PREVENTING HEEL PRESSURE INJURIES

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Introduction

The heel is one of the most common anatomical sites for PIs.[1,2] In adults the posterior aspect of the heel rim is particularly vulnerable, even when a support surface with pressure redistribution properties is used.[3] In standing or sitting positions, normal stresses are transmitted via the Achilles tendon and the plantar fascia, and the heel rim is not directly weight-bearing. Mechanical loads are transmitted directly perpendicular to the bone, and the posterior aspect of the heel is covered with only a small volume of subcutaneous tissue. [1] The shape of the individual's calcaneus, [4,5] and the posture of the foot,[6] normally influence the strain on muscles and tissue at the heel.

The plantar aspect of the heel and the heel rim is surrounded by a matrix of fat cells which are designed to act as a cushion transferring stress through them like a coil in a sprung bed. They are particularly sensitive to shear. When a person is supine, the foot is moved into plantarflexion, and the heel rim comes in contact with the supporting surface.

In immobile and critically ill individuals, the heel commonly endures extended pressure from resting on the full body support surface or pillow if it does not receive appropriate preventive care and positioning. This includes individuals in the operating room, diagnostic units, and those in the early stage of spinal cord injury who are positioned supine for an extended duration due to their clinical needs. [7]Atrophy of the fat pad found in older frail adults or those who have an altered vascular function (e.g., peripheral vascular disease, diabetes mellitus, etc.) and/or altered sensation (e.g., peripheral neuropathy, spinal cord injury, etc.).[8-10] can further increase the risk.[11] The guideline section *Pressure Injury Risk* identifies key risk factors to consider in a risk assessment. The guideline section *Skin and Tissue Assessment* contains comprehensive discussion and recommendation on assessing the skin and tissues.

Selection of an appropriate pressure redistribution full body support surface and regular repositioning are critically important PI preventive strategies and should be implemented for individuals at risk of heel PIs. The recommendations and good practice statements below address additional interventions that should be added to the PI prevention plan for adult at risk of heel pressure injuries.

General Considerations

Clinical question: What are the general considerations for preventing heel pressure injuries for individuals at risk?

H1: It is good practice to elevate the heels of individuals at risk of pressure injuries, so the heels are not in contact with the support surface.

(Good practice statement)

Supporting information

It is considered best practice to offload pressure from the heels by elevating the lower leg and calf in individuals who have a risk of PIs and who are lying in bed.[12-14] Reducing pressure and shear at the heel are the most important focus in preventing heel PIs. Given the small heel surface area, redistribution of load and forces can be challenging, and fully offloading pressure by elevation is good clinical practice. This has been evidenced by an observational study demonstrating that when the heels are fully offloaded, there is increased tissue blood flow to the heels[15] as well as several randomized controlled trials (RCTs) that showed a reduction in heel PI occurrence when heel elevation is implemented.[12-14]

Heels should be elevated in such a way that they are fully free from the full body support surface (a state sometimes called 'floating heels').[16] Optimal positioning is addressed in the implementation considerations.

Implementation considerations

- Elevate heels by distributing the weight of the leg along the full length of the calves ensuring that no direct pressure is applied to the Achilles tendon, popliteal vein or peroneal nerve. Avoid using heel elevation techniques that place pressure on the back of the foot (e.g., rolled up blankets or towels). without distributing the pressure across that full length of the calves. Ensuring the leg is supported over a larger area helps to reduce the risk of PIs, neurological compression and vascular compromise.
- Position the knee in slight (5° to 10°) flexion.
- Ensure the foot is positioned in neutral to slight dorsiflexion (slightly upwards) to prevent contraction of the extensor and flexor muscles of the foot and reduce the risk of developing any neurological or vascular compression issues.
- Assess the heels regularly.[2] Facilitate skin inspection by leaving the heels exposed if possible (e.g., removing regular socks). Positioning the individual laterally during heel inspection can promote better visual assessment. When lateral positioning is not possible, using mirrors is an option or easier inspection.[2]
- Consider the risk of device-related heel/foot PIs associated with seating (e.g., footrests and other equipment), footwear (e.g., from ill-fitting shoes[17]) and devices applied to the feet (e.g., compression therapy). Further guidance is available in the section on *Preventing Device Related Pressure Injuries*.

Heel Offloading Devices

Clinical question: Should any heel offloading device versus standard pillows be used to prevent heel PI occurrence in people at risk?

Clinical question: Should any other heel offloading device versus a fluid-filled bag/glove be used to prevent heel PI occurrence in people at risk?

H2: We suggest using a heel offloading device that is appropriate to the individual's mobility and activity level.

