Mitigating the damaging effects of tissue distortions using a low-friction heel protector

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Conclusions:

- 30 enrolled patients had existing pressure damage to the heels, which improved over 14 days using the low-friction bootees
- Low-friction bootees should be considered as part of routine pressure ulcer prevention practice in all settings

ABSTRACT

A small non-controlled evaluation of low-friction bootees for the management of heel PU (hPU) was conducted over a 2-week period in three different care settings: a residential care home, an acute stroke unit and a community intermediate care hospital. At initial recruitment 30 patients were identified by clinical assessment as being at high risk of developing a hPU. Further inclusion criteria were identifying heels that had existing signs of pressure damage, blanching and non-blanching erythema, blistering and category 2 ulceration. 15 patients fully completed the evaluation over a 14-day period. The mean age was 86 years. The low-friction bootee was worn constantly while in bed and seated in chairs, only being removed for heel checks and hygiene care. No patients were independently mobile during the evaluation; products were not worn to walk in due to a risk of falling—patients in the community hospital who had to mobilise for rehabilitation removed the bootees for this activity. All had pressure mapping and ultrasound of pedal pulses prior to and after evaluation by the tissue viability specialist nurse. Pressure mapping revealed reduced peak heel pressures on application of the bootees and, at final review, reduced visual signs of heel damage, reduced pain, increased comfort and ease of use. These results indicate that a standardised care pathway approach to heel protection using low-friction heel bootees is effective in all care settings for the reduction and prevention of heel pressure damage

INTRODUCTION: Heel pressure ulcers are reported to be the most prevalent of hospital acquired PU's (VanGilder et al, 2008) despite the variety of products available, wedges, boots, gel supports and mattresses. A recent study by Guest et al (2017) calculated that NHS costs of treating a PU over 12 months ranged from £1400 to £8500 depending on the severity.

Personal costs to the patient are in the form of pain, discomfort, limitations in mobility, decreased quality of life (Gorecki et al, 2010). Strategies that focus on prevention benefit the patient and the NHS, such strategies must consider effectiveness, cost, ease of application, comfort and choice (Wilson, 2002) The heel is particularly vulnerable due to the weight of the leg and foot, the shape of the calcaneus, a thin layer of skin and often poor blood supply in the higher risk patient (Langelmo, 2015). Biomechanical research has found that tissue deformation very quickly leading to cell death faster than hypoxia (Gefen & Weihs, 2016). The squashing and stretching caused by shearing and friction can cause such damage and static friction even if using other devices, puts stresses under the skin surface (Gefen, 2017).

An evaluation of Low friction fabric bootees (LFB: APA Parafricta, Bedford, UK) was performed in North Lincolnshire and Goole NHS Trust by the Tissue Viability Lead nurse (AS) due to a high incidence of reporting in heel PU. It took place across 3 different settings, acute stroke ward, intermediate care and residential home demonstrating the cycle of care and that the risk remains despite the setting. LFB were provided to the patients enrolled and were used when patients were both in bed and when sitting in a chair without mobilising due to falls risk.

RESULTS

Table 1. Existing support surfaces and heel pressure damage at enrolment

Setting	Type of mattress	Current heel prevention	Mobility	Heel appearance
Residential care home (N=7)	Static foam: 2 Powered hybrid: 1 Air alternating dynamic: 4	Repositioning Skin inspections Risk assessment Offloading—1 patient had offloading boot to left heel	Bed-bound & immobile: 4 Bed or chair: 3	Blanching erythema: 1 Non-blanching erythema: 6 DTI: 1, offloading boot in place
Community hospital (N=4)	Static foam: 3 Powered hybrid: 1	Offloading using pillow elevated on foot stool when sat in chair: 2	Bed or chair: 4 Assisted walking: 3 (rehabilitation programme)	Non-blanching erythema: 2 Category 2: 1 DTI with blister: 1
Stroke ward at acute hospital (N=4)	Powered hybrid: 1 Air alternating dynamic: 3	Offloading using Repose wedge: 1	All bed bound, unable to self-reposition	Non-blanching erythema: 3 DTI with blistering: 1, using Repose wedge

Table 2. Pressure mapping of patients' heels in bed and seated: representative patients

