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Effectiveness of Biatain Silver Dressing versus Simple Vaseline Gauze in the Healing of Skin Graft Burn Wounds

Mostafa Dahmardehei[1], Ali Dahmardehei[2], Zahra Dahmardehei[3*], Maryam Milanifard[4,5] Sahar Rezaei[6], Hamidreza Atashhoosh[7]

[1]Plastic Surgeon, Burn and stem cell Regenerative Medicine Research Center, Iran University of Medical Sciences, Tehran, Iran;
[2]General Surgery Resident, Tehran University of Medical Sciences, Tehran, Iran
[3]General Practitioner, Iran University of Medical Sciences, Shahriar Hospital, Iran
[4]Trauma and Injury Research Center, Iran University of Medical Sciences, Tehran, Iran
[5]Student Research Committee, Iran University of Medical Sciences, Tehran, Iran
[6]Bachelor of Nursing, Sales Manager in Coloplast, Tehran, Iran
[7]Master of Economics, Vise President of Sales and Commercial Affairs, Tehran, Iran

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ABSTRACT

Background: Burn wounds treated with skin grafts are associated with risks of infection and delayed healing, making effective treatment crucial. Biatain Silver dressing, through the release of silver ions, possesses strong antibacterial and anti-biofilm properties that can accelerate the wound healing process. This randomized controlled trial evaluates the efficacy of Biatain Silver dressing compared to conventional dressing in skin graft burn wounds. The study aims to reduce microbial load, promote re-epithelialization, and shorten wound healing time.

Methods: This randomized controlled trial was conducted on 60 burn patients with skin grafts at Motahari Burn Hospital in Tehran, who were randomly assigned to two groups receiving either Biatain Silver dressing or conventional dressing. Assessments included clinical examinations and wound cultures on days 7, 14, and 21 post-intervention. Data were analyzed using SPSS version 22, with a significance level set at $p \leq 0.05$.

Results: The study results showed that Biatain Silver dressing significantly reduced wound size ($p=0.00$), wound exudate ($p=0.00$), and patient pain intensity ($p<0.001$), while accelerating the epithelialization process ($p=0.00$). Additionally, the percentage of negative wound culture results was significantly higher in the intervention group ($p=0.00$). These findings confirm the efficacy of Biatain Silver dressing in faster wound healing and infection control in burn wounds.

Conclusion: The results of this study demonstrated that Biatain Silver dressing effectively reduces wound exudate, controls infection and pain, and accelerates the epithelialization process. By creating a moist environment and gradually releasing silver ions, this dressing decreases microbial load and local inflammation. Therefore, Biatain Silver is an efficient option for managing burn wounds and warrants further investigation with larger sample sizes.

Corresponding Author: **Ali Dahmardehei (Email:Ali.phoenix1373@gmail.com)*
[1]Email:m.dahmardehei@gmail.com
[3]Email: Loya_dahmardeh@yahoo.com
[4,5]Email:maryammilani837@yahoo.com
[6]Email:saharrezaei557@gmail.com
[7]Email: Hamidreza.atashhoosh@gmail.com

Introduction

Burns are among the most common traumatic injuries worldwide, imposing significant clinical, economic, and psychological burdens on patients and healthcare systems(1). According to the World Health Organization (WHO), over 11 million people annually require medical care due to burns, with approximately 180,000 fatalities(2). Skin graft burn wounds are typically accompanied by symptoms such as localized inflammation, pain, exudate, edema, and an increased risk of infection, necessitating careful management(3). Inadequate management can lead to extensive scarring, functional impairments in affected limbs, and psychological disorders(4). Furthermore, insufficient or delayed wound healing substantially raises the risk of local and systemic infections, including sepsis, which accounts for up to 65% of mortality in burn centers(5). Delayed healing also prolongs hospitalization, increases the need for specialized care, and escalates both direct and indirect treatment costs(6). For instance, a study conducted in the Netherlands reported an average treatment cost of approximately €26,540 within the first three months post-injury, largely due to prolonged wound healing and ongoing care requirements(7). Additionally, burn scars are associated with chronic pain, itching, and psychological issues such as depression and anxiety, significantly diminishing patients' quality of life(8). Effective treatment of skin graft burn wounds plays a vital role in accelerating healing and preventing secondary infections(9). Selecting an appropriate dressing, particularly advanced silver-containing dressings like Biatain Silver, can significantly control microbial load and disrupt resistant biofilms(3). These dressings release silver ions steadily, exhibiting broad-spectrum antibacterial properties that inhibit resistant bacteria such as MRSA and Pseudomonas, reduce inflammation, and promote re-epithelialization(10). The three-dimensional foam structure of Biatain Silver provides high exudate absorption and soft adhesion, minimizing pain during dressing changes(11). Moreover, these dressings maintain a moist wound environment, optimizing tissue regeneration and protecting healthy cells from damage(12).

Clinical studies have demonstrated that silver-containing dressings, compared to traditional dressings like simple Vaseline gauze, reduce infection rates, accelerate wound healing, and decrease scar formation, thereby improving burn patients' quality of life(13).

Despite preliminary evidence supporting the positive effects of silver ion dressings such as Biatain Silver on burn wound healing, definitive and generalizable conclusions cannot yet be drawn. Many previous studies have been limited by small sample sizes, non-randomized designs, or focus on specific patient groups. Furthermore, direct comparisons between silver dressings and traditional dressings like simple Vaseline gauze in randomized controlled trials, especially in patients with skin graft burn wounds, remain insufficient. This research gap highlights the need for well-designed, rigorous studies to generate reliable and generalizable evidence. The present study was designed to address this need and fill the scientific gap.

