Dermatological Health, 2024, Volume 2, Issue 4
http://ojs.bbwpublisher.com/index.php/DH
Online ISSN: 2981-8206

Comparison of Traditional Dressing Change Techniques and Vacuum Sealing Drainage Techniques in the Treatment of Skin and Soft Tissue Injuries

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Abstract: *Objective:* To analyze the therapeutic effects of traditional dressing change techniques and vacuum sealing drainage (VSD) techniques on skin and soft tissue injuries. *Methods:* 60 patients with skin and soft tissue injuries admitted to the hospital from October 2021 to October 2023 were selected. They were randomly divided into an observation group (30 cases) receiving VSD treatment and a control group (30 cases) receiving the traditional dressing change technique. The total effective rate, treatment indicators, inflammatory factors, and complication rate were compared between the two groups. *Results:* The total effective rate of the observation group was higher than that of the control group, and the treatment indicators were better than those of the control group ($P < 0.05$). Before treatment, the levels of inflammatory factors were similar between the two groups ($P > 0.05$). After four weeks of treatment, the levels of inflammatory factors in the observation group were lower than those in the control group ($P < 0.05$). The complication rate of the observation group was lower than that of the control group ($P < 0.05$). *Conclusion:* In the treatment of skin and soft tissue injuries, VSD can improve the total effective rate, shorten the treatment cycle, alleviate the degree of inflammatory reaction, and reduce the risk of complications.

Keywords: Traditional dressing change technique; Vacuum sealing drainage technique; Skin and soft tissue injuries; Total effective rate; Complication rate

Online publication: December 9, 2024

1. Introduction

Soft tissue injury refers to a traumatic syndrome that occurs in skeletal muscles, skin surfaces, or soft tissue sites, with skin damage as the primary manifestation. It can lead to microcirculatory disorders in patients, causing local skin redness and swelling [1]. Minor injuries can heal spontaneously without special treatment,

while more severe skin and soft tissue injuries require standardized therapy and regular dressing changes to accelerate wound healing. Traditional dressing change techniques involve repeated debridement and timed replacement of dressings. Although the operation method is simple, the prolonged exposure time of the wound can easily lead to complications such as infection. Currently, vacuum sealing drainage (VSD) represents a novel dressing change technique for this condition. It can accelerate granulation growth, regulate blood circulation in the wound area, ensure wound cleanliness, and thus promote faster healing [2]. This technology addresses the limitations of traditional dressing change techniques, reducing wound complications while ensuring therapeutic efficacy, thereby offering more significant treatment advantages. Therefore, this study selected 60 patients with skin and soft tissue injuries to evaluate the application effects of traditional dressing change techniques and VSD technology.

2. Materials and methods

2.1. General information

Sixty patients with skin and soft tissue injuries, admitted between October 2021 and October 2023, were included in this study. They were randomly divided into the observation group and the control group using a random number table method, with 30 patients in each group. In the observation group, there were 19 male patients and 11 female patients, with ages ranging from 21 to 61 years old, and a mean age of 39.65 ± 4.18 years. There were nine cases of blunt force crush injuries, 11 cases of traffic accidents, seven cases of mechanical entanglement injuries, and three cases attributed to other causes. In the control group, there were 20 male patients and 10 female patients, aged between 20 and 62 years old, with a mean age of 39.97 ± 4.25 years. There were eight cases of blunt force crush injuries, 12 cases resulting from traffic accidents, six cases of mechanical entanglement injuries, and four cases due to other factors. A comparison of the baseline data between the two groups showed no statistically significant difference ($P > 0.05$).

Patients were included in the study if they met the following criteria: the time from injury to the first debridement was less than 12 hours; they had a clear consciousness and were able to cooperate with dressing changes and treatment; their clinical data was essentially complete; and they were informed about the study and had provided consent.

Patients were excluded from the study if they had any of the following conditions: the presence of psychiatric disorders; comorbidities such as cardiovascular and cerebrovascular diseases; concurrent diseases like sepsis or septicemia; abnormal coagulation function; or allergies to the medications required for the study.

2.2. Methods

The control group received traditional dressing change techniques: Before dressing change, the wound was disinfected with povidone-iodine (0.5%) and irrigated with sodium chloride injection (0.9%) to remove contaminants. The necrotic tissue at the wound edge was trimmed thoroughly. After achieving uniform and minor oozing of blood from the wound, it was covered with Vaseline gauze. If the dressing was contaminated, it was immediately replaced. The treatment cycle was four weeks.

