

What is the most effective topical method for preventing presacral pressure sores that occur after hip fractures?

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Abstract

Aim: To investigate the effectiveness of topical agents in preventing pressure ulcers in patients with hip fractures. Patients with hip fractures often remain immobile in the preoperative preparation period due to pain, lie in the supine position, and have to use diapers to meet their toilet needs. In patients using diapers, incontinence-related dermatitis is observed, which is a fundamental cause of pressure ulcer formation. The comparison of local topical treatment alternatives that can be applied before surgical treatment has not yet been done in the literature.

Methods: A total of 114 patient images and data operated for hip fractures between 2020–2022 were retrospectively examined in our clinic. The aim was to find the most effective method for this important problem by comparing three different materials used in topical treatment and the control group.

Results: When comparing the groups, the most effective method was found to be washing the wound with isotonic solution, followed by the application of a barrier cream clothes and a barrier spray to protect against destructive fluids such as feces and urine. In terms of patient outcomes and satisfaction, the spray was better tolerated than the cream.

Conclusions: This study is the first and only study in the literature focused on the topical treatment of pressure ulcers that occur after hip fractures. Pressure ulcers are frequently seen in hip fractures, and the most effective method for preventing their formation and maceration is topical barrier creams and sprays.

Keywords: Pressure sore, Hip fracture, Local treatment, incontinence-related dermatitis

1. Introduction

Pressure ulcers are wounds that develop in areas of the body where tissues are subjected to prolonged pressure, particularly in regions with bony prominences. These wounds almost always involve ischemic tissue loss. The term "decubitus ulcer" is derived from the Latin word "de cubare," meaning "to lie down." However, since pressure is the most significant factor contributing to the development of these wounds, the term "pressure ulcer" is now considered a more accurate and appropriate name.¹ Determining the exact incidence of pressure ulcers can be challenging. It has been reported that pressure ulcers occur in approximately 15% of cases following orthopedic injuries.

The frequency of pressure ulcer development is particularly high in patients with hip fractures. This situation is actively addressed with good patient care, advanced rehabilitation, and additional treatments aimed at prevention and management.^{2,3}

The most significant factor in the development of pressure ulcers is pressure itself. Compression of soft tissues under pressure leads to ischemia, and if the pressure is not relieved, it can result in necrosis and ulceration. Additional extrinsic factors that contribute to the development of pressure ulcers in patients with hip fractures prior to surgery include immobility due to pain, moisture from the use of diapers due to difficulty in reaching the toilet, infections, friction, and shear forces during patient transfers. Intrinsic factors such as the patient's overall health, malnutrition, advanced age, diabetes, and edema also reduce the resilience of the area, making it more susceptible to the development of pressure ulcers.^{1,4}

In his 1930 microinjection study, Landis determined the blood pressure in pre-capillary arterioles to be 32 mm Hg. According to this finding, when tissue pressure exceeds this value, it will obstruct blood flow to the capillary bed, leading to tissue ischemia. The areas most exposed to pressure are the soft tissues located over bony

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prominences. In 1965, Lind calculated the pressures to which the body is exposed in various positions. In a supine position, pressure on the sacrum, buttocks, and heels ranges from 40-60 mm Hg, whereas when sitting, there is a pressure of 75-100 mm Hg over the ischial tuberosities. In the development of pressure ulcers, both the intensity and duration of pressure are crucial factors to consider.^{1,5} Kosiak's study from 1959, conducted on dogs, revealed that exposure to low-intensity pressure for a prolonged duration of 2 hours at 70 mmHg or brief exposure to high-intensity pressure can lead to tissue damage similar to pressure ulcer formation. Even if the pressure is brief, its removal significantly enhances the tissue's resistance. Different tissues are affected by pressure at varying rates. This is due to differences in tissue sensitivity to pressure and how pressure is distributed at different tissue depths. Measurements of tissue internal pressure indicate that pressure affects a broader area in deep tissues adjacent to the bone and a narrower region on the surface.

