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FEATURE

Practice Recommendations for Preventing Heel Pressure Ulcers

Evonne Fowler, RN,CNS, CWOCN; Suzy Scott-Williams, MSN, RN, CWOCN; and James B. McGuire, DPM, PT, CPed, CWS, FAPWCA

Heels are the second most common anatomical location for pressure ulcers. A combination of risk factors, including pressure, may cause ulceration. Heel pressure ulcers are a particular concern for surgical patients. A review of the literature, including poster presentations, shows that controlled clinical studies to assess the effectiveness and cost-effectiveness of available interventions are not available. Case series (with or without historical controls) as well as pressure ulcer guideline recommendations suggest the most important aspect of heel ulcer prevention is pressure relief (offloading). It also has been documented that the incidence of heel ulcers can be reduced using a total-patient care approach and heel offloading devices. Guidelines, observational studies, and expert opinion intimate that reducing heel ulceration rates can be expected to improve patient outcomes, decrease costs associated with their care, and avoid costs related to hospital-acquired pressure ulcers. The heel pressure ulcer prevention strategies reviewed should be implemented until the results of prospective, randomized controlled studies to compare the effectiveness and cost-effectiveness of these strategies are available.

KEYWORDS: heel pressure ulcer, perioperative pressure ulcer, heel protector device, heel offloading device

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A pressure ulcer is a localized injury to the skin and/or underlying tissue that usually develops over a bony prominence as a result of pressure or pressure with shear or friction forces.[1] Heel ulcers are the most common facility-acquired pressure ulcer in long-term acute care facilities[2] and the second most common pressure ulcer overall.[3] Heel ulcers can be physically debilitating and painful and can lead to serious complications such as infection, cellulitis, osteomyelitis, septicemia, limb amputation, or death, and can increase healthcare and litigation costs. However, with appropriate evidence-based prevention, most heel pressure ulcers can be avoided.[4] To summarize pertinent information on the clinical, emotional, and financial significance of heel pressure ulcers, selected literature and poster presentations are reviewed and wound care clinicians' insights on the challenges of heel pressure ulcers are provided.

Anatomy/Physiology/Pathophysiology of the Heel Pressure Ulcer

Pressure ulcers are ultimately a result of tissue damage due to inadequate tissue perfusion.[5] Direct sustained pressure, repetitive moderate pressure, shear forces, and

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reperfusion injury all contribute to tissue ischemia and thrombotic occlusion of the capillary vasculature.[6]

Tissue compromised by maceration, friction injury, or dryness is particularly vulnerable.[7] Bacterial colonization of existing ulcers, altered cellular responses, and systemic stress also may contribute to tissue injury.[8]

According to a model proposed by Mustoe et al,[8] reperfusion injury is an exacerbation of tissue injury that results as blood returns to the tissue and white blood cells accumulate in and around the damaged small capillaries. The accumulation of damaged cell byproducts and white blood cells obstructs the capillaries, aggravating ischemia and local inflammatory response. Free radicals produced in the cells during ischemia are released when blood flow is restored. These free radicals damage cellular proteins, DNA, and cell membranes, contributing to cell death. Thus, tissues damaged by pressure-induced ischemia are further damaged as the tissue is reperfused.

Heels are particularly vulnerable to pressure injury. The plantar surface of the heel is well adapted to resisting the forces of standing and ambulation but the posterior heel is not — it is covered with only a thin layer of fat and skin. The superficial fascia of the heel is firmly bound to the deep fascia with fat contained in the interstices between segments, creating a tough elastic pad capable of absorbing shock and shear forces during gait.[9] This area is well supplied with blood from the medial calcaneal branch of the posterior tibial artery and is supported and padded by attachments of the flexor digitorum brevis and abductor digiti minimi muscles.

When patients are supine, the posterior aspect of the heel is in contact with the supporting surface. The posterior aspect of the heel lacks fat-filled fascial interstices to absorb the compressive forces of prolonged pressure or shear forces generated during limb movement or transfers. The fat layer is thin and the skin is bound tightly to the underlying deep fascia and Achilles tendon fibers. The blood supply to the skin is poor and there is no underlying muscle to cushion the bone and tendon or distribute pressure. When the foot is resting with pressure on the posterior heel, all the pressure from the weight of the foot and lower leg is concentrated on the small area of skin overlying the posterior tubercle of the calcaneus. This skin is supplied by small branches from the calcaneal and peroneal arteries and prolonged pressure on these relatively small vessels can lead to ischemia.[9]