The aim of this study is to evaluate and compare the efficacy of two types of dressings—Biatain Silver and conventional dressing—in accelerating the healing process of skin graft burn wounds. This randomized controlled trial is designed to control confounding variables precisely and provide reliable, generalizable results. The primary hypothesis is that Biatain Silver dressing, compared to conventional dressing, reduces microbial load, accelerates re-epithelialization, and shortens wound healing time. The findings of this study may offer scientific guidance for selecting more effective therapeutic approaches in the clinical management of skin graft burn wounds.

Study Design

This study was conducted as a randomized controlled trial with a control group at Motahari Burn Hospital in Tehran during the years 2024 to 2025, aiming to evaluate the efficacy of Biatain Silver dressing compared to conventional dressing in accelerating the healing of skin graft burn wounds.

Participants: The target population of this study included all patients with skin graft burn wounds, and the study population comprised all burn patients referred to Motahari Burn Hospital in Tehran. In this research, 60 patients with this type of wound were selected through convenience sampling and randomly assigned into two groups of 30 each.

Inclusion criteria: were age between 12 and 60 years and having skin graft burn wounds. Exclusion criteria included underlying conditions affecting wound healing (such as uncontrolled diabetes or immunodeficiency), use of immunosuppressive drugs, active infection at the wound site, and any other medical conditions that could influence the wound healing process and consequently affect the study outcomes.

Randomization: Block randomization with a block size of six was used to allocate participants into the intervention group (Biatain Silver dressing) and the control group (conventional dressing) to maintain balance in the number of participants in each group throughout the study. The allocation sequence was randomly generated using all possible combinations within six-person blocks. To prevent bias and enhance internal validity, group assignments were concealed using sealed, coded envelopes containing only the participant's number, which were opened

sequentially upon patient enrollment. The study was designed as double-blind, with both patients and outcome assessors blinded to group allocation to minimize bias in outcome evaluation. However, the interventions were administered by the clinical team, who could not be blinded.

Interventions: In this randomized controlled trial (RCT), two groups of patients with skin graft burn wounds received the following interventions. In the intervention group, after initial assessment of second-degree skin graft burn wounds, Biatain Silver dressing (Biatain Ag) from Coolest Company was selected as the treatment. Wounds were first prepared under strict sterile and hygienic conditions. The dressing was then carefully cut to fit the size and shape of the wound and applied using 3DFit technology to ensure maximum contact and conformity with the wound bed. This precise fit reduced exudate accumulation beneath the dressing and improved healing conditions. Dressings were regularly changed every 3 to 7 days based on wound exudate and condition. During each change, the old dressing was carefully removed, and the wound was evaluated for signs of infection, exudate amount, and healing status. If necessary, gentle cleansing with sterile solutions was performed before applying a new dressing in the same manner. All procedures were carried out by trained wound care specialists following standard protocols to maintain sterility while minimizing pain and damage to healthy tissues. This process continued until complete wound healing and patient discharge.

In the control group, skin graft burn wounds were covered with simple Vaseline gauze. After thorough wound assessment and initial cleansing, appropriately sized Vaseline gauze was placed completely over the wound bed to prevent direct contact with environmental factors and maintain suitable moisture for healing. Dressings were regularly changed every 2 to 3 days by wound care specialists. At each dressing change, the old dressing was carefully removed, and the wound was assessed for exudate, infection signs, and healing progress. Gentle cleansing with sterile solutions was performed as needed to prepare the wound bed for the new dressing. This protocol aimed to maintain hygiene, prevent excessive wound dryness, and reduce the risk of secondary infection. Supportive care and patient education on hygiene and injury prevention were provided. The process continued until full wound healing and patient discharge. In both groups, wound exudate samples were collected at different treatment stages for microbial culture to assess microbial load and presence or absence of pathogenic flora. Samples were taken under sterile conditions before dressing changes and after wound cleansing and sent to the microbiology laboratory. To maintain blinding, outcome assessors were unaware of the type of dressing used, and wound care providers responsible for dressing changes were separate from the assessors.

Characteristics of Biatain Silver Dressing (Biatain Ag): Biatain Ag dressing features 3DFit technology, providing optimal conformity to the wound bed and controlled, sustained release of silver ions (Ag+) for up to 7 days. These ions exert strong antibacterial and anti-biofilm effects by inhibiting bacterial respiratory systems, disrupting cell division, and blocking material transport to the cell wall, achieving up to 99.99% eradication of mature biofilms including Pseudomonas aeruginosa in laboratory tests. The dressing has a three-dimensional foam structure that allows vertical absorption and proper retention of exudate, while its soft adhesion reduces pain during dressing changes. It is suitable for wounds with low to high exudate levels, including second-degree burns, diabetic ulcers, pressure ulcers, postoperative wounds, and trauma wounds. Additionally, it is compatible with MRI imaging up to 3 Tesla field strength.

Outcome Measures: The primary outcome of this study was a detailed clinical assessment of the wound, including evaluation of characteristics such as appearance, color, odor, depth, and size by a wound care specialist through direct examination of the affected area. Secondary outcomes included the overall wound healing process, absence of infection, effectiveness of antibiotics in infection control, prevention of microbial biofilm formation, re-epithelialization (regeneration of epithelial cells over the wound), and the microbial status of the wound based on culture results. These variables were monitored at specific time points post-intervention, particularly on days 7, 14, and 21, and were assessed based on clinical evaluations and recorded observations by wound care experts. All outcomes were systematically documented and analyzed by trained assessors to accurately and comprehensively evaluate the effects of the therapeutic interventions on wound healing.

