ABSTRACT**

This non-randomized controlled trial evaluated the efficacy of Dakin's solution-enhanced Negative-Pressure Wound Therapy (D-NPWT) compared to Continuous NPWT (C-NPWT) in enhancing split thickness skin graft (STSG) survival and reducing wound site infections. A total of 100 patients (65 men, 35 women) undergoing lower extremity grafting were enrolled and divided into two groups: D-NPWT (n=50) and C-NPWT (n=50). The D-NPWT group received NPWT with intermittent Dakin's solution cleansing, while the C-NPWT group underwent continuous NPWT. Baseline characteristics, including age, gender, wound type, and size, were recorded. The primary outcome measured was STSG survival, calculated using a predefined formula, and categorized into Excellent, Good, Moderate, Poor Graft Take, and Graft Failure. Wound site infection was assessed clinically. The D-NPWT group showed significantly higher rates of Excellent Graft Take (96%) compared to the C-NPWT group (60%,  $p < 0.001$ ). Good Graft Take was observed in 4% of the D-NPWT group and 30% of the C-NPWT group. There were no instances of Moderate or Poor Graft Take in the D-NPWT group, while the C-NPWT group had 10% Moderate Graft Take and no Poor Graft Take. Graft failure was absent in the D-NPWT group but occurred in 10% of the C-NPWT group. The incidence of wound site infection was significantly lower in the D-NPWT group (4%) compared to the C-NPWT group (24%,  $p < 0.05$ ). The D-NPWT group also demonstrated superior average graft survival rate (mean: 96.25%, SD: 4.46%) relative to the C-NPWT group (mean: 69.52%, SD: 11.08%,  $p < 0.05$ ). The study demonstrates that D-NPWT significantly improves STSG survival and reduces wound site infections compared to Continuous NPWT, suggesting that Dakin's solution is a valuable adjunct in wound therapy protocols.

**KEYWORDS:** Antiseptic Solutions, Dakin's Solution, Negative-Pressure Wound Therapy, Skin Graft Survival, Split Skin Grafts, Wound Healing, Wound Infection.

**INTRODUCTION**

Managing complex wounds presents a significant challenge in clinical practice, often compounded by the risk of infection and difficulties in achieving prompt and effective healing. Traditional wound management strategies frequently fall short in addressing these complexities, necessitating the exploration of more advanced therapeutic modalities. Among these, Negative-Pressure Wound Therapy (NPWT) has been increasingly recognized for its efficacy in promoting wound healing and reducing infection rates, compared to Continuous wound care methods (Smith et al., 2021).

NPWT, a technology that employs sub-atmospheric pressure to the wound bed, has evolved from continuous to intermittent application. This progression has been the subject of extensive research, aiming to optimize wound healing dynamics. Continuous NPWT (cNPWT) maintains a constant level of negative pressure, whereas intermittent NPWT (iNPWT) alternates between periods of negative pressure and no pressure. Comparative studies have demonstrated variable outcomes in wound healing rates, with some suggesting enhanced granulation tissue formation in iNPWT (Johnson and Brown, 2020).

The adjunct of antimicrobial instillation in NPWT has opened new avenues in wound management. The concept of instilling an antimicrobial solution into the wound bed during NPWT aims to reduce the bioburden and prevent infection, potentially expediting the healing process. The use of Dakin's solution, a sodium hypochlorite-based antiseptic, in this context has garnered attention due to its proven antimicrobial properties and safety profile (Miller *et al.*, 2022).

The rationale for the present study stems from the need to comprehensively evaluate the efficacy of NPWT combined with Dakin's solution instillation. While existing literature underscores the benefits of NPWT and the adjunctive use of antimicrobials, there remains a paucity of data specifically comparing the outcomes of NPWT with and without Dakin's solution instillation, particularly in the context of wound site infection prevention and enhancement of split skin graft take. This study, therefore, aims to fill this knowledge gap by conducting a rigorous comparative analysis, thereby informing clinical practice and contributing to the advancement of wound care management strategies (Williams *et al.*, 2023).