The observation group was treated with VSD: Foreign bodies, exudate, bloody tissue, and necrotic tissue were removed from the wound surface. Foam dressings were selected rationally based on the area and characteristics of the wound. The foam dressing was appropriately drilled, and a drainage tube was inserted

into it, ensuring that both the end hole and side holes of the drainage tube were wrapped within the dressing. The wound surface was filled with the dressing, ensuring tight and gap-free contact. The wound edge and dressing were sutured to prevent the dressing from moving freely. A small amount of sterile gauze dipped in medical alcohol was used to clean and disinfect the skin around the wound, completely removing dirt and grease. The surrounding skin was dried with a dry gauze, and a complete layer of adhesive film (biologically semi-permeable) was applied over the wound. The negative pressure device and drainage tube were connected for 24-hour negative pressure drainage treatment with a negative pressure value of 50–60 kPa. If there was no fluid accumulation under the film and the dressing appeared collapsed, the negative pressure was considered effective. The duration of negative pressure treatment was 7–10 days. After the emergence of new granulation tissue on the wound surface, symptomatic treatments such as second-stage skin grafting were performed. The wound surface was then covered with a foam dressing, and negative pressure treatment was continued for another week. The skin grafting condition was evaluated, and if the wound healed well, ordinary dressings could be used during dressing changes.

2.3. Observation indices

(1) Treatment indices: Treatment indicators were observed such as wound healing time, duration of antimicrobial therapy, number of dressing changes, wound area, pain score (using a visual analog scale ranging from 0 to 10, with higher scores indicating greater pain), and length of hospital stay.

(2) Inflammatory factors: 3 ml of venous blood was collected and an automated cell counter was used to measure white blood cell count (WBC). Additionally, C-reactive protein (CRP) and procalcitonin (PCT) were measured using an automated biochemical analyzer.

(3) Complication rates: The incidence of complications was monitored such as skin necrosis, incision infection, muscle atrophy, flap necrosis, bone blackening, and osteomyelitis.

2.4. Efficacy evaluation criteria

Cured: The wound is dry, with new granulation tissue, no infection, and complete wound healing or a reduction in size of more than 50%. Significant efficacy: The wound has minimal exudate, new granulation tissue, no infection, and a reduction in size ranging from 25% to 50%. No efficacy: The wound has excessive exudate, no new granulation tissue, and a reduction in size of less than 25%.

2.5. Statistical analysis

Data were processed using SPSS28.0 software. Measurement data were expressed as mean ± standard deviation (SD) and compared using the *t*-test. Count data were expressed as frequencies and percentages [*n* (%)] and compared using the chi-square test (χ^2). Statistical significance was set at $P < 0.05$.

3. Results

3.1. Comparison of total effective rates between the two groups

As shown in **Table 1**, the total effective rate of the observation group was significantly higher than that of the control group ($P < 0.05$).

Table 1. Comparison of total effective rates between the two groups [*n* (%)]

Group	*n*	Cured	Significant efficacy	No efficacy	Total effectiveness
Observation group	30	15 (50.00)	14 (46.67)	1 (3.33)	96.67 (29/30)
Control group	30	13 (43.33)	10 (33.33)	7 (23.33)	76.67 (23/30)
χ^2	-	-	-	-	5.192
P	-	-	-	-	0.023

3.2. Comparison of treatment indicators between the two groups

Based on **Table 2**, all treatment indicators in the observation group were significantly better than those in the control group ($P < 0.05$).

Table 2. Comparison of treatment indicators between the two groups [±s]

Group	*n*	Wound healing time (d)	Antimicrobial treatment duration (d)	Number of dressing changes (times)	Wound area (cm^2)	Pain score (points)	Hospitalization time (d)
Observation group	30	14.29 ± 2.61	5.78 ± 1.02	1.98 ± 0.63	10.11 ± 1.54	1.87 ± 0.43	18.31 ± 2.60
Control group	30	27.61 ± 3.99	11.26 ± 1.09	9.85 ± 1.27	14.69 ± 1.68	3.80 ± 0.56	27.19 ± 2.72
t	-	15.302	20.106	30.406	11.007	14.972	12.926
P	-	0.000	0.000	0.000	0.000	0.000	0.000

3.3. Comparison of inflammatory factors between the two groups

Before treatment, the levels of inflammatory factors were similar between the groups ($P > 0.05$). After treatment, the levels of inflammatory factors in the observation group were significantly lower than those in the control group ($P < 0.05$), as presented in **Table 3**.

Table 3. Comparison of inflammatory factors between the two groups (mean ± SD)

Group	*n*	WBC ($\times 10^9$/L)		CRP (mg/L)		PCT (ng/ml)	
		Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
Observation group	30	16.79 ± 2.05	5.38 ± 0.47	61.59 ± 6.77	3.23 ± 0.42	1.38 ± 0.36	0.23 ± 0.05
Control group	30	16.82 ± 2.09	9.41 ± 0.52	61.52 ± 6.72	9.17 ± 1.55	1.41 ± 0.39	0.61 ± 0.09
t	-	0.056	31.491	0.040	20.260	0.310	20.216
P	-	0.955	0.000	0.968	0.000	0.758	0.000

3.4. Comparison of complication rates between two groups

According to **Table 4**, the complication rate in the observation group was significantly lower than that in the control group ($P < 0.05$).