As a result, in pressure ulcers that develop in a cone shape expanding towards deeper layers, the skin ulcer on the surface is typically like the tip of the iceberg, while the main damage occurs deeper within the tissues. This pattern often results in more extensive and earlier necrosis in deeper, less ischemia-tolerant muscle tissues, while the superficial skin is less affected.³

Urinary incontinence is a common issue leading to patients remaining wet. It can cause both maceration of the skin and increase the risk of ulcer formation in pressure-prone tissues. Friction, in a similar manner, disrupts the integrity of the skin and accelerates the development of pressure ulcers. At one point, shear forces, which were believed to be one of the major causes of pressure ulcers, were thought to occur when the patient was pulled up in bed or slid down while in a seated position. It was believed that this led to the tearing of perforating vessels from muscle to skin and disrupted skin perfusion. However, Dinsdale has proposed that this mechanism is not valid and that direct mechanical effects on the epidermis are responsible for ulcer development.¹

One of the factors that facilitate the development of pressure ulcers is infection. In 1942, Groth demonstrated that in the presence of bacteremia, bacteria settle in areas under pressure, leading to local infection. Furthermore, it has been reported that when pressure is applied to contaminated wounds, bacteria multiply 100 times faster. Pressure ulcers almost always accompany bacterial infection. This is due to impaired lymphatic flow, ischemia, and immune system abnormalities.^{5,6}

In patients with hip fractures, particularly in the early stages, there is a widespread development of tissue edema, especially in the fractured area. One of the reasons for this is the impairment of lymphatic flow due to decreased muscle function. Additionally, inflammatory mediators released due to pressure also contribute to edema. Increased edema raises interstitial pressure. When external pressure is added to this, capillary blood flow stops, and an ischemic process begins. Moreover, edema reduces the formation of sebum, which is an important substance in maintaining skin integrity.

In addition to these factors, the presence of pathologies that affect wound healing, such as the patient's overall health being compromised, the development of negative nitrogen balance, advanced age, diabetes, or connective tissue diseases, also makes the development of pressure ulcers more likely.⁷

1.1. Patogenesis

Although pressure ulcers are often considered chronic lesions, they have an acute onset period. During the acute phase, the skin exposed to pressure develops redness, followed by induration, blister formation, cyanosis, and tissue necrosis. In the acute phase, taking measures to eliminate pressure can prevent ulcer development. During the induration stage, the lesions can be mistaken for local abscess formation. Making an incision for drainage purposes can lead to infection and facilitate ulcer formation.⁸

In the chronic phase, pressure ulcers exhibit profound damage involving the skin, subcutaneous tissue, fat, fascia, and muscle. Long-standing ulcers are often characterized by recurring cycles of healing and ulceration attacks. Sometimes, pressure ulcers may have a thin, shiny epithelium covering. A wide, scarred area surrounds the lesion. In deep and extensive ulcers, epithelial progression halts, and the wound edges thicken, curling inward. The ulcer bed is usually covered with a pale granulation tissue with purulent characteristics due to bacterial invasion and tissue breakdown, often accompanied by a foul odor. In extensive ulcers, continuous drainage can lead to protein loss and anemia. Staphylococci, streptococci, *Pseudomonas aeruginosa*, *E. coli*, *Proteus mirabilis*, and combinations of these are frequently identified in wound cultures. Systemic antibiotic treatments are often ineffective due to the extensive scar tissue surrounding the lesion.

Pressure ulcers can be categorized into two groups based on their development. In the type associated with factors like friction, moisture, shear forces, or incontinence-related dermatitis, the lesion starts on the skin and progresses deeper into the tissues if not addressed. In the type developed due to pressure, you may observe skin redness or a small ulceration on the skin, but deep tissues exhibit a large cone-shaped damage. These differences in development patterns complicate the staging of pressure ulcers. However, staging can still be useful for standardized diagnosis.

2. Materials and methods

The study was conducted between 2020 and 2022, focusing on patients treated for hip fractures. After obtaining local ethics committee approval(2023-430), retrospective photographic data and file reviews were completed in 2023. Patients with Stage 1, 2, 3 wounds according to the wound classification and those with no wound formation were included in the study. Patients with Stage 4 wounds requiring surgery were not included. The effects of various products used in local treatment were compared.

The Anova test conducted among the groups revealed no significant demographic differences. And also used independent samples T-test for comparing results.