Pressure Ulcer Prevalence, Mortality, and Morbidity

Prevalence rates vary across patient populations and are as high as 25.1% in a mixture of acute and nonacute care settings.[10] In a study[3] conducted in intensive care units, prevalence rates reported in a 24-hour data collection period ranged from 14% to 17%. Long-term care facilities have reported prevalence rates as high as 27.3% — of these, 23.6% were heel ulcers.[2] In a single-center, prospective controlled study of surgical patients (mean age 61.6 years), the incidence of pressure ulcers was 23% — 52% of these were on the heels.[11] Heel pressure ulcers account for approximately one third of all pressure ulcers in acute care and mixed acute care/long-term care settings.[2,12] Higher proportions of heel pressure ulcers have been reported in individual institutions; prevalence rates were as high as 43% for a population of patients (mean age 74.9 years) in a Midwestern community acute care hospital.[13] Mortality rates are also higher in patients with pressure ulcers. In an observational cohort study (n = 3,103), the relative risk for death in elderly individuals with pressure ulcers was 1.92,

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KEY POINTS

- Although heel pressure ulcers are very common, the authors of this review found that currently available literature provides limited evidence about optimal heel pressure ulcer prevention and care.
- There is general agreement that offloading is the first step to preventing and healing these ulcers.
- Results of descriptive studies and expert opinion also suggest that the use of heel offloading reduces the incidence of heel pressure ulcers.
- Until more robust data are available, clinicians should implement the heel ulcer prevention strategies discussed to help prevent heel ulcers and their associated morbidity, mortality, and cost.

almost double that of persons without pressure ulcers.[14] According to national multiple cause-coded death records, septicemia is the cause of death in 40% of pressure ulcer patients.[15]

Morbidity manifests in most heel ulcer patients as pain and reduced mobility but also can include loss of a limb. A prospective study of patients with heel ulcers who were referred to a specialist multidisciplinary clinic between January 2000 and November 2003 included 154 heel ulcers. Of the 53 nonhealed ulcers, 11 (71% of 154) resulted in major amputation. A retrospective database and medical record review[17] of 788 patients (average age 66.7 years) with 959 consecutive lower extremity amputations found that amputation patients are at high risk for surgical complications, with 30-day mortality rates of 5.7% for below-the-knee amputation, infection rates of 5.5%, and re-operation rates of 18.4%.

Clinical Presentation of the Heel Pressure Ulcer

A pressure-related injury may first present clinically with discoloration, tenderness, and changes in consistency or temperature compared to the surrounding skin. Nonblanchable erythema is early evidence of abnormal perfusion due to pressure-related injury or friction or shearing forces.[18] With deep tissue injury (a category of pressure injury that is not visible as an ulcer), the skin may be purple or maroon, boggy or firm, and warmer or cooler than surrounding tissues. The area may be painful and may develop blood- or serum-filled blisters. As damage evolves, the blister roof dries and an eschar develops, which may in time become an open wound. The progression from local ischemia to pressure injury and damage to the skin may be rapid even under circumstances of optimal treatment.

The National Pressure Ulcer Advisory Panel (NPUAP)[1] recently revised the definition and staging of pressure ulcers to include deep tissue injury and unstageable ulcers (see Table 1).

Pressure Ulcer Risk Factors

Various conditions have been associated with an increased risk of pressure ulcer development. The Institute for Healthcare Improvement (IHI)[19] lists age, immobility, incontinence, inadequate nutrition, sensory deficiency, multiple concurrent morbidities (eg, diabetes), circulatory abnormalities, and dehydration as key factors contributing to the development of pressure ulcers. Additional literature includes immobility (eg, spinal cord injury[20] or stroke), major surgery, shock/resuscitation, limited or no responsiveness, inactivity, skin moisture, inadequate nutrition, friction and shear forces on the skin[21]; hypoalbuminemia, anemia, diabetes mellitus (DM), peripheral vascular disease (PVD), hip fracture, low Braden Scale score[13]; and iatrogenic causes, such as misapplication of pressure stockings[22] among factors that have been found to be associated with pressure ulcer development. Studies specifically designed to assess the risk of heel pressure ulcers have not been conducted.