Sample Size Calculation: The sample size for this study was determined using the formula for comparing means between two independent groups, considering a significance level of 0.05 (α=0.05) and a power of 80% (Power=80%). Input parameters included the mean difference in wound healing time between the two groups and the pooled standard deviation based on a similar study with a sample size of 60, which reported an average healing time difference of approximately 7 days and a pooled standard deviation of 10 days(14). Accounting for potential dropout, a total of 60 participants (30 per group) were ultimately selected to ensure sufficient power to detect a significant difference between the groups.

Statistical Analysis: Data were analyzed and graphs were generated using SPSS software version 22, with a statistical significance level set at $p \leq 0.05$.

Results

Normality of continuous data was assessed using the Shapiro–Wilk test. Non-normally distributed data were analyzed with non-parametric tests. Numerical data are presented as mean ± standard deviation, and categorical data as frequency (percentage). Independent t-test or Mann–Whitney test was used to compare numerical variables, while Chi-square or Fisher's exact test was applied for categorical variables. A p-value less than 0.05 was considered statistically significant. Baseline characteristics of participants in the intervention (n=30) and control (n=30) groups are presented in Table 1. The mean age was 34.47 ± 11.97 in the control group and 34.37 ± 10.99 in the intervention group, with no significant difference between groups (p=0.973, t-test). Gender distribution was similar, with 51.6% males in the control group and 51.7% in the intervention group (p=0.796, Chi-square test). Wound color showed no statistically significant difference between groups (p=0.443). Overall, results indicated homogeneity between the two groups regarding baseline characteristics including age, gender, burn type, wound location, and wound count, with no significant differences observed.Groups were also homogeneous in terms of wound location (Trunk, Upper Limb, Lower Limb, Other) (p=0.528) and wound count (p=0.855). Similarly, wound color did not differ significantly (p=0.443). These findings confirm the comparability of the two groups in baseline variables without significant differences.

Table 1. Baseline Demographic Characteristics and Burn Profiles of Patients in the Intervention and Control Groups

Variable	Intervention Group Biatain Silver dressing (n=30)	Control Group Petrolatum gauze (n=30)	Statistical Test	p-value
Age	34.37 ± 10.997	34.47 ± 11.973	T-TEST	0.973
Gender – Male, n (%)	15 (51.7%)	16 (51.6%)	Chi-Square Test	0.796
Gender – Female, n (%)	15 (48.4%)	14 (48.3%)	Chi-Square Test	0.796
Wound Location – Trunk, n (%)	8 (66.7%)	4 (33.3%)	Chi-Square Test	0.528
Wound Location – Upper Limb, n (%)	10 (50%)	10 (50%)	Chi-Square Test	0.528
Wound Location – Lower Limb, n (%)	7 (38.9%)	11 (61.1%)	Chi-Square Test	0.528
Wound Location – Other, n (%)	5 (50%)	5 (50%)	Chi-Square Test	0.528
Number of Wounds	2.50 ± 1.456	2.43 ± 1.357	T-TEST	0.855
Wound Color – Pink	2 (100%)	0 (0.0%)	Chi-Square Test	0.443
Wound Color – Red	9 (56.3%)	7 (43.8%)	Chi-Square Test	0.443
Wound Color – Yellow	9 (52.9%)	8 (47.1%)	Chi-Square Test	0.443
Wound Color – Brown	9 (42.9%)	12 (57.1%)	Chi-Square Test	0.443
Wound Color – Black	1 (25%)	3 (75%)	Chi-Square Test	0.443

The primary and secondary outcomes of the study are summarized in Table 2. There was no significant difference in wound size (TBSA%) on day 0 between the simple petrolatum gauze dressing group (control) and the Biatain Silver dressing group (intervention) (mean 30.33 in control vs. 30.67 in intervention, p=0.941). However, the intervention group demonstrated a significant improvement in wound healing over time; on days 14 and 21, wound size was significantly smaller compared to the control group (p=0.00).

Wound exudate levels on days 14 and 21 also showed a significant difference between groups (p=0.00), with the intervention group exhibiting lower exudate amounts. Pain intensity was significantly lower in the Biatain Silver group at all measured time points (p<0.01). Although pain intensity was slightly higher in the intervention group on day 0 (p=0.009), a significant reduction was observed on days 7, 14, and 21 compared to the control group (p<0.001), indicating the efficacy of Biatain Silver dressing in pain relief for burn patients.

Epithelialization progressed significantly faster in the intervention group on days 14 and 21 compared to the control group (p=0.00), reflecting accelerated wound healing with Biatain Silver dressing. Additionally, wound culture results on days 7, 14, and 21 revealed a significant difference between groups, with the intervention group showing a higher percentage of negative cultures (no infection) (p=0.00), indicating the positive impact of Biatain Silver in reducing wound infections. Specifically, on days 7 and 14, 30 samples (58.8%) in the intervention group were culture-negative with no positive samples reported (p=0.00). On day 21, 30