(Conditional recommendation, low certainty of evidence)

Evidence summary

We conducted two analyses for the first clinical question. The first meta-analysis included two RCTs[18,19] that compared using a heel offloading device* to using standard pillows/a regular foam bootee to elevate the heels for individuals at risk of PIs. For this analysis, we used the heel as the unit of analysis (i.e., if one individual experienced two heel PIs, this was counted as two events). The meta-analysis showed that using a heel offloading device was associated with a statistically significant lower rate of heel PI occurrence (0.4% versus 8.4%, relative risk [RR] 0.06, 95% confidence interval [CI] 0.01–0.31, difference of 79 fewer individuals per 1,000 experiencing a heel PI). There is very little confidence that this effect estimate represents a true effect; it ranges from 83 fewer to 58 fewer individuals per 1,000 treated experiencing a heel PI. The body of evidence was downgraded due to risk of bias and imprecision. The studies were conducted in critical care settings and the offloading devices were used for between 5 days and 28 days.[18,19] In the second analysis, we analyzed the data in the largest study[18] using the individual as the unit of analysis (i.e., if one person experienced two heel PIs, this was counted as one event). This meta-analysis showed that using a heel offloading device was associated with a non-significant lower rate of heel PI occurrence (0.5% versus 4.1%, RR 0.13, 95% CI 0.02–0.99, difference of 35 fewer individuals per 1,000 experiencing a heel PI). There is low confidence that this effect estimate represents a true effect; it ranges from 40 fewer to 0 fewer individuals per 1,000 treated experiencing a heel PI. The body of evidence was downgraded due to risk of bias (single blinded study with attrition bias) and imprecision.

The second clinical question was addressed by one non-randomized study[20] that compared using heel offloading device (a medical grade foam boot) to using an intravenous fluid bag to offload pressure at the heels for adults following orthopedic surgery. Using a heel offloading device was associated with a non-significant lower rate of heel PI occurrence (0% versus 40%, RR 0.08, 95% CI 0.0–1.25, difference of 368 fewer individuals per 1,000 treated experiencing a heel PI). There is very little confidence that this effect estimate represents a true effect, it ranges from 400 fewer to 10 more individuals per 1,000 treated experiencing a heel PI. The body of evidence was downgraded due to risk of bias and imprecision.

There was limited information about potential undesirable effects associated with using a heel offloading device. One of the studies reported skin damage in one individual (0.4% of participants) who used a heel suspension boot.[12] The Expert Panel Group provided opinion that a heel offloading device could:

- result in device-related PIs if they are not correctly fitted and used
- reduce the ability of individuals to move in the bed, which could increase the risk of PIs at other anatomical locations
- increase the risk of falls if the individual is ambulant.

* Both studies used the same heel offloading device, as summarized in the data extraction tables.

However, if the heel offloading device is appropriate to the individual's mobility and activity level, the balance of effects probably favors using a heel offloading device.

Accessibility and cost of heel offloading devices are variable across different clinical and geographic settings. Acceptability is varied and limited to an evaluation[12] of one type of heel offloading device that individuals rated as 'warm' or 'sweaty' (70%), causing friction (39%) or itchy (30%). Less than half of individuals who evaluated the heel offloading boot described it as comfortable in lying positions.[12] However, this may not reflect other heel offloading devices.

The Guideline Governance Group warned that using an intravenous fluid bag or other fluid filled bag/glove as a heel elevation device is off-label use, and might cause foot or heel damage (e.g., due to inappropriate interface pressure). **The practice of using an intravenous fluid bag or other fluid filled bag/glove is not recommended for preventing PIs.**

Clinical question: Should a convoluted foam /"egg crate" cushion versus any other heel offloading device be used to prevent heel PI occurrence in people at risk?

Clinical question: Should a polyfiber cushion versus any other heel offloading device be used to prevent heel PI occurrence in people at risk?

Clinical question: Should a medical-grade sheepskin versus any other heel offloading device be used to prevent heel PI occurrence in people at risk?

H3: It is good practice to elevate the heels of individuals at risk of pressure injuries using standard pillows or cushions with sufficient height to ensure the heels are not in contact with the support surface, if a heel offloading device is not available or is inappropriate for the individual's activity and mobility level.

(Good practice statement)

Supporting information

No clinical studies were identified that directly compared different types of cushions to any other type of heel offloading devices for reducing occurrence of heel PIs. No recommendation is made on the effectiveness of convoluted/"egg crate" foam cushions or polyfiber cushions specifically.