Risks in the surgical patient population. Prevalence studies[23] have shown that patients who undergo surgery are at higher risk for developing pressure ulcers than the general patient population. Overall rates of pressure ulcers in all anatomical locations ranged from 3.5% in an observational cross-sectional prevalence study[24] (n = 281) to 14.3% in a prospective comparative 6-week incidence study[25] of surgical patients (n = 286). Results from the former study indicated that long periods of immobility and decreased sensorium related to the type of anesthesia used were associated with a higher risk of pressure ulcer development. In a small study[26] of elderly patients (50 undergoing emergency surgery and 150 undergoing elective surgery), 13% of patients undergoing elective surgery and 14.2% of patients undergoing surgery for hip fracture developed heel pressure ulcers. Heel pressure ulcers have been reported in a case study[27] of older patients (average 74.3 years) undergoing nerve blocks for hip or knee replacement. A retrospective study[28] of 34 patients receiving elective hip or knee replacements conducted from August 2002 to December 2004 concluded if a heel has altered sensation or unrelieved pressure, patients undergoing knee replacements can develop heel pressure ulcers. Further, central and/or peripheral nerve blockade is a disadvantage due to reduced heel sensation.

A prospective matched control comparison study of 323 high-risk surgical patients conducted by Scott-Williams et al[11] reported that a combination of age

TABLE 1
NATIONAL PRESSURE ULCER ADVISORY PANEL REVISED PRESSURE ULCER STAGING SYSTEM[1]

Stage/Clinical Presentation	Photo	Pressure Ulcer Definition
		A pressure ulcer is localized injury to the skin and/or underlying tissue, usually over a bony prominence, as a result of pressure or pressure in combination with shear and/or friction. A number of contributing or confounding factors also are associated with pressure ulcers; the significance of these factors is yet to be elucidated.
Stage I: Red heel		**Stage I:** Intact skin with nonblanchable redness of a localized area, usually over a bony prominence. Darkly pigmented skin may not have visible blanching; its color may differ from the surrounding area **Further description:** The area may be painful, firm, soft, warmer, or cooler as compared to adjacent tissue. Stage I may be difficult to detect in individuals with dark skin tones. May indicate "at risk" persons (heralding sign of risk)
Stage II: Serous-filled blister		**Stage II:** Partial-thickness loss of dermis presenting as a shallow open ulcer with a red-pink wound bed, without slough. Also may present as an intact or open/ruptured serum-filled blister
Stage II: Partial-thickness open wound		**Further description:** Presents as a shiny or dry shallow ulcer without slough or bruising.* This stage should not be used to describe skin tears, tape burns, perineal dermatitis, maceration, or excoriation *Bruising may be a sign of deep tissue injury
Stage III: Full-thickness wound		**Stage III:** Full-thickness tissue loss. Subcutaneous fat may be visible but bone, tendon, or muscle are not exposed. Slough may be present but does not obscure the depth of tissue loss. May include undermining and tunneling **Further description:** The depth of a Stage III pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput, and malleolus do not have subcutaneous tissue and Stage III ulcers can be shallow. In contrast, areas of significant adiposity can develop extremely deep Stage III pressure ulcers. Bone/tendon is not visible or directly palpable

Continued on next page

>62, albumin levels <3.5, and American Society of Anesthesia (ASA) scores ≤3 was predictive of perioperative pressure ulcer development. In this two-group comparison study, the incidence of perioperative pressure ulcers was 74 (23%) and 61 (52%) of the 118 pressure ulcers that developed were located on the heels.

In addition to the risk of developing pressure ulcers during surgery, surgical patients may be immobile due to injury or illness. In observational reports, the presence of obesity,[29] decreased sensation due to central or peripheral nerve blocks,[27,28] and lower body mass index with low serum albumin have been found to be associated with

Continued from previous page

Stage IV: Full-thickness wound with muscle and bone exposure
(the black mark shows undermining)

Stage IV:
Full-thickness tissue loss with exposed bone, tendon, or muscle. Slough or eschar may be present on some parts of the wound bed. Often include undermining and tunneling

Further description:
The depth of a Stage IV pressure ulcer varies by anatomical location. The bridge of the nose, ear, occiput, and malleolus do not have subcutaneous tissue and these ulcers can be shallow. Stage IV ulcers can extend into muscle and/or supporting structures (eg, fascia, tendon, or joint capsule) making osteomyelitis possible. Exposed bone/tendon is visible or directly palpable

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Unstageable eschar/ slough-covered wound

Unstageable:
Full-thickness tissue loss in which the base of the ulcer is covered by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown, or black) in the wound bed