Patients with systemic diseases were excluded from the study, including those with malnutrition, anemia, liver failure, kidney failure, organ transplant recipients, rheumatoid diseases, patients undergoing chemotherapy, and uncontrolled diabetes patients. Morbidly obese patients, those who had pilonidal sinus or sacrum surgery, received negative-pressure wound therapy (WAC), and were unable to mobilize with full weight-bearing during the postoperative period were also excluded from the study.

The patients' wound sizes and characteristics were compared. The condition of the wounds on the 1st and 21st day of the 3-week treatment period was assessed. The same treatment protocols were applied in each group, with only the topical products used being different. Patients were provided with a high-protein diet, and albumin levels were monitored. Low-fiber diets were given to reduce stool contamination due to liquid stool caused by high-fiber diets. Frequent position changes were implemented in 30-minute intervals (not applied in the preoperative period due to hip pain). All patients were placed on an air mattress.

Patients aged 65 and above who had hip fractures and were treated for presacral pressure ulcers were retrospectively reviewed. The study included patients who had undergone partial hip arthroplasty surgery due to hip fracture during the postoperative period and were allowed to mobilize with full weight-bearing. They were all treated in the same clinic by the same team and received the same treatment protocol for presacral pressure ulcers during their hospitalization.

Table 1

Demographics of the patients

	Group1	Group 2	Group 3	Group 4
Number of patients	34	25	28	27
Average age	67.5	70.2	74.5	72
Number of diabetic patients	24	19	21	20
Intertrochanteric fractures	19	18	18	20
Femoral neck fractures	9	8	10	7
Preoperative length of stay	3,9	3,8	4,1	4
Postoperative length of stay	5,7	5,5	5,4	6
Presacral wound classification average	1,79	1,8	1,75	1,82
Patient satisfaction score	55	61	75	71
Number of patients using diapers	28	26	28	27
Number of patients using urinary catheters	28	26	28	27
Use of antibiotics due to infection	25	20	14	16
Right hip	15	13	13	14
Left hip	19	12	15	13

Only different product types used in patients were compared. Patient variables and demographic characteristics were recorded.

Patients were divided into four groups, and the groups and their demographic characteristics are listed in Table 1.

Group 1 (Control Group):

In this group, wound dressings were applied twice daily. During each dressing change, wound exudate was wiped with a sterile gauze, and then the wound was rinsed with 20 cc of isotonic solution. Subsequently, the wound was covered with a sterile gauze. For patients without incontinence issues and without wound formation, the perineal area was cleaned twice a day using classic warm water and cotton.

Group 2:

In this group, wound dressings were applied twice daily. During each dressing change, wound exudate was wiped with a sterile gauze, and then the wound was rinsed with 20 cc of isotonic solution. Afterward, the area immediately around the wound was wiped with a Med-Cover barrier cream clothes (% 3 dimethicone, Medoffice Health, Izmir , Turkey), and then the wound was covered with a sterile gauze. For patients without incontinence issues and without wound formation, the perineal area was treated with a Med-Cover Barrier Cream clothes twice daily.

Table 2

Staging System for Pressure Ulcers Recommended by the National Pressure Ulcer Advisory Panel

Stage 1: Characterized by persistent erythema that does not blanch when pressed. The epidermis is intact.

Stage 2: Characterized by partial-thickness skin loss with the presence of abrasion, vesicle, or a shallow crater, involving the epidermis and/or dermis.

Stage 3: Characterized by full-thickness skin loss extending down to the underlying fascia, but not involving the fascia itself.

Stage 4: Characterized by extensive tissue loss, tissue necrosis, or damage to muscles, bone, or supporting structures, involving full-thickness skin loss that is contiguous with body cavities.

These descriptions outline the stages of pressure ulcers as recommended by the National Pressure Ulcer Advisory Panel.

Group 3:

In this group, wound dressings were applied twice daily. During each dressing change, wound exudate was wiped with a sterile gauze, and then the wound was rinsed with 20 cc of isotonic solution. After that, the area immediately around the wound was wiped with a Med-Cover barrier cream clothes(% 3 dimethicone), and then Med-Cover barrier film spray (%100 silicone, Medoffice Health, Izmir, Turkey) was applied with 4 puffs around the microenvironment of the wound. The wound was then covered with a sterile gauze. For patients without incontinence issues and without wound formation, the perineal area was treated with a Med-Cover Barrier Cream clothes, followed by the application of Med-Cover Barrier Film Spray with 4 puffs, twice a day.