samples (56.6%) remained negative with no positive cultures (p=0.00). These findings demonstrate a significant reduction in wound infection rates in the intervention group compared to control, confirming the treatment's effectiveness in managing burn wound infections. Clinical infection rates on days 7, 14, and 21 showed no significant difference on day 7 (p=0.78), with 47.6% (10 patients) uninfected and 51.3% (20 patients) clinically infected. However, on days 14 and 21, a significant difference was observed (p=0.02); all patients in the intervention group were free of clinical infection (100% uninfected), whereas 54.4% of control patients remained infection-free. These results highlight the positive effect of the intervention in reducing clinical wound infections during follow-up.At baseline (day 0), wound status distribution was similar between control (petrolatum gauze) and intervention (Biatain Silver) groups, evenly divided among clean, exudative, and malodorous wounds (p=1.00). Over time, the intervention group showed marked improvement; on days 7 and 14, fewer infected and exudative wounds were observed compared to control, and by day 21, the majority of wounds in the intervention group (90.6%) were clean, with a significant reduction in infected and exudative wounds (p=0.00). Conversely, the control group exhibited less pronounced improvement in infection signs, exudate, and odor. These results indicate that Biatain Silver dressing is more effective than petrolatum gauze in improving wound appearance and reducing infection signs, exudate, and malodor, thereby significantly accelerating the healing process of burn wounds. Overall, the study findings demonstrate that Biatain Silver dressing significantly improves burn wound healing compared to petrolatum gauze. The intervention group showed faster wound size reduction, lower exudate levels, and decreased pain intensity. Moreover, epithelialization was accelerated, and the proportion of negative wound cultures and clinical infection reduction were higher in the Biatain Silver group. Wound appearance also improved markedly, with significant decreases in infection signs, exudate, and odor. Collectively, these results confirm the effectiveness of Biatain Silver dressing in accelerating healing, reducing infection, and alleviating pain in burn patients, supporting its use as an effective treatment option in burn wound care.

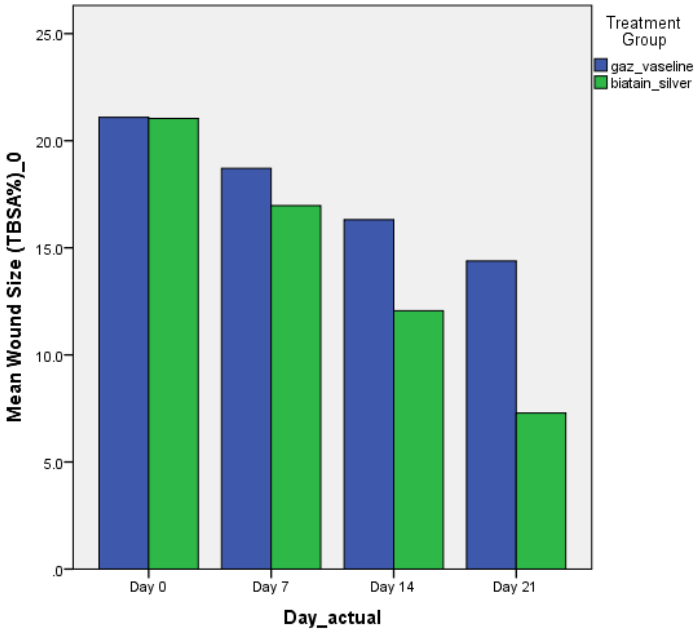

Figure 1. Illustrates a bar chart depicting changes in wound size in the study groups on days 0, 7, 14, and 21.

The horizontal axis represents the follow-up days, while the vertical axis indicates the mean wound size. This chart demonstrates the trend of wound size reduction over time, showing that wound sizes decreased in both groups as time progressed. Moreover, a significant difference between the intervention and control groups is evident, with the intervention group exhibiting a faster and greater reduction in wound size compared to the control group, indicating the effectiveness of the therapeutic intervention in accelerating wound healing.

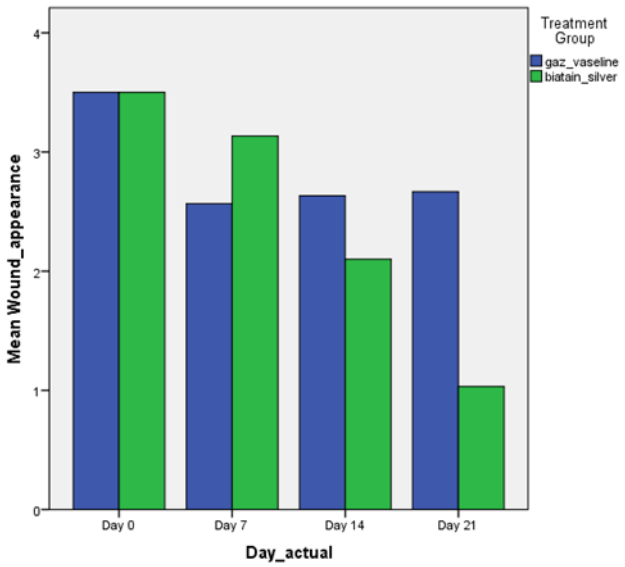

Figure 2. Presents a bar chart illustrating changes in the wound appearance status in the study groups on days 0, 7, 14, and 21.

The horizontal axis represents the follow-up days, while the vertical axis shows the percentage of wounds that were clean, free of exudate, and without malodor. This chart depicts the trend of improvement and cleanliness of wound appearance over time, demonstrating an increasing percentage of healthy wounds as time progresses. Furthermore, a significant difference between the intervention and control groups is observed, with the intervention group consistently showing a higher percentage of clean wounds without signs of infection at all follow-up points, indicating the effectiveness of the therapeutic intervention in improving wound appearance.

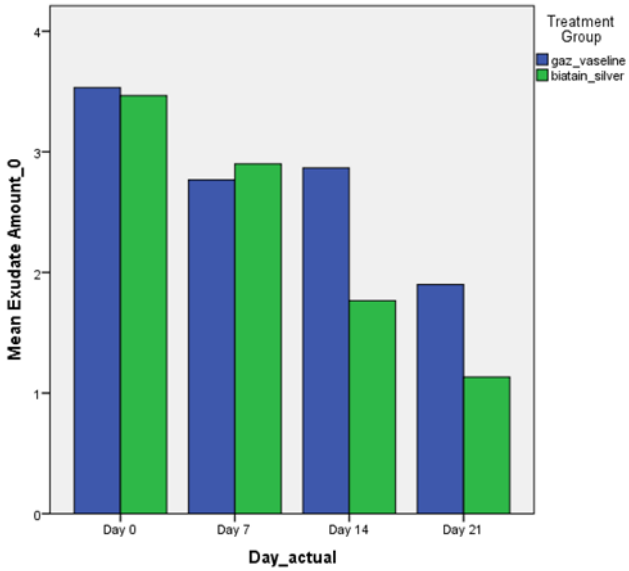

Figure 3. Presents a bar chart illustrating changes in wound exudate levels in the study groups during the follow-up periods.