Further description:
Until enough slough and/or eschar is removed to expose the base of the wound, the true depth, and therefore stage, cannot be determined. Stable (dry, adherent, intact without erythema or fluctuance) eschar on the heels serves as the body's natural (biological) cover and should not be removed

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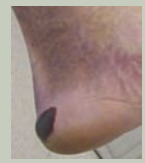
Deep tissue injury

Suspected deep tissue injury:
Purple or maroon localized area of discolored intact skin or blood-filled blister due to damage of underlying soft tissue from pressure and/or shear. The area may be preceded by tissue that is painful, firm, mushy, boggy, warmer, or cooler as compared to adjacent tissue

Deep tissue injury: blood-filled blister



Further description:
Deep tissue injury may be difficult to detect in individuals with dark skin tones. Evolution may include a thin blister over a dark wound bed. The wound may further evolve and become covered by thin eschar. Evolution may be rapid, exposing additional layers of tissue even with optimal treatment

heel ulceration.[25] In a comprehensive literature review[30] of studies involving cardiac surgery patients, temperature manipulation, treatment with vasoactive drugs, periods of hypotension related to the surgery, and reduced hemoglobin and hematocrit levels were frequently associated with increased risk for pressure ulceration as a complication of surgery. Hip fracture surgery patients often are considered to be at high risk of developing ulcers because many have risk factors such as a limited mobility, a history of stroke, multisystem failure, DM, diabetic neuropathy, or abnormal peripheral perfusion.[31] In addition, anesthetic drugs, the effects of hypothermia, and positioning devices that reduce peripheral circulation and oxygen supply to the extremities can contribute to pressure ulcer formation in surgical patients. Also, specific surgical positions such as supine, semi-Fowler, Trendelenburg, and lithotomy can increase pressure, shear, or friction if the heels are not protected.[32]

Assessment of the At-Risk Patient

The Braden Scale is the most widely used and, although not perfect, the best tool currently available

to assess patient risk of developing pressure ulcers.[33] Use of the Braden Scale increases provider awareness about patient risk and provides a baseline for a plan of care. The Braden Scale includes six subcategories of potential risk: sensory perception (the ability to respond meaningfully to pressure-related discomfort), moisture (the degree to which skin is exposed to perspiration, wound drainage, urine, and stool), nutrition (the usual food intake pattern), mobility (the ability to change and control body position), friction and shear (the presence of friction and shear forces — eg, the degree to which the skin slides against a fixed surface such as the bed or chair), and activity (the degree of physical activity). The score in each category indicates the risk potential where 1 indicates the greatest risk and 4 indicates the least risk. The lowest possible overall Braden score (addition of the score in all six categories) is 6 and the highest score is 23; the lower the score, the higher the risk. Identified risks using the Braden Scale can be addressed with category-specific interventions (see Table 2).

The Braden scale is useful for measuring general risk factors, as well as risk factors related to activity and mobility in select patient populations. A cross-sectional survey[34] of 21,574 hospital patients and nursing home residents found that patients with lower Braden scores have more severe pressure ulcers. More recent data from a prospective study[11] comparing the effects of different surgical bed surfaces in various surgical patients suggest that overall Braden scores may not be predictive of risk in surgical patients because most patients undergoing general anesthesia will score low in the immediate postoperative period. In an acute care prevalence study,[35] the Braden subscales appear to be more useful than the overall Braden score and provide a valuable way to assess a patient's risk.

The IHI's first recommendation for pressure ulcer prevention is to conduct a skin and pressure ulcer risk admission assessment for all patients.[19] The initial general assessment of a patient on admission must include a complete medical history, head-to-toe physical examination, and Braden scale assessment to identify risk factors. Comorbidities such as stroke, cognitive impairment, cardiopulmonary disease, hemodynamic status, DM, PVD, malnutrition, and hydration can influence the response to injury and repair and should be documented. Prompt identification of patients at risk is essential for timely implementation of intervention and prevention measures.[19]

Documentation of skin assessments must include notations on even minor skin changes such as bruising.[19] Hospital-wide, documentation of skin conditions and wounds must be consistent. When differences exist between assessment and documentation, a rationale for the differences should be noted. Many facilities require reassessment every shift or daily and as the patient's condition changes. The authors suggest that the skin of surgical patients should be assessed preoperatively, immediately postoperatively, and at least daily for 5 days or until discharge because perioperative pressure ulcers may not present until several days after surgery. The Braden tool can be used for daily risk assessments and a Braden Score of 18 or below requires immediate implementation of pressure ulcer prevention measures. An example of a pressure ulcer prevention and skin care intervention protocol based on the Braden Subscales is presented in Table 2.