Group 4:

In this group, wound dressings were applied twice daily. During each dressing change, wound exudate was wiped with a sterile gauze, and then the wound was rinsed with 20 cc of isotonic solution. After that, the area immediately around the wound was wiped with a Med-Cover barrier cream clothes (% 3 dimethicone), and then a thin layer of Med-Cover barrier cream (% 3 dimethicone+%5 natural beeswax, Medoffice Health, Izmir , Turkey), was applied to the microenvironment of the wound.

Figure 1

Comparative images of patients from all three grades were provided on the 1st and 21st days in the study



The wound was then covered with a sterile gauze. For patients without incontinence issues and without wound formation, the perineal area was treated with a Med-Cover Barrier Cream clothes, followed by the application of a thin layer of Med-Cover Barrier Cream, twice a day.

In the case of presacral pressure ulcers, Baticon, which slows down wound healing, was not used in any of the groups.

Presacral pressure ulcer treatment was initiated as soon as the patient arrived at the clinic after recording necessary forms and details. The treatment continued in the postoperative period. Catheters were inserted for all patients on the 2nd postoperative day. Patients who required catheter monitoring during treatment and had to use adult diapers due to fecal incontinence were included in the study. When the patient was discharged, their caregiver was also instructed to continue treatment at home.

During weekly follow-up appointments, wound monitoring, wound classification, size, exudate status, infection status, and incontinence-related dermatitis were assessed. The response to treatment was evaluated by comparing the wound classification on the 21st day with the initial classification. Staging is essential for standardized diagnosis and treatment monitoring in pressure ulcers. For this purpose, a staging system recommended by the National Pressure Ulcer Advisory Panel is commonly used (see Table 2).³ The images of patients from all three classes, categorized according to the ulcer classification used in the study, are presented in Figure 1.

All patients were able to mobilize with full weight-bearing during the postoperative period. Patients who were unable to mobilize were excluded from the study as prolonged immobility would affect the pressure duration. All patients received the same walking protocol, exercises, and rehabilitation procedures, and were taught and ensured to follow them. Patients who showed non-compliance with treatment and did not attend regular follow-up appointments were not included in the study.

3. Results

In the study, there were 34 patients in the control group (Group 1), 25 patients in Group 2, 28 patients in Group 3, and 27 patients in Group 4. In Group 1 (control group), the average wound classification at the time of hospital admission was 2.3, while it was 2.2 in Group 2, 2.5 in Group 3, and 2 in Group 4.

The average ages were 67.5 in Group 1, 70.2 in Group 2, 74.5 in Group 3, and 72 in Group 4. The comparison of groups was evaluated using Anova test and no statistically significant differences were found. During the 21-day treatment period, the fastest improvement was observed in Group 3. (Table3) The wound classification decreased from 2.5 at the initial presentation to 1.5, indicating the most effective treatment. It can be said that the spray applied in this group effectively created a barrier to protect the wound from the destructive effects of urine and feces and provided greater resistance against friction. The application, which involved the use of isotonic solution during and subsequent to the application, followed by the application of Med-Cover barrier cream clothes to remove and neutralize toxic and destructive effects of urine and feces from the skin, and then protecting it with the barrier created by the spray, emerged as the most effective method. This method, in comparison to the cream used in Group 4, does not involve a painful process such as manually applying the cream around the open wound, making it easier for patients to tolerate. The fact that the highest satisfaction score for the application method was given in this group also supports this.

This indicates that patients found it easier to tolerate using the spray rather than applying cream around the open wound. In all three groups, it was observed that the method significantly prevent-

Table 3

Comparison of the results of groups based on wound classification at 1st and 21st days

	Group1	Group2	Group3	Group4
Average patient satisfaction score	55	61	75	71
Wound classification at the time of admission	2,3	2,2	2,5	2
Wound classification after treatment	2	1,8	1,5	1,5
p	0.09	0.07	0.02	0.038

-ed maceration compared to the control group and also significantly prevented incontinence-related dermatitis in areas without wounds. Statistically significant improvement was observed in group 3 and group 4 in the comparison of group satisfaction survey results and wound sizes. The sentence describes the use of an dependent sample T-test to compare four independent variables and finding a significant difference among the groups based on the test results. To determine which specific groups have differences, a post hoc analysis using the Scheffe test was conducted, and it revealed that there is a significant difference in favor of Group 3 when comparing Group 3 and Group 4.