However, when a heel offloading device is not available, elevating the heels using pillows or cushions is good practice if they are maintained in position and fully elevate the heels off the full body support surface. The pillow or cushion that is chosen should have sufficient height after the legs are resting on it to maintain the heels fully free from the support surface, while distributing the pressure across the full length of the calves.

No clinical studies were identified that directly compared medical-grade sheepskins to any other type of heel offloading devices for reducing occurrence of heel PIs. However, sheepskins do not fully offload the heels from the support surface and can therefore not fully offload pressure. **Using a medical-grade sheepskin or a synthetic sheepskin under heels is not recommended as the only preventive strategy to prevent heel PIs in an individual who is immobile**.

Implementation considerations

Device selection

- Customize policies to the health service and setting, and consult with the collaborative healthcare team when selecting a heel offloading device (e.g., a boot, pillow or cushion). Clinicians with expertise in assessing and managing the foot might be consulted (e.g., including but not limited to podiatrist, orthotist, prosthetist, physical therapist, physiotherapist, etc.)
- Select a heel offloading device with consideration to the individual's:
  - Level of activity and mobility and risk of falls[2]
  - Heel PI risk factors (e.g., peripheral neuropathy)
  - Clinical condition (including cognitive function)
  - Skin integrity and presence of edema
  - Anatomical appearance/alignment of the hip, foot and lower leg, including any contractures
  - Preferences and tolerance of the device.[12]
- Consider using a heel offloading device with low friction properties for individuals for whom shear on the heels is a particular concern (e.g., for individuals with agitation, dementia, muscle spasms, restless legs syndrome, etc.).[21] A heel offloading device might be a more appropriate choice because individuals who move their legs/feet more often who may dislodge pillows or cushions.
- Carefully select heel offloading devices for individuals with reduced lower limb sensation (e.g., individuals with spinal cord injury, peripheral neuropathy, etc.) who are unable to identify pressure or pain. Be aware of the increased risk of device-related PIs if fitted heel offloading devices are not applied and managed correctly.

Using heel offloading devices, pillows and cushions

- Measure and fit heel offloading devices to the individual (where this is consistent with the manufacturer's directions). For example, consider the individual's shoe size when fitting a heel offloading boot. A heel offloading device that is not correctly fitted and used could cause device-related PIs.
- Ensure the individual's foot is in optimal alignment (i.e., lateral or external rotation of the foot is avoided). If the foot is not well-aligned, review pelvic positioning, and consider using a device with a positioning block or a trough to promote optimal positioning of the foot. The block should be removed for side-lying positions.
- Refrain from adding an additional pillow under the knee when using a heel offloading boot in the supine position. Adding additional pillows under the knee when a heel offloading boot is being used can lead to the heel being in direct contact with the bed surface, rendering the device ineffective and the heels at increased risk for direct pressure.
- Avoid using sheets or pillowcases on heel offloading devices as this could reduce the effectiveness of the device by causing a hammocking effect.[22] Instead, use correctly fitted covers.
- Ensure that pillows or cushions are sufficient in height when supporting the lower legs. Placing one pillow under the whole length of each calf (i.e., use one pillow per leg) might assist in achieving full pressure offloading from the heel. Confirm that the pillow is below the popliteal fossa. Regularly check and readjust pillows to ensure the heel remains offloaded.
- Regularly check that the heel offloading device is correctly positioned. Use a hand check underneath a heel offloading device to check the heel is "floating" above the full body support surface.
- Review the guideline section on *Preventing Pressure Injuries for Seated Individuals* for additional considerations when the individual is seated out of bed.
- When available as a feature on the bed system, the foot of the bed can be lowered to offload pressure from the heel.

Assessment

- Assess the individual's activity and mobility levels regularly and change to a different heel offloading option (e.g. pillows or cushions) when appropriate.[22] As mobility and activity change, re-evaluate the type of heel offloading device in use. For example, consider:

  - Is a heel offloading device restricting bed mobility as an individual's activity and self-repositioning ability improves?
  - Is a fitted heel offloading device increasing the risk of falls when the individual is ambulating?
- Remove the heel offloading device periodically (at least twice/day) to assess skin integrity, perfusion status, fluid shifts and edema.[2] Remove the device more frequently if edema or fluid shifting is present or a risk, and for individuals at higher risk of heel PIs (e.g., those with peripheral vascular disease, diabetes mellitus, neuropathy/reduced sensation or inability to communicate points of pressure or pain). Guidance for assessing the skin and tissues is provided in the guideline section *Skin and Tissue Assessment*.
- If there are signs of early pressure damage anywhere on the foot, consider changing to a different type of heel offloading device and/or reposition the feet more regularly.
- Evaluate the individual's comfort at regular intervals. Some heel offloading devices may be too warm or uncomfortable.[12,23]

Preventive Dressings for Heels

Clinical question: Should any preventive dressing versus no preventive dressing be used to prevent heel PI occurrence in people at risk?