Care setting and patient location	Average/peak heel pressures:standard care	Average/peak heel pressures: LFB
Residential care home Patient in bed, high-risk foam mattress	Ave. 45mmHg Peak 124mmHg, right heel	Ave 27 mmHg Peak 79 mmHg*
Residential care home Patient in bed, static foam mattress	Ave. 28mmHg Peak 104mmHg, right heel	Ave. 23 mmHg Peak 65 mmHg
Community intermediate care hospital Patient sitting in standard high seat chair in bedroom, heels on floor	Ave. 63mmHg Peak 195mmHg	T=0: Ave. 44 mmHg Peak 112 mmHg T=10 mins post-application: Ave. 39mmHg Peak 83mmHg
Residential care home Patient sitting in lounge chair with heels resting on floor	Ave. 21mmHg Peak 51mmHg, left heel	Ave. 15 mmHg Peak 36 mmHg
Acute hospital stroke ward Patient lying on powered hybrid mattress	Ave. 42mmHg Peak 214mmHg	Ave. 34mmHg Peak 99mmHg
Acute hospital stroke ward Patient lying on air-alternating dynamic mattress	Ave. 24mmHg Peak 78mmHg, right heel	T=0: Ave. 29 mmHg Peak 49mmHg T=10 mins post-application: Ave. 21mmHg Peak 35 mmHg

Table 3. Evaluation of heels at day 14 for 15 patients in low-friction bootees, all 3 settings

Performance rating of LFB 1=poor, 4=excellent	Appearance of skin at end of treatment	Patient, carer, health professional view on LFB
14 patients rated as 'excellent' (score=4) 1 patient rated as 'good' (score=3)	All non-blanching & blanching erythema fully resolved to normal intact skin after 3–4 days 1 DTI* resolved after 7 days 2 blistered DTIs reduced in size, reabsorbed dry and intact	All responses were for bootees to be continued as a treatment due to ease of use, comfort factor and positive results. Patient adherence was not an issue

Figure 1. Clinical and pressure mapping outcomes for one representative patient

Figure 1a. At enrolment with category 1 pressure damage to both heels | Figure 1b. LFB fitted to both feet | Figure 1c. After 7 days use of LFB showing blanching heels | Figure 1a. After 14 days. Clinically normal intact skin

Patient in a residential care home. Presented with bilateral category 1 pressure damage. LFB were fitted to both feet. The patient was assessed at day 7. Category 1 pressure damage had reduced and both heels had blanching erythema. Final assessment at 14 days showed that the category 1 damage to the heel skin had resolved to clinically normal skin

15 patients completed the evaluation (Table 1). 15 patients were excluded because of deaths; discharges from the settings prior to completion; enrolment criteria not met. 1 patient withdrew when their rehabilitation programme increased their mobility. Walking wearing LFB is not recommended; doing so may present a falls risk. Pressure mapping (Table 2) showed reduced peak heel pressure after application of the LFB. Pressure reduced further in combination with an offloading wedge. One patient in residential care had peak heel pressure on the bed of 104mm Hg, reduced to 65mm Hg after introducing LFB. Pressure reduced further to 20mm Hg when a wedge was also used. A patient on the stroke ward had peak heel pressures of 214mm Hg on a hybrid mattress, reduced to 99mm Hg with LFB applied. On the same ward a patient on a dynamic mattress system had peak heel pressure of 78mm Hg which reduced to 35mm Hg. In the community hospital a patient sitting in a chair with feet resting on the floor had heel pressure of 195mm Hg, reduced to 83mm Hg with LFB. All signs of pressure damage resolved within 7 days (Table 3, Figure 1). No further damage occurred in the 14 day period. Patient comfort and ease of application scored highly. All patients were adherent.

METHOD: The inclusion criteria were: patients >65 years, assessed at red risk level on the local Trust risk assessment tool (RA) which has a traffic light system of risk level. All patients in the red risk level, with existing pressure damage to the heels, category 1-2, were selected. 30 patients fitting the inclusion criteria were recruited. All patients were assessed as high risk using RA and Doppler ultrasound. All had pressure mapping performed on the heels prior to intervention and once LFB were in place, both on the bed and on the floor surfaces. Pressure mapping was conducted using the XSENSOR ForeSite™ pressure map (XSENSOR Technology Corporation, Calgary, Alberta, Canada). The patients were evaluated over a 14 days. Flow friction bootees were removed for heel checks and hygiene care.

DISCUSSION: Micro movement alleviating the microcirculation of pressure in the heels is provided by the double layer of the low friction fabric in the bootee. A study by Gefen (2017) explained if a person is lying in bed dynamic and static frictional forces occur, if the patient is moved then the heels travel with gravity, distorting the skin, cells and internal heel structure, this is minimised by use of the low friction fabric.

Protecting the heel tissues needs to balance alleviating tissue deformations in a sustainable manner whilst also allowing free movement of the rest of the body. Patients do not always accept gel pads or offloading heel boots.

Standard care should always be applied with heel offloading and correct support surfaces if at risk of pressure damage. However, the addition of low friction fabric further reduces stresses to the heel as reflected in this evaluation. Microenvironment is essential also and the bootee is breathable and lightweight for patient comfort which gives a high compliance.

Conclusion: Low-friction fabric when used in routine practice for patients at risk of heel pressure ulceration is an additional benefit to standard care strategies. The patient journey through care settings requires a multidisciplinary approach to reduce the risks and implementing easy to use but effective measures that can continue wherever the care is delivered.

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