Skin and wound assessment documentation. The NPUAP[1] advises inclusion of the following variables in all skin and pressure ulcer documentation: location, stage, size, color, drainage, odor, inflammation, undermining, edema, and signs of infection as well as date of ulcer onset, treatment history, and previous response to treatments. If the diagnosis of the skin condition is not known, the appearance of the skin or the ulcer should be carefully documented. Photographs of the ulcer and skin changes are useful for documentation and should, at a minimum (per the authors), be taken at the time of admission and discharge with appropriate informed consent obtained from the patient. All photographs should be taken at the same distance and a measuring device that includes date, location of the wound, patient initials, and medical record number should be placed next to the wound. Because pressure ulcers are painful, appropriate care of patients who have or who are at risk for pressure ulceration includes pain assessment and management. The degree and effectiveness of pain relief efforts must be documented.[36] Wound status should be documented after each dressing change — weekly photographs and an evaluation of changes in skin/wound status help assess the effectiveness of the treatment plan.[36]

TABLE 2
INTERVENTION PROTOCOL FOR BRADEN SUBSCALES*

Sensory perception *(Cutaneous and cognitive perception of sensory stimuli)* **Able to respond meaningfully to pressure-related discomfort**	**4. No impairment** a. Provide routine skin care **3. Slightly limited** a. Teach patient/family the importance of changing positions for prevention of pressure ulcers. Encourage small frequent position changes b. Encourage/assist with turning and repositioning at least q 2 hours when in bed. Consider use of pillows to separate pressure areas, with special attention to offloading contracted joints c. Consider offloading heels d. Consider keeping head of bed (HOB) at or below 30°. HOB may be elevated for meals then lowered within 1 hour p.c. When elevating HOB, gatch the knee area (elevate 10° to 20°) e. When in wheelchair (W/C) instruct/assist with position changes to alter pressure points at least every hour. f. Consider W/C cushion (especially with existing skin breakdown) **2. Very limited** a. Provide above interventions b. Instruct/assist to shift weight in W/C q 15 minutes c. Consider limitation of W/C to 1- to 2-hour intervals d. Use draw sheet to lift up in bed or turn **1. Completely limited** a. Provide all of the above as needed
Moisture **Degree to which skin is exposed to moisture.**	**4. Rarely moist** a. Instruct resident to request care as needed b. Assess and provide routine skin care as needed to keep skin clean and dry **3. Occasionally moist** a. Provide above with use of incontinent care products after each incontinent episode. (no-rinse pH-balanced cleanser, protective ointment, absorbent briefs. Baby powder impairs absorptive ability of briefs. Ensure treatment of fungal dermatitis) b. Assess and address cause of moisture (eg, diaphoresis, incontinence) c. Apply semiocclusive dressings over ulcers affected by incontinence d. Consider keeping HOB at or below 30°. HOB may be elevated for meals then lowered within 1 hour p.c. When elevating HOB, gatch the knee area (elevate 10° to 20°) **2. Very moist** a. Provide all of above as needed b. Consider fecal/urinary incontinence containment device (especially with existing skin breakdown) **1. Constantly moist** a. Provide all of above b. Apply fecal/urinary incontinence containment device (especially if ulcer healing is impaired by repeated effluent contamination)

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Activity	**4. Walks frequently** a. Encourage activity as tolerated
Degree of physical activity	**3. Walks occasionally** a. Provide above b. Teach patient/family the importance of changing positions for prevention of pressure ulcers. Encourage small frequent position changes c. Consider OT/PT consult
	2. Chairfast a. Provide all of the above b. Obtain W/C cushion c. Instruct/assist to shift weight in W/C q 15 minutes. Consider limiting W/C to 1- to 2-hour intervals
	1. Bedfast a. Provide all of above, as needed b. Consider higher level pressure redistribution surface (especially with existing skin breakdown)
Mobility	**4. No limitation** a. Provide routine skin care
Ability to change and control body position	**3. Slightly limited** a. Teach patient/family the importance of changing positions for prevention of pressure ulcers. Encourage small frequent position changes b. Encourage turning and repositioning at least q 2 hours when in bed. Consider use of pillows to separate pressure areas with special attention to offloading contracted joints c. Consider offloading heels d. Consider use of foam wedges to help maintain positioning. Use draw sheet to lift up in bed or turn e. Consider keeping HOB at or below 30°. HOB may be elevated for meals then lowered within 1 hour p.c. When elevating HOB, gatch the knee area (elevate 10° to 20°) f. Instruct/assist to shift weight in W/C q 15 minutes g. Consider use of assistive device (eg, trapeze) h. Consider OT/PT consult
	2. Very limited a. Provide above interventions as needed b. Limit W/C to 1- to 2-hour intervals c. Consider pressure redistribution surface for W/C and/or bed (especially with existing skin breakdown) d. Consider offloading the heels with pillow firm enough to float the heels or use a heel offloading device
	1. Completely immobile a. Provide above