Clinical question: Should any preventive dressing versus a leave-on topical product be used to prevent heel PI occurrence in people at risk?

Clinical question: Should a multilayered soft silicone foam dressing versus any other type of preventive dressing be used to prevent heel PI occurrence in people at risk?

H4: We suggest that a preventive dressing could be used as an adjunct to heel elevation and regular repositioning for preventing heel pressure injuries, where resources permit.

(Conditional recommendation, low certainty of evidence)

H5: We suggest that if a preventive dressing is used for the heels, a multilayered soft silicone foam dressing should be selected.

(Conditional recommendation, very low certainty of evidence)

Evidence summary

We found no studies comparing heel elevation to using a preventive dressing to prevent heel PI occurrence. Heel offloading in which heels are elevated completely off the full body support surface is considered good clinical practice and should be implemented wherever possible. In all the available research, preventive dressings were used in addition to usual care that included heel elevation.

A meta-analysis[24] of four RCTs[25-28] that compared using a preventive heel dressing to no preventive dressing for people at PI risk showed that a preventive heel dressing was associated with a statistically significant lower rate of PI occurrence (1.5% versus 3.7%, RR 0.44, 95% CI 0.21–0.95, difference of 21 fewer heel PIs per 1,000 individuals treated). There is little confidence that this effect estimate represents a true effect, it ranges from 39 fewer to 2 more heel PIs per 1,000 individuals treated. The body of evidence was downgraded due to risk of bias. The studies were conducted in critical care, aged care and tertiary hospitals. In all the studies, the preventive dressing was a soft silicone adhesive multilayered foam

dressing designed for use on the heels.* In all the studies, a daily assessment of the heels was conducted, and the preventive dressings were changed every three days and/or if they became soiled, dislodged or had loss of adhesion.[25-28] The trial durations were approximately 2–4 weeks.[25,26,28]

A second meta-analysis that was conducted included two RCTs[29,30] that compared a multilayered soft silicone foam dressing to another type of preventive dressing (a polyurethane film dressing in both studies) for preventing heel PIs.# This meta-analysis showed that the soft silicone adhesive multilayered preventive dressing was associated with a statistically significant lower rate of PI occurrence (19.4% versus 33%, RR 0.59, 95% CI 0.43–0.80, difference of 135 fewer heel PIs per 1,000 individuals treated. There is very little confidence that this effect estimate represents a true effect, it ranges from 188 fewer to 68 fewer heel PIs per 1,000 individuals treated. The body of evidence was downgraded due to risk of bias and imprecision.

The third meta-analysis included two non-randomized comparative studies[31,32] comparing a preventive dressingϒ to a leave-on topical product. This meta-analysis showed that using a preventive heel dressing was associated with a non-significant lower rate of PI occurrence (2.6% versus 6.7%, RR 0.89, 95% CI 0.02–49.24, difference of 7 fewer heel PIs per 1,000 individuals treated). There is very little confidence that this effect estimate represents a true effect, it ranges from 66 fewer to 1,000 more heel PIs per 1,000 individuals treated. The body of evidence was downgraded due to risk of bias, inconsistency and imprecision. There is lack of empirical evidence on the mechanism through which a topical leave-on product might prevent PIs,[24] and concerns about potential undesirable effects on the skin barrier function from leave-on products.

Data on undesirable effects associated with a soft silicone multilayered foam preventive dressing was limited. A large study reported an undesirable effect rate of 3% and the adverse events were not considered to be serious.[25] One report[33] analyzed costs of using a soft silicone multilayered foam preventive dressing in a critical care setting for three days. This analysis could not be extrapolated to different clinical and geographic settings, and cost effectiveness is likely to vary depending on the context and duration of the intervention. When they are accessible and resources permit, soft silicone multilayered foam preventive dressings are probably feasible to use.

Implementation considerations

- Continue to elevate the individual's heels and implement regular repositioning;[25] even if a preventive heel dressing is in situ.
- If used, a preventive heel dressing could be applied as early as possible in the care pathway (e.g., in the ambulance or emergency room).[27]
- Assess the heels daily or more often for signs of PI by observing the skin under the preventive dressing.[25] Using a preventive dressing does not negate the need to evaluate the heel. One strategy that might facilitate daily lifting of the preventive dressing for skin assessment is to develop a local procedure to mark the outside of the preventive dressing (e.g., with a letter 'P') to differentiate it from a treatment wound dressing (e.g., mark with a letter 'T').
- Encourage people who are ambulant to use well-fitting shoes or gripped socks to prevent slipping when walking with a preventive dressing in situ.[25]
- Change the preventive dressing according to the manufacturer's recommendations (usually at least every three days). Replace the preventive dressing when it becomes soiled, excessively moist or loose/dislodged.[25-28]

* Specific products are summarized in the data extraction tables.