## METHODOLOGY

Ethical approval for this revised study protocol was secured from the Institutional Review Board (IRB) of Shifa Al Jazeera Hospital (SJH-IRB-2022-023). All procedures performed were in accordance with the ethical standards of the 1964 Helsinki declaration and its later amendments. Informed consent was obtained from all individual participants. This study was conducted as a non-randomized controlled trial over a period of 2 years from July 2020-June 2022. Sample size was calculated based on pilot study. A total of 100 patients were enrolled and divided into two groups. D-NPWT Group: Patients in this group received NPWT at the time of the procedure, with the dressing removed after 48–72 hours for cleaning the graft site with 0.125% Dakin's solution, and reapplication of NPWT for an additional 72 hours. On postoperative day 6, the dressing was removed, the wound was cleansed again with Dakin's solution, and local wound care was applied. C-NPWT Group: Patients underwent continuous NPWT for 5–7 days, after which the site was cleansed with normal saline 0.9%. Subsequent wound care followed the same protocol as the D-NPWT group. Baseline characteristics such as age, gender, wound type, size, and location were recorded. The inclusion criteria for the study were specifically delineated to encompass patients aged 18 years or older, those presenting with wounds necessitating split skin grafts, and those able to provide informed consent. Conversely, the exclusion criteria were stringently defined to omit patients with a known hypersensitivity to Dakin's solution or any component of the NPWT system, those with uncontrolled systemic infections, pregnant or breastfeeding women, patients with coagulopathy or on anticoagulant therapy, and individuals with wounds demonstrating malignant transformation. The primary

outcome measured was Split Thickness Skin Graft (STSG) survival. STSG survival was calculated using the formula.

$$\text{STSG survival} = \frac{\text{original wound area} - (\text{length} \times \text{width of denuded area})}{\text{original wound area}} \times 100\%$$

In the study, graft take was categorized as follows: Excellent Graft Take for graft survival above 90-100%, indicating near-complete or complete adherence; Good Graft Take for 75-90% take, signifying high but not full adherence; Moderate Graft Take for 50-75% take, showing a moderate level of graft survival; Poor Graft Take for less than 50% take, indicating a lower level of graft integration; and Graft Failure for 0% take, representing a complete lack of graft adherence. Wound site infection was identified by clinical signs like erythema, swelling, and purulent discharge.

The demographic and baseline characteristics of the patients, including age, gender distribution, and wound size, were compared between the two groups using independent t-tests for continuous variables and chi-square tests for categorical variables. No significant differences were found between the D-NPWT and C-NPWT groups in terms of these baseline characteristics, ensuring comparability of the two groups.

## RESULTS

In the current study, a total of 100 patients, comprising 65 men and 35 women, were enrolled and followed up for a minimum of 6 months. Most of the grafted wounds were located on the lower extremity, with 98% of patients undergoing lower extremity grafting. The remaining 2% had grafts on the upper extremity, equally distributed between the D-NPWT and C-NPWT groups. The study population was divided into two groups: the D-NPWT group (n = 50) and the C-NPWT group (n = 50). The average age at the time of surgery was 62±14 years for the D-NPWT group and 60±15 years for the C-NPWT group. The average duration for which the dressing was applied before initial removal was 2.7±1.0 days for the D-NPWT group, in line with the modified protocol, and 6.3±1.1 days for the C-NPWT group. The average wound size was found to be 150±180cm<sup>2</sup> for the D-NPWT group and 140±170cm<sup>2</sup> for the C-NPWT group, indicating a slightly larger average wound size in the D-NPWT group. The D-NPWT Group significantly outperformed the C-NPWT Group in graft take and wound site infection outcomes. A higher rate of Excellent Graft Take (above 90-100%) was observed in the D-NPWT Group, with 48 out of 50 patients (96%) achieving this level, compared to only 30 out of 50 patients (60%) in the C-NPWT Group (p < 0.001). Good Graft Take (75-90%) was noted in 2 patients (4%) in the D-NPWT Group and 15 patients (30%) in the C-NPWT Group. Notably, none of the patients in the D-NPWT Group fell into the Moderate or Poor Graft Take categories, whereas 5 patients (10%) in the C-NPWT Group had Moderate Graft Take, with no instances of Poor Graft Take. Graft failure (0% Take) was absent in

the D-NPWT Group but was recorded in 5 cases (10%) in the C-NPWT Group. Additionally, the D-NPWT Group exhibited a significantly lower incidence of wound site infection, with only 2 out of 50 patients (4%) showing signs of infection, in stark contrast to 12 out of 50 patients (24%) in the C-NPWT Group ( $p < 0.05$ ). In

the study, the D-NPWT Group demonstrated a superior average graft survival rate (mean: 96.25%, SD: 4.46%) compared to the C-NPWT Group (mean: 69.52%, SD: 11.08%), highlighting the enhanced efficacy and consistency of the D-NPWT protocol over the Continuous NPWT approach ( $p < 0.05$ ).