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Nutrition	**4. Excellent** a. Provide tray set up and other routine assistance as needed
Usual food intake pattern	**3. Adequate** a. Encourage intake and assist with meals as needed b. Offer ordered supplements c. Assess needs for oral care, assist PRN
	2. Probably inadequate a. Provide above interventions. Patient may need to be fed b. Consider pressure redistribution surface for W/C and/or bed (especially with existing skin breakdown) b. Consider dietary consult
	1. Very poor a. Provide above interventions
Friction and shear	**3. No apparent problem** a. Provide routine skin care
	2. Potential problem a. Use a draw sheet to lift up in bed or turn b. Consider keeping HOB at or below 30°. HOB may be elevated for meals then lowered within 1 hour p.c. When elevating HOB, gatch the knee area (elevate 10° to 20°) d. Consider heel/elbow pads or socks
	1. Problem a. Provide above interventions b. Consider use of assistive device (eg, trapeze)

** Adapted with permission from Braden Scale for Predicting Pressure Sore Risk (copyright 1988 by Barbara Braden and Nancy Bergstrom) by Jennifer Hurlow to include offloading recommendations*

CMS Rules and Regulations

The Centers for Medicare and Medicaid Services (CMS) have started the process of selecting hospital-acquired conditions that are reasonably preventable through implementation of evidence-based guidelines. These conditions, which include pressure ulcers, are subject to the new nonreimbursement rules that went into effect on October 1, 2008 through which the CMS will deny reimbursement for any pressure ulcers that develop during hospitalization.[37]

Healthcare providers must demonstrate use of evidence-based pressure ulcer prevention and care. In nursing homes, failure to comply with recommendations may result in F-Tag fines.[38] Across the continuum of care, the entire healthcare team must be involved in the assessment and continuous reevaluation of the patient. This will require professional collaboration with better communication and more detailed summaries of patient status.

Preventative Interventions

Immobile and other at-risk patients need a care plan that incorporates heel pressure relief.[39] Table 3 summarizes recent articles and posters describing interventions for heel pressure ulcer prevention.[13,18,39-43] However, it should be noted that randomized controlled clinical studies are not available and the results of some noncontrolled studies are inconsistent or conflicting. The general consensus is that total heel offloading is the only effective method for heel ulcer prevention.

Pillows. Although the literature includes evidence that pillows are acceptable offloading devices, types of pillows available and how pillows are used for offloading vary greatly. Some pillows are soft and compressible, others are firm and less conforming. The NPUAP[36] recommends pillows for short-term use with cooperative patients. Pillow usefulness is a factor of several

TABLE 3
SUMMARY OF SELECTED HEEL ULCER PREVENTATIVE INTERVENTIONS REPORTS*

Authors	Heel Ulcer Intervention (Report/study patient sample size)	Findings	Comments
Brainard et al 2007[39]	Use of the heel offloading device in a Veteran Administration Hospital (acute care and extended care) (N = 240)	Pre-intervention average facility-acquired heel pressure ulcer (FAHPU) = 11.7%; Post-intervention = FAHPU 4%	
Burda 2007[40]	Heel offloading device (N = 550)	Heel offloading devices resulted in a 95% reduction in heel ulcers in high-risk patients (Braden score of 18 or lower and comorbidities)	
Jones 2007[41]	Heel offloading device (N = 52)	Application of a heel offloading device reduced heel ulceration rates from 6.38% to 0%	
Loehne 2007[42]	Heel offloading device use in a long-term care facility (N = 8)	N = 2 IMCU, 6 nursing home — total of 16 heel protectors. Despite low Braden scores and comorbidities, no new pressure ulcers developed with intervention	
Meeker 2007[32]	Heel positioning devices	Positioning devices such as IV bags, rolled towels or sheets, and compressed beanbags can increase pressure and potential skin damage	When using positioning devices in the OR, it is important to use items designed to redistribute or eliminate pressure
Meyers et al 2007[43]	Use of heel offloading devices in high-risk sedated ICU patients (N = 53)	100% prevention of heel pressure ulcers and plantar flexion contractures; 9.4% with improvement in heel status; 11.3% with pre-existing heel skin conditions stayed the same or no change/worsening	
Vanderwee 2007[18]	Frequent turning (N = 235)	Frequent turning reduced rates of heel ulceration. Turning more frequently than every 4 hours did not lead to further improvement	
Walsh 2007[13]	Heel offloading devices (N = 46)	Patients with low Braden scores and comorbidities were given heel offloading devices and the heel ulcer rate was reduced to zero	