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ϒ The studies used different preventive dressings and leave-on topical products, as summarized in the data extraction tables.

- Consider securing the preventive dressing with appropriately fitted tubular bandage to prevent the edges rolling or the dressing becoming dislodged from friction (e.g. for individuals with agitation or dementia).[27]

Topical Leave-on Products for Heels

Commonly used terms to describe leave-on topical products (e.g., cream, emollient, moisturizer, oil, etc.) are varied and may not accurately characterize the product.[34] For example, products described as hyperoxygenated fatty acid-based preparations consist of esters from glycerol and different fatty acids. Although it is present, fatty acid is not the only defining product characteristic. The descriptors 'cream' or 'moisturizer' are unclear characterization of products, because these preparations are mixtures of many ingredients leading to various product characteristics and functions. Because of the huge number, variety and non-comparability of topical products the Guideline Governance Group considered the use of any '(topical) leave-on product', which includes all different kinds of oils, creams, emulsions etc. used for specifically for PI prevention.

Clinical question: Should a leave-on topical product versus no leave-on topical product be used to prevent heel PI occurrence in people at risk?

H6: We make no recommendation on the routine use of leave-on topical skin products to prevent heel pressure injuries.

(Very low certainty of evidence)

Evidence summary

Effect estimates were reported[24] from one RCT[35] that compared using a leave-on topical product to no leave-on topical product (usual care) for preventing heel PIs. The topical leave-on product was described as sweet almond oil, and it was applied by hand (without massage or pressure) once daily to the heels, for a total of seven days. The control group received usual heel care that did not include any topical leave-on product.[24] The result showed that using a topical leave-on product on the heels was associated with a non-significant lower rate of heel PIs (0% versus 5.6%, RR 0.19, 95% CI 0.01–4.08, difference of 45 fewer individuals per 1,000 [from 55 fewer to 171 more]). However, it is very uncertain if the result represents a true effect. The body of evidence was downgraded due to risk of bias and imprecision. In the study, no individuals who were treated with sweet almond oil experienced any adverse events.[35] However, there is a body of evidence[36,37] suggesting that vegetable-based oils may not be appropriate for individuals with skin barrier impairments, because of disruption to the stratum corneum (e.g., from free fatty acids) that could lead to skin irritation and other adverse events.

The Guideline Governance Group noted the desirable and undesirable effects, and the very low certainty of the evidence. Evidence was also unclear about the role and safety of leave-on topical products for protecting the skin of neonates and infants.[38-40] Based on the lack of evidence fully elucidating any mechanism by which leave-on topical products could influence PI development on the heels,[24] the Guideline Governance Group determined that no recommendation could be made about the use of leave-on products for preventing heel PIs.

Future Research

The evidence available to address the clinical questions on preventing heel PIs was generally of low or very low certainty. This was primarily because the studies were at high risk of bias due to challenges designing blinded studies without confounding factors and with sufficiently large populations. The Guideline Governance Group did not identify comparative studies that provided evidence on the following clinical questions for preventing heel PIs

- Convoluted foam cushion versus any other heel offloading cushion/device,
- Medical grade sheepskin versus any other heel offloading cushion/device,
- Polyfiber cushion versus any other heel offloading cushion/device, or
- Any preventive dressing compared to a heel offloading device.

The Guideline Governance Group noted gaps in the evidence addressing the topics in this section that require future research:

- There was limited information about potential undesirable effects associated with techniques to reduce the risk of a heel PI.
- Establishing mechanisms by which leave-on topical products could influence PI development on the heels.[24]
- There is limited evidence on the effectiveness of preventive dressings in some specific population groups, including but not limited to individuals at the end of life, individuals with spinal cord injury, and individuals with dark skin tones. Exploration of the role preventive dressings can play in the care trajectory of these individuals would be beneficial.
- There is limited evidence on the effectiveness of heel offloading strategies in individuals for whom heel offloading is often challenging, including those with agitation or cognitive impairment.
- There is an overall paucity of research that is co-designed with consumers or that focusses on patient reported outcome measures (PROMs, e.g., comfort) associated with different preventive skin care interventions.

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