4. Discussions

Pressure ulcers are extremely challenging to treat once they have developed. Recurrence rates of up to 95% have been reported in wounds closed using surgical methods. Therefore, the most effective treatment is the recognition of at-risk patients and the prevention of pressure ulcer formation. Treatment can be broadly categorized into systemic and local approaches. Systemic treatment includes protecting patients from developing wounds, correcting their nutritional status, treating anemia, and preventing incontinence-related dermatitis. Local treatment can be further divided into conservative and surgical methods. These patients should be evaluated as a whole, and treatment should be tailored accordingly; otherwise, local treatments may prove inadequate in the absence of systemic interventions.^{3,4,7,8}

After the initial assessment of the patient, preventive measures should be taken to avoid pressure. Subsequently, the nutritional status of the patient should be evaluated. Patients with losses resulting from ulcer surfaces often suffer from malnutrition and negative nitrogen balance. Therefore, a high-calorie, high-protein, and vitamin-rich diet should be initiated for these patients. To support normal wound healing, serum albumin levels should be at least 2 g/100 ml. Essential nutrients for normal wound healing, such as vitamins A and C, calcium for epithelization and fibroblast function, and iron and copper for collagen metabolism, should be included in the diet. Low-fiber foods are preferred to avoid fecal contamination, which is a significant issue in the treatment of pressure ulcers.⁹

If a patient cannot consume sufficient nutrients orally, they may be given nutrition through a feeding tube, gastric diet, or ready-made formulas. In cases where enteral nutrition is insufficient or not possible, parenteral hyperalimentation should be applied. In this case, potential issues related to catheters should be kept in mind, and the patient should be closely monitored.^{3,5,9}

To ensure adequate tissue oxygenation, it is essential to maintain high hemoglobin levels. For this purpose, dietary supplements that promote blood production, such as those containing liver, should be considered, and iron preparations should be administered.

In the presence of bacteremia, bacteria localized in ischemic tissues under pressure can lead to the development of localized infection. Systemic infections should be treated with appropriate antibiotics,

and care should be taken to clean urinary catheters and change them frequently, with residual urine being emptied.⁶

Pressure sores can also become infected through direct contamination, aside from the endogenous route. To prevent fecal contamination, a low-residue diet should be provided, and when changing the patient's diapers, barrier cream (effective) products should be preferred. In advanced ulcers, the temporary or permanent creation of a colostomy may also be considered.

The fundamental principle in both the prevention and treatment of pressure ulcers is to minimize the pressure exerted on weight-bearing areas and avoid prolonged pressure. The position of bedridden patients should be changed every 2 hours, and a prone sleeping position is preferred during sleep. The goal is to evenly distribute the patient's weight, ideally allowing no area of the body to experience pressure exceeding 32 mm Hg. In pursuit of this goal, the use of air mattresses is a common practice.^{10,11,12}

The local treatment of pressure ulcers includes both conservative wound care and local surgical procedures. When faced with a pressure ulcer, the initial step is to evaluate the wound. In cases where surgery is not considered, the treatment plan should be based on the wound classification. The objectives include protecting the wound from friction and shearing forces, ensuring pressure distribution, providing adequate ventilation, safeguarding against local destructive substances like urine and feces, and preventing infection.^{11,12}

Small and superficial ulcers can heal through pressure relief and proper wound care, with granulation tissue growing from below and eventually being covered by epithelium from the periphery. However, in wounds that heal in this way, the protective barrier is often not strong enough, leading to a higher risk of recurrence.

In topical wound care, the goal is to maintain moisture in the wound, mechanically remove debris that develops in the wound, and reduce local infection with bactericidal effects. Solutions commonly used for wound dressing purposes include bactericidal solutions such as saline, povidone-iodine, hydrogen peroxide, acetic acid, and sodium hypochlorite (Dakin's solution). Bactericidal solutions can help reduce infection, but they can also lead to tissue toxicity, which makes their use controversial. Although it has been suggested that 1:1000 diluted povidone-iodine and 1:100 Dakin's solution can exhibit bactericidal effects without causing tissue toxicity, it is not appropriate to use them in cases where there is no active wound infection. Hydrogen peroxide and acetic acid, even when diluted, can still cause tissue toxicity.