Table 4. Comparison of complication rates between two groups [*n* (%)]

Group	*n*	Skin necrosis	Incision infection	Muscle atrophy	Skin flap necrosis	Blackened bone	Osteomyelitis	Incidence rate
Observation group	30	0	0	1（3.33)	1（3.33)	0	0	6.67（2/30)
Control group	30	1 (3.33)	1 (3.33)	2 (6.67)	2 (6.67)	1 (3.33)	1 (3.33)	26.67 (8/30)
χ^2	-	-	-	-	-	-	-	4.320
P	-	-	-	-	-	-	-	0.038

4. Discussion

Soft tissue injury is a common condition in the locomotor system, often caused by external forces such as traffic accidents and mechanical injuries. It manifests as bleeding and severe pain in the affected area and can affect the blood circulation status of surrounding tissues, leading to serious complications. Compared with other soft tissues, skin tissue has a greater thickness, rich sebaceous glands, and hair follicles, but poor mobility. Due to its superficial location, skin is prone to severe injury under external forces and has a high infection rate [3]. Therefore, early treatment of skin and soft tissue injuries is necessary for thorough debridement, accelerated wound healing, and improved prognosis.

Conventional dressing change technique is a commonly used treatment for this condition, allowing regular debridement and dressing changes to promote good wound healing. However, this therapy has limitations, including a long treatment cycle, frequent dressing changes, and increased risk of complications such as infection and skin flap necrosis, which can cause significant physical and psychological stress to patients [4]. VSD, a novel treatment method, can thoroughly remove wound exudate, allowing harmful substances and necrotic tissue to be fully discharged. Simultaneously, it can isolate the wound from the external environment, preventing prolonged exposure to air and reducing infections. The highly permeable dressing used in VSD can regulate blood circulation around the skin, accelerating healing. Additionally, this technique does not require multiple dressing changes, causing minimal pain, and thus has a higher acceptance rate among patients [5].

The results showed that the total effective rate of the observation group was higher than that of the control group, and all treatment indicators were better in the observation group ($P < 0.05$). This is because VSD, as an emerging treatment technology, combines the therapeutic effects of irrigation and sealing, providing continuous negative pressure suction therapy to the wound. Irrigation therapy prevents the dressing from drying out or blocking the wound tissue [6]. The purpose of sealing therapy is to completely seal the wound, isolating it from the external environment and preventing complications such as cross-infection. Negative pressure suction provides adequate and comprehensive drainage treatment to the wound, preventing the formation of necrotic tissue, avoiding bacterial accumulation on the wound surface, and reducing bleeding and fluid leakage [7]. Furthermore, negative pressure suction can accelerate granulation tissue growth, prevent tissue edema, regulate the microcirculation status around the wound, accelerate wound healing, and quickly reduce the wound area without requiring frequent dressing changes.

After treatment, the level of inflammatory factors in the observation group was lower than that in the control group ($P < 0.05$). This is because this technology is simple, easy to implement, and can reduce the number of times the wound is exposed to air, preventing bacteria from colonizing the wound surface in large numbers. Therefore, it does not easily lead to significant inflammatory reactions [8]. Additionally, this

technology allows for standardized antibiotic treatment regimens tailored to the specific conditions of the wound, preventing antibiotic abuse and effectively controlling inflammatory responses.

The complication rate in the observation group was lower than that in the control group ($P < 0.05$). This is because VSD treatment fully covers the wound with a dressing, uses a bio-semi-transparent membrane for strict sealing, and provides thorough irrigation and continuous drainage to maintain a moist environment in the wound. This preserves nutrients and active substances such as tissue proteinases, which dissolve necrotic tissue and prevent complications such as infection [9]. Negative pressure irrigation can drain wound secretions, remove necrotic tissue, maintain wound cleanliness, and promote rapid granulation tissue growth. Therefore, the incidence of skin necrosis and muscle atrophy is low. However, it is important to note that before VSD treatment, the wound should be thoroughly cleaned to ensure the dressing closely adheres to the wound, improving blood circulation and exerting the hemostatic effect of the dressing. Simultaneously, dynamic evaluation of the wound condition and reasonable adjustment of negative pressure are necessary to ensure efficacy [10].

5. Conclusion

In summary, VSD demonstrates excellent efficacy in the treatment of skin and soft tissue injuries. It can shorten patients' recovery time, reduce inflammatory responses in the body, and actively prevent complications, exhibiting significant therapeutic advantages.

Disclosure statement

The author declares no conflict of interest.

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