The horizontal axis represents the measurement days, while the vertical axis indicates the percentage of wounds that were either free of exudate or exhibited reduced exudate. This chart demonstrates the trend of decreasing wound exudate over time. Additionally, the intervention group consistently showed a higher percentage of wounds with no or reduced exudate compared to the control group across all follow-up days, indicating the positive effect of the therapeutic intervention in reducing exudate and improving wound status.

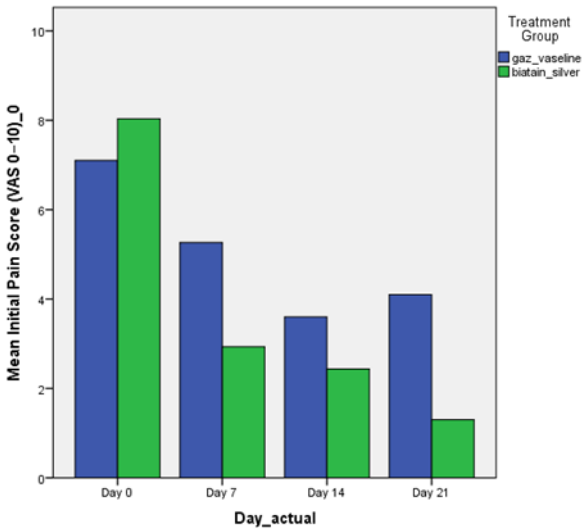

Figure 4. Presents a bar chart illustrating changes in pain intensity in the study groups during the follow-up periods.

The horizontal axis represents the measurement days, while the vertical axis shows the pain intensity reported by patients. This chart demonstrates a significant reduction in pain over time, with the intervention group experiencing a greater decrease in pain levels compared to the control group, indicating the effectiveness of the therapeutic intervention in alleviating pain in patients.

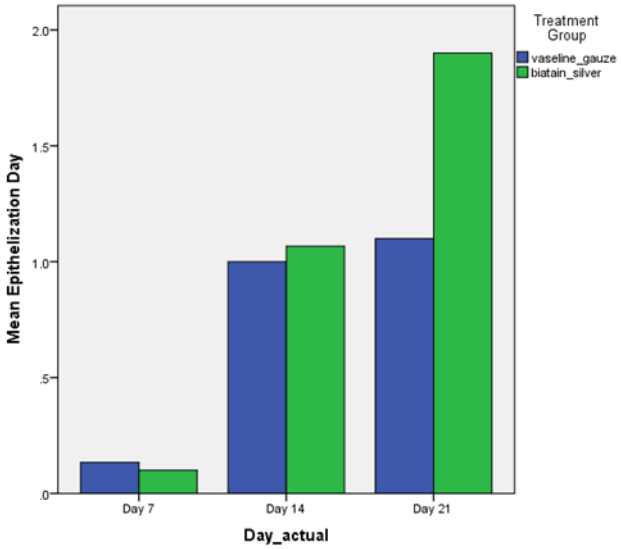

Figure 5. Presents a bar chart illustrating changes in wound epithelialization in the study groups during the follow-up periods.

The horizontal axis represents the measurement days, while the vertical axis indicates the percentage or extent of epithelialization progress. This chart depicts the gradual growth and spread of epithelial cells across the wound surface, reflecting skin repair and regeneration. Moreover, the intervention group demonstrated a faster rate and greater extent of epithelialization compared to the control group, indicating the effectiveness of the therapeutic intervention in accelerating the wound healing process.

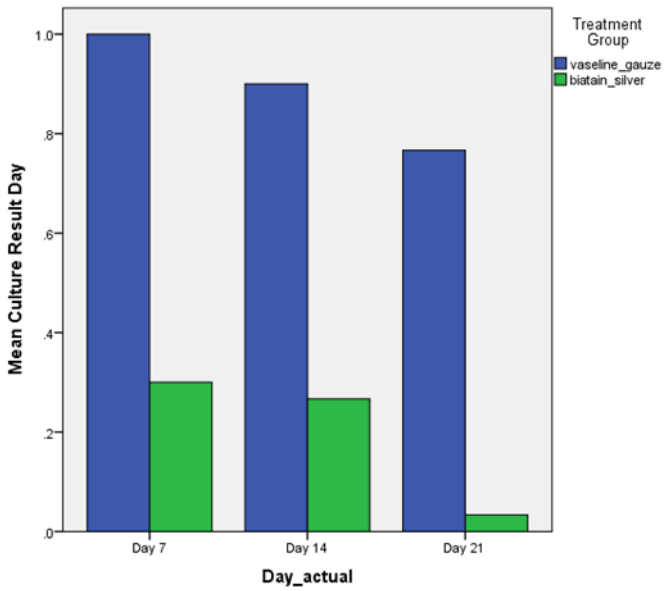

Figure 6. Presents a bar chart illustrating changes in wound culture results in the study groups during the follow-up periods.

The horizontal axis represents the measurement days, while the vertical axis shows the percentage of samples with either positive or negative culture results. This chart depicts the trend of wound infection status over time. Additionally, the intervention group exhibited a lower percentage of positive culture results compared to the control group, indicating the effectiveness of the therapeutic intervention in reducing infection and improving wound condition.