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For a dressing to be effective, gauze should fill the entire cavity, and it should be changed every 6-8 hours. This helps remove tissues that provide a breeding ground for bacteria from the wound. The bactericidal properties of the dressing are more dependent on mechanical action than the solution used. Deep cavitated wounds should be

irrigated at least once a day for mechanical cleansing. These traditional dressing methods, while providing rapid improvement in the wound, can be time-consuming and require the involvement of numerous healthcare professionals.

Appropriate wound care, pressure relief, barrier-effective applications, and addressing nutritional status can lead to the rapid healing of many superficial ulcers. In the case of deep wounds, only long-term dressings can promote healing. The rapid development of wound dressing materials and the high morbidity, cost, and subsequent high recurrence rates associated with surgical interventions have directed healthcare professionals toward conservative treatment as much as possible.

In orthopedic treatment, orthopedic surgeons often focus on the fracture, but additional pathologies are frequently observed in elderly patients. A comprehensive approach should be taken to prevent potential additional morbidities in the patient. In clinical practice, pressure ulcers occurring after hip fractures can significantly impact the patient's course of recovery and even their survival, especially in elderly patients with multiple comorbidities, and they can lead to life-threatening situations.¹³ They also significantly increase treatment costs and hospitalization durations. It is clear that the most crucial aspect of these wounds is prevention. In the prevention of wounds, the foremost step is the awareness of orthopedists regarding the potential development of presacral pressure ulcers in every patient with a hip fracture. In this study, we compared three commonly used medical products, and we found that after cleansing the area with isotonic solution, the use of Med-Cover Barrier Cream clothes followed by Med-Cover Barrier Film Spray to protect the region under pressure, at least from enzymatic damage caused by bodily fluids and medical adhesives, significantly reduces the risk of pressure ulcer formation. It has been observed that when Med-Cover Barrier Effective products are applied to the wound area, they have a preventive effect on friction and the formation of incontinence-associated dermatitis.

In cases of presacral pressure ulcers that occur after a hip fracture, the situation is somewhat complicated. Hip fractures primarily affect an elderly patient population, often secondary to osteoporosis. Managing these patients systemically is of utmost importance. Furthermore, considering that these patients have undergone surgery for their hip fractures, treatment becomes even more complex and challenging. Patients with hip fractures are prone to systemic bleeding, either from the fracture site or intraoperative bleeding, both of which can lead to a decrease in hemoglobin levels. Hemoglobin deficiency reduces tissue oxygenation. These patients are often immobile during the preoperative preparation and postoperative recovery periods, which leads to an increased risk of pressure and pressure-related complications. Additionally, during this period, they may be unable to attend to their toileting needs, necessitating the use of adult diapers and catheters. The use of adult diapers reduces tissue ventilation, increases moisture levels, and raises friction forces. Moreover, skin irritation occurs following contact with feces and urine, which accelerates pressure ulcer formation¹⁴.

In our study, there were no significant differences between the groups we compared in terms of systemic and positional changes. However, the results of patients who used different local topical products were compared.¹⁵ The literature shows varying outcomes regarding the effects of local products, which can be attributed to the need for a multifactorial treatment approach and the presence of highly variable patients. We believe that the differences in results reported in the literature can be attributed to insufficient exclusion criteria and the difficulty in standardizing patients. Our study is unique in that it is the only one comparing three different topical products.

5. Conclusions

Pressure ulcers in hip fracture patients are frequently observed, and the most effective method for preventing their formation and maceration is the application of a barrier cream clothes and a barrier spray after washing with isotonic solution. This study was conducted with a limited number of patients who had 1st, 2nd, and 3rd-degree ulcers and observed incontinence. In the future, conducting studies with a larger number of patients will shed further light on the literature.

Statement of ethics

The study received approval from the Ethics Committee of Selçuk University (Decision date: 2023, Number: 430).

Conflict of interest statement

Author declare that they have no financial conflict of interest with regard to the content of this report.

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