**Table: Comparative Efficacy of Dakin's Solution NPWT versus Continuous NPWT in Skin Graft Survival and Wound Infection Rates.**

Outcome Parameter	D-NPWT Group (N=50)	C-NPWT Group (N=50)	Statistical Significance (p-value)
Excellent Graft Take (>90-100%)	48 (96%)	30 (60%)	< 0.001
Good Graft Take (75-90%)	2 (4%)	15 (30%)	< 0.001
Moderate Graft Take (50-75%)	0 (0%)	5 (10%)	Not Applicable
Poor Graft Take (<50%)	0 (0%)	0 (0%)	Not Applicable
Graft Failure (0% Take)	0 (0%)	5 (10%)	< 0.05
Wound Site Infection	2 (4%)	12 (24%)	< 0.05

## DISCUSSION

The study presented here offers significant insights into the efficacy of Negative-Pressure Wound Therapy (NPWT), particularly in the context of Dakin's solution instillation (D-NPWT) compared to Continuous NPWT (C-NPWT). The results clearly indicate a superior performance of D-NPWT in terms of graft take and reduced incidence of wound site infection, echoing and extending the findings of previous research in this domain.

The enhanced graft survival rate observed in the D-NPWT group aligns with the evolving understanding of wound healing dynamics. Previous studies, such as those conducted by Thompson et al. (2018), have shown that NPWT aids in wound bed preparation for grafting by promoting granulation tissue formation and removing exudates. The addition of Dakin's solution, as demonstrated in our study, appears to further improve these outcomes, a finding that is consistent with the antiseptic properties of Dakin's solution reported by Patel and Levin (2019). The significantly higher rate of Excellent Graft Take in the D-NPWT group (96% vs. 60% in the C-NPWT group) is a testament to this synergistic effect.

Furthermore, our findings on the reduced incidence of wound site infection in the D-NPWT group corroborate with the study by Jensen et al. (2020), which highlighted the role of adjunctive antiseptic solutions in minimizing bacterial colonization in wound beds. The low infection rate in the D-NPWT group (4%) compared to the C-NPWT group (24%) underscores the importance of considering adjunctive therapies in wound management protocols. The demographic and baseline characteristics of our study population were well-matched with comparable studies in the field, ensuring the generalizability of our findings. The average age and wound sizes were similar to those reported by Smith and Jones (2021), who also noted the prevalence of lower extremity wounds in their NPWT study cohort.

The methodology employed in our study, particularly the use of nonprobability consecutive sampling, aligns with current research trends focusing on real-world clinical settings, as discussed by Lee and Kim (2022). This approach enhances the applicability of our findings to routine clinical practice. A notable aspect of our study was the absence of graft failure in the D-NPWT group, an outcome that starkly contrasts with the 10% failure rate observed in the C-NPWT group. This finding aligns with the research by Gomez and Rodriguez (2017), which suggested that the integration of antiseptic solutions in NPWT could potentially mitigate factors that lead to graft failure.

Our study also sheds light on the optimal duration for dressing application, with the D-NPWT group demonstrating superior outcomes with a shorter initial dressing application period compared to the C-NPWT group. This finding is in line with the recommendations by Adams and Morris (2018), who advocated for tailored dressing application durations based on wound characteristics and therapeutic protocols.

The statistical significance of our results ( $p < 0.05$ ) across all primary and secondary outcome measures provides a robust foundation for the adoption of D-NPWT in clinical practice. These findings have the potential to influence clinical guidelines and protocols, as suggested by the work of Zhang and Liu (2019), who emphasized the need for evidence-based approaches in wound management.

## CONCLUSION

In conclusion, our study provides compelling evidence in favor of the D-NPWT protocol, highlighting its superiority over Continuous NPWT in terms of graft survival and infection control. These findings are poised to contribute significantly to the field of wound care, offering a valuable perspective for clinicians and researchers alike. Further research is warranted to explore the long-term outcomes of D-NPWT and its

applicability across diverse wound types and patient populations.

**Conflict of interest:** None declared.

#### **Authors contribution**

AAS conceptualized the study and led the surgical procedures; TAM contributed to the design and implementation of the research, and to the analysis of the results; LN was involved in patient recruitment and data collection, and played a significant role in the interpretation of the data; RD contributed to drafting the manuscript and revising it critically for important intellectual content. All authors read and approved the final manuscript.

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