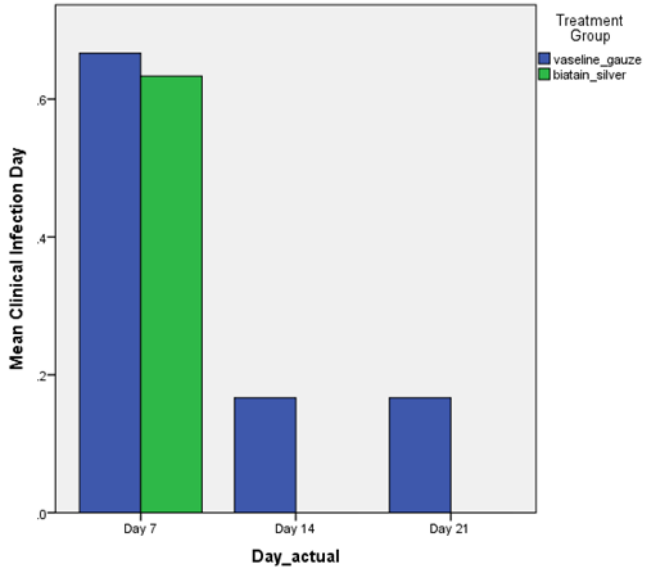

Figure 7. Presents a chart illustrating changes in the incidence of clinical infection in the study groups during the follow-up periods.

The horizontal axis represents the measurement days, while the vertical axis indicates the percentage of patients exhibiting clinical signs of infection. This chart demonstrates the trend of clinical infection status over time. Additionally, the intervention group consistently showed a lower percentage of patients with clinical infection compared to the control group at all follow-up points, indicating the positive impact of the therapeutic intervention in reducing clinical infections and improving patient outcomes.

Table 2. Primary and Secondary Clinical Outcomes and Statistical Comparison Between Study Groups

Variable	Biatain Silver dressing Group (Intervention)	Petrolatum gauze Group (Control)	Statistical Test	P-value
Wound Size (TBSA%)_0	30.67	30.33	Mann-Whitney Test	0.941
Wound Size (TBSA%)_7	16.967 ± 16.967	18.713 ± 2.6389	T-TEST	0.083
Wound Size (TBSA%)_14	18.67	42.33	Mann-Whitney Test	0.00*
Wound Size (TBSA%)_21	15.50	45.50	Mann-Whitney Test	0.00*
Exudate Level_0	Moderate (53.3%) 16 High (46.7%) 14	(46.7%) 14 (53.3%) 16	Chi-Square Test	0.60
Exudate Level_7	Low (30%) 3 Moderate (54%) 27	(70%) 7 (46%) 23	Chi-Square Test	0.16
Exudate Level_14	None (100%) 12 Low (59.1%) 13 Moderate (23.8%) 5 High (0.00%) 0	(0.00%) 0 (40.9%) 9 (76.2%) 16 (100%) 0	Chi-Square Test	0.00*
Exudate Level_21	None (89.7%) 26 Low (12.9%) 4	(10.3%) 3 (87.1%) 27	Chi-Square Test	0.00*
Pain VAS Initial_0	36.23	24.77	Mann-Whitney Test	0.009*
Pain VAS Initial_7	17.02	43.98	Mann-Whitney Test	0.00*
Pain VAS Initial_14	18.38	42.62	Mann-Whitney Test	0.00*
Pain VAS Initial_21	15.63	45.37	Mann-Whitney Test	0.00*
Epithelialization_7	None (50.9%) 27 Partial (42.9%) 3	(49.1%) 26 (57.1%) 4	Chi-Square Test	0.68
Epithelialization_14	None (100%) 1 Partial (46.4%) 26 Complete (100%) 3	(0.00%) 0 (53.6%) 30 (0.00%) 0	Chi-Square Test	0.11
Epithelialization_21	Partial (10%) 3 None (90%) 27	(90%) 27 (10%) 3	Chi-Square Test	0.00*
Culture Result_7	Positive (0.00%) 0 Negative (58.8%) 30	٩ (%١٠٠) (41.2%) 21	Chi-Square Test	0.00*
Culture Result_14	Positive (0.00%) 0 Negative (58.8%) 30	٩ (%١٠٠) ٢١ (%٤١,٢)	Chi-Square Test	0.00*
Culture Result_21	Positive (0%) 0 Negative (56.6%) 30	(%١٠٠)7 (43.4%) 23	Chi-Square Test	0.00*
Clinical Infection_7	No (52.4%) 11 Yes (48.7%) 19	(47.6%) 10 (51.3%) 20	Chi-Square Test	0.78
Clinical Infection_14	No (54.4%) 30 Yes (0.00%) 0	(45.5%) 25 (100%) 5	Chi-Square Test	0.02*
Clinical Infection_21	No (54.4%) 30 Yes (0.00%) 0	(45.5%) 25 (100%) 5	Chi-Square Test	0.02*
Wound Appearance_0	Exudative (50%) 15 Odor (50%) 15	(50%) 15 (50%) 15	Chi-Square Test	1.00
Wound Appearance_7	Infected (31.6%) 6	(68.4%) 13	Chi-Square Test	0.002*

	Exudative (45.2%) 14 Odor (100%) 10	(54.8%) 17 (0.00%) 0		
Wound Appearance_14	Infected (64.3%) 27 Exudative (21.4%) 3 Odor (0.00%) 0	(35.7%) 15 (78.6%) 11 (100%) 4	Chi-Square Test	0.002*
Wound Appearance_21	Clean (90.6%) 29 Infected (7.7%) 1 Exudative (0.00%) 0 Odor (0.00%) 0	(9.4%) 3 (92.3%) 12 (100%) 7 (100%) 8	Chi-Square Test	0.00*