**There are no controlled studies comparing the use of heel-protector devices/prevention efforts. All reports summarized are observational studies with or without historical controls.*

Figure 1a,b. *Inadequate pillow support provides no heel pressure relief. Note that the heels are not offloaded in the first picture, despite the presence of the pillow.*

characteristics that include size, amount of fill weight (minimum 18 oz), covering, and patient comfort.[44] Raising the heel off the bed with pillows is best accomplished when the pillow is placed longitudinally underneath the calf with the heel suspended in air. This approach allows complete offloading of the heel.[44] Disadvantages of longitudinal pillows include difficulty in maintaining proper positioning — patient movement and gravity can cause the pillow to move, placing the patient's heel against the bed surface (see Figure 1). Furthermore, pillows do not prevent plantar flexion contracture or lateral foot and leg rotation.

Heel offloading devices. Heel offloading devices (HOLDs) solve most problems associated with pillow offloading and are more efficient because the devices stay in intimate contact with the foot and lower leg and can remain in place 24 hours a day. Padding devices such as sheep skin, bunny boots, and rigid splints (see Figure 2) protect the heels but do not remove all pressure. These padding devices are designed to remove friction and shear but do not remove pressure. Heel offloading devices can be pillow-based, foam-based, and air-based (see Figure 2). An important advantage of HOLDs is that they not only reduce friction and shear, but they also completely offload the heel while staying in place, even with patient movement (see Figure 3).

Costs

Data are limited but studies suggest the cost of care for pressure ulcers is high. In a tertiary hospital, total cost of care for hip fracture patients with a pressure ulcer (unspecified type) averaged $37,288 compared to $13,924 in patients without pressure ulcers.[45] Costs of patient care in a New Mexico Medicaid population hospitalized for the treatment of pressure ulcers (unspecified type) averaged $15,760.[46] Results of a long-term care study showed that the average cost of treatment per pressure ulcer in these older adults (mean age 71.4 years) was $2,731 per ulcer, including hospitalization costs.[47] Costs of treatment also were found to increase with ulcer severity, ranging from an average of $1,119 for Stage II to $10,185 for Stage III and Stage IV ulcers. Courtney et al[48] reported a per-case additional cost of $3,037 for patients with a pressure ulcer in a population of patients in a university hospital.

Additional costs of heel pressure ulcers. The cost of pressure ulcers extends beyond medical expenses.