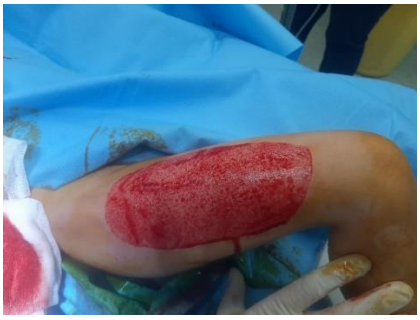

Figure 8. Before using Coloplast silver biatine dressing on a 4-year-old girl

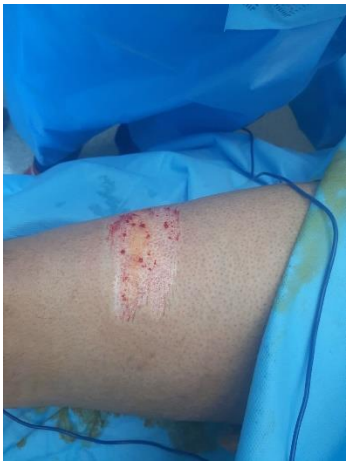

Figure 9. 10 days after using Coloplast silver biatine dressing on a 4-year-old girl

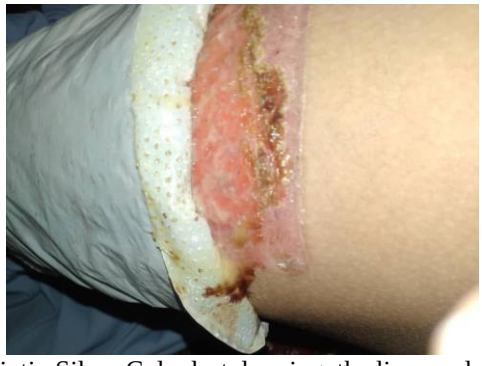

Figure 10. After removing the Biotin Silver Coloplast dressing, the lines and patterns on the skin are related to the use of Biotin.

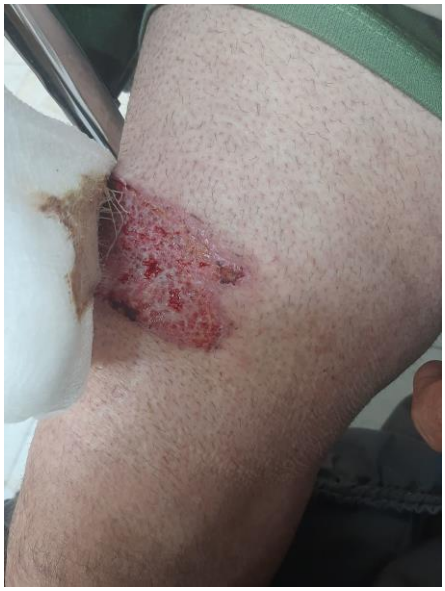

Figure 11. After using the pan, it healed very quickly, considering the depth of the area removed.

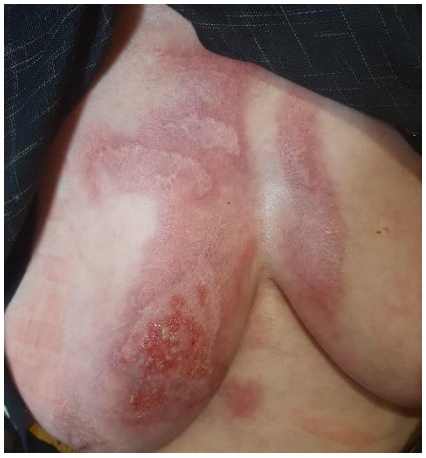

Figure 12. After using the silver biatine dressing.

Discussion

The Effect of Biatain Silver Dressing on the Healing of Skin-Grafted Burn Wounds and Reduction of Exudate and Wound Size .The present study demonstrated that silver-containing dressings significantly accelerate the reduction of burn wound size. This finding is consistent with the clinical trial by Muangman et al. (2010), which compared silver-containing hydro fiber dressings with 1% silver sulfadiazine cream and showed that silver dressings lead to faster healing and wound size reduction(15). Additionally, a recent study by Yazaluo et al. (2023) investigating hydrogel dressings containing silver nanoparticles confirmed that these dressings accelerate the healing of second-degree burn wounds and reduce wound size(16).These effects are attributed to the strong antimicrobial properties of silver, maintenance of a moist environment, and reduction of local inflammation, which together provide optimal conditions for repair and epithelialization. These findings emphasize the importance of using advanced silver dressings in burn wound care to accelerate healing. The reduction of wound exudate levels in the Biatain Silver dressing group on days 14 and 21 indicates better control of inflammation and infection. Silver dressings create a suitable moist environment and reduce exudate due to effective absorption of exudate and controlled release of silver ions. Lafontaine et al. (2023) also highlighted that these dressings prevent secondary infections by reducing exudate and accelerate the healing process. These features reduce infection risk and promote faster repair(17).