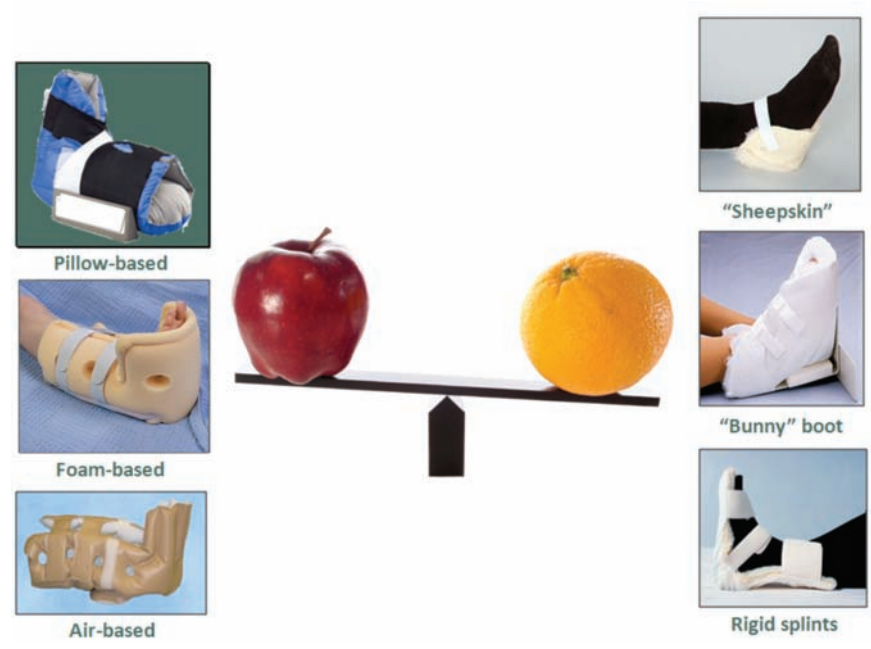

Figure 2. *Heel offloading devices (left) are not the same thing as heel padding devices (right)..*

Most patients with heel ulcers are unable to ambulate, require assistance with activities of daily living, and cannot return to work until their ulcers are healed. Patients with DM and peripheral arterial disease may need partial-foot or below-knee amputation, even with the best of care.

The cost of litigation also must be considered because these wounds are reported to be one of the most common sources of litigation involving nursing home care.[49] Filed claims for pressure ulcers are reported to be the second most common filed claim after wrongful death. The average compensation for pressure ulcer cases is almost $1 million.[49]

Proposed cost savings model. The use of heel protector boots for preventing heel ulcers requires an initial financial investment but significantly offsets the expense of treating heel pressure ulcers. Using cost and incidence data from a 710-bed, multi-site, not-for-profit facility, Courtney et al[48] calculated that $9,600 could be saved by using HOLD devices for every 100 patients in an at-risk population.

Case Reports

As clinicians working in a wound care center, the authors have observed first-hand the considerable amount of patient suffering related to pressure ulcers. These wounds exact a high emotional and physical toll due to prolonged rehabilitation, loss of limb, loss of work, and caregiver burdens. The following are examples typical of the challenges wound care patients and providers face.

Case 1. Mr. R, a 78-year old man with Parkinson's disease and PVD, was admitted to the hospital for a cholecystectomy. Mr. R was 6'2", weighed 250 lb, and his legs were large and heavy. His size and heavy legs, combined with the slow shuffling gait associated with Parkinson's disease, made movement difficult. Following his surgery, he developed blisters on his heels that progressed to full-thickness wounds. He recuperated well from the operative procedure but his rehabilitation period was prolonged as a result of the heel ulcers. During this recuperation time, his mobility was severely compromised and his frail wife, who was his caregiver, had difficulty pushing him in the wheelchair. He was followed in the wound care center for 4 months until the ulcers finally healed.

Figure 3. *Placing a heel offloading device on a patient.*

Case 2. Mr. K, 36 years old and otherwise healthy, overdosed on recreational drugs, fell, and remained on the floor for an extended period of time before he was found. He developed pressure injuries on his shoulder and sacral area. By the time he was able to ambulate, he had developed foot drop and heel ulcers. After 6 months of rehabilitation, the ulcers healed and he could walk normally.

Case 3. Mr. M was a 76-year-old patient with DM, admitted for a surgical procedure to address the severe pain in his back. During his hospital stay, he developed a foot ulcer on his left great toe and dried blisters on his heels. After a 1-month stay in a skilled nursing facility, he was discharged home, where he had limited mobility and sat in a recliner or in bed most of the day. His wife noticed a dry crust on his heel that started to drain. The foot became infected and eventually required below-the-knee amputation.

Conclusion

The comorbidities and risk factors associated with heel pressure ulceration are common among hospitalized individuals and include immobility and resultant pressure, skin condition (eg, moisture level), poor perfusion, friction, and shear forces. However, heel ulcers can be prevented if pressure is completely alleviated. Heel offloading devices are easier to manage than pillows but it is critically important to completely relieve pressure from the heels without causing pressure in other areas. Results of observational studies suggest that their use reduces the rate of pressure ulceration. This approach, combined with complete and frequent

patient assessment, can improve patient outcomes while preventing the additional cost of hospital-acquired pressure ulcers. Although studies to assess the effect of HOLDs on heel ulcer healing have not been conducted, clearly pressure reduction is the first step in healing all pressure ulcers. Prospective, randomized controlled studies to compare the effectiveness and cost-effectiveness of heel pressure reduction strategies are needed to support the validity of the observations contained herein. -OWM

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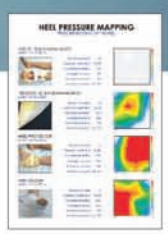

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