Reduction of Pain and Improvement of Patient Quality of Life with Biatain Silver Dressing.The significant reduction in pain intensity in the Biatain Silver dressing group aligns with similar study findings. Muangman et al. (2023) demonstrated that silver dressings effectively reduce pain in burn patients by maintaining a moist environment and decreasing local inflammation. This pain reduction not only improves patients' quality of life but also facilitates more comfortable dressing changes and better wound care(15). Therefore, Biatain Silver dressing can be considered an effective therapeutic

option for alleviating discomfort symptoms in burn patients. Improvement of Epithelialization and Wound Appearance with Biatain Silver Dressing.The epithelialization process was significantly accelerated in the Biatain Silver dressing group. Silver dressings stimulate epithelial cell growth by creating a moist environment and controlling microbial load. Li et al. (2017) reported that these dressings enable faster skin repair by reducing infection and maintaining moisture(18). Silver dressings facilitate the removal of necrotic tissue and maintain wound moisture, providing favorable conditions for new cell growth. Improved wound appearance is important not only cosmetically but also as an indicator of reduced inflammation and infection, which can help decrease scarring and enhance skin function. The wound appearance in the Biatain Silver group showed significant improvement, with greater reductions in infection signs, exudate, and malodor. Luo et al. (2022) demonstrated that silver dressings accelerate wound appearance improvement and reduce infection symptoms. These results underscore the importance of specialized care and advanced dressings in enhancing burn patients' quality of life(19).Role of Biatain Silver Dressing in Infection Control and Improvement of Wound Microbiological Status .Biatain Silver dressing exhibits strong antibacterial activity through gradual release of silver ions and is highly effective in controlling wound infections. Multiple clinical studies have reported that these dressings reduce microbial burden and clinical infections in burn wounds. Lazareth et al. (2012) emphasized that these dressings can reduce antibiotic use and improve treatment outcomes(20).In the Biatain Silver group, a high percentage of wound cultures were negative, indicating reduced microbial infection. These results align with Li et al. (2023), who stated that silver dressings inhibit the growth of resistant bacteria(18).Clinical Significance and Future Applications of Biatain Silver Dressing in Managing Skin-Grafted Burn Wounds Considering the positive results of this study and previous evidence, Biatain Silver dressing is presented as an effective and low-adverse treatment method for managing burn wounds. In addition to its strong antibacterial properties from gradual silver ion release, it maintains a moist environment and controls microbial load, contributing to reduced healing time, pain, infection, and improved patient quality of life. Given the complexity of burn wound healing and the need for specialized care, the use of Biatain Silver dressing as a complementary approach in standard treatment protocols is recommended. Future studies may explore the long-term effects of this dressing, compare it with other therapies, and define its precise role in wound healing to expand its clinical applications.

Strengths and Limitations of the Study

One of the major strengths of this study was its randomized controlled trial design, which enhanced the validity of the results and allowed for precise comparison between the intervention and control groups. Additionally, patient follow-up at multiple specified time points and the use of diverse clinical criteria such as wound size, pain intensity, wound appearance, and microbial culture results improved the comprehensiveness and accuracy of treatment effect assessment. However, several limitations should be considered when interpreting the findings. These include a relatively small sample size, which may reduce the statistical power of the study and limit the generalizability of the results to larger populations. Furthermore, complete control over factors influencing wound healing, such as nutritional status, underlying diseases, and concurrent care, was not feasible and may have impacted the outcomes. The limited duration of follow-up also restricted the ability to evaluate long-term treatment effects. These limitations highlight the need for future studies with larger sample sizes, more rigorous control of confounding variables, and longer follow-up periods to obtain more definitive and generalizable results.

Conclusion

The results of this study demonstrated that Biatain Silver dressing effectively reduces wound exudate, controls infection, alleviates pain, and accelerates the epithelialization process in burn patients. By creating a moist environment and gradually releasing silver ions, this dressing decreases the microbial load of the wound and controls local inflammation, ultimately leading to faster healing and improved wound quality. Therefore, Biatain Silver dressing can be utilized as an advanced and efficient therapeutic option in the management of burn wounds. It is recommended that future studies with larger sample sizes and longer follow-up periods comprehensively evaluate the efficacy and clinical benefits of this dressing.

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Appendices

Patient Demographic and Baseline Characteristics Form

Section	Variable / Item	Value / Options
1. Demographic and Baseline Information	Patient Code	……
	Treatment Group	☐ Prontosan ☐ Normal Saline
	Age	…… years
	Gender	☐ Male ☐ Female
	Admission Date	
	Hospital Ward	
	Time from Injury to Treatment	…… days
2. Initial Wound Characteristics	Burn Type	☐ Superficial Second Degree ☐ Deep Second Degree
	Wound Location	☐ Trunk ☐ Upper Limb ☐ Lower Limb ☐ Other: ……
	Wound Size (TBSA%)	
	Number of Wounds	
	Wound Depth	
	Wound Appearance	☐ Clean ☐ Infected ☐ Exudative ☐ Malodorous
	Wound Color	☐ Pink ☐ Red ☐ Yellow ☐ Brown ☐ Black
	Exudate Level	☐ None ☐ Low ☐ Moderate ☐ High
	Pain Intensity (VAS: 0–10)	……

Patient Follow-up and Clinical Assessment Form During Treatment (Days 7, 14, and 21)

Variable / Assessment Indicator	Day 7	Day 14	Day 21
Remaining wound size (TBSA%)	……	……	……
Wound exudate status (None, Low, Moderate, High)	☐ None	☐ None	☐ None
Wound appearance (color, cleanliness)	……	……	……
Pain intensity (VAS: 0–10)	……	……	……
Epithelization status (None, Partial, Complete)	☐ None	☐ None	☐ None
Microbial culture from wound	☐ Positive ☐ Negative Type: ……	☐ Positive ☐ Negative Type: ……	☐ Positive ☐ Negative Type: ……
Clinical infection occurrence	☐ Yes ☐No Symptoms: ……	☐ Yes ☐No Symptoms: ……	☐ Yes ☐ No Symptoms: ……
Antibiotic usage	☐ Yes ☐ No Drug type: ……	☐Yes ☐No Drug type: ……	☐ Yes ☐ No Drug type: ……

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Authors' Contributions
All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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