

## ORIGINAL ARTICLE

## Challenges in pressure ulcer prevention

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**Abstract**

Although this article is a stand-alone article, it sets the scene for later articles in this issue. Pressure ulcers are considered to be a largely preventable problem, and yet despite extensive training and the expenditure of a large amount of resources, they persist. This article reviews the current understanding of pressure ulcer aetiology: pressure, shear and microclimate. Individual risk factors for pressure ulceration also need to be understood in order to determine the level of risk of an individual. Such an assessment is essential to determine appropriate prevention strategies. The main prevention strategies in terms of reducing pressure and shear and managing microclimate are studied in this article. The problem of pressure ulceration related to medical devices is also considered as most of the standard prevention strategies are not effective in preventing this type of damage. Finally, the possibility of using dressings as an additional preventive strategy is raised along with the question: is there enough evidence to support their use?

**Introduction**

Pressure ulcers are often considered to be largely preventable and while this may be true, health care professionals still seem to be struggling to reduce their occurrence. For example, the USA has the longest record of large-scale pressure ulcer prevalence surveys undertaken over many years and found the rates to range between 9.2% and 15% in surveys undertaken between 1990 and 2001 (1). Van Gilder *et al.* found a slight reduction in prevalence from 13.5% to 12.3% in their surveys from 2006 to 2009 (2). The situation is similar elsewhere in the world where studies have shown some reduction, but not large reductions. For example, in Germany, there was a reduction in prevalence from 13.9% in 2001 to 7.3% in 2007 (3). Over the same time frame, one of the states in Canada observed reduction in their prevalence rate from 18% to 14% (4). It is not possible to prevent all pressure ulcers, and it would appear that despite provision of education and considerable resources, time and effort, the numbers of patients with pressure ulcers have not really reduced as much as has been hoped. To try and understand this situation better, it may be helpful to review current understanding of pressure ulcers, their causation and appropriate prevention strategies.

**Pressure ulcer aetiology**

The most recent definition of pressure ulcers defines them as:

*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. A number of contributing or confounding factors are also associated with pressure ulcers; the significance of these factors is yet to be elucidated (5).*

**Key Messages**

- pressure ulcers continue to be a challenge to health care professionals
- there is improved understanding of the causation of pressure ulcers, that is, pressure, shear and microclimate
- there are a range of prevention strategies in use, but there is increasing interest in the use of dressings as an additional preventive strategy

It is well recognised that pressure is a major factor in the development of pressure ulcers. Simplistically, when prolonged perpendicular pressure is applied over a small area, especially a bony prominence, it causes compression of the tissues beneath the skin, disruption to the local blood supply and ultimately pressure damage. In the 1970s, it was proposed that high pressure for short periods of time or low pressure for prolonged periods of time were both likely to cause pressure damage (6). More recent work has led to a proposal that this should be modified as it has been shown that low pressure can be applied for long periods without pressure damage occurring (5,7).

What is less well recognised is that the applied pressure also causes tissue distortion, resulting in shear stresses near the bony prominence (8). Shear stress also results from the application of a force parallel (tangential) to the surface of an object while the base of the object stays stationary (9). Such shear stresses intensify the injury to the tissues caused by pressure because they result in one layer of tissue moving relative to another. The amount of movement depends on the stiffness of the tissue layer, for example, skin in young people is relatively elastic and skin turgor is pronounced ensuring that the layers are stiffer and better able to resist shear forces compared with older people with less elastic skin and reduced turgor (9). Friction that does not directly cause pressure damage, but may cause shear stresses should also be mentioned. It occurs when two surfaces rub together, the common example being when a patient slips down the bed.

Recently, there has been increased interest in the role of microclimate in pressure ulceration (10). Microclimate is not mentioned in any of the current definitions of pressure ulcers and at present there is limited evidence of its precise role in pressure ulcer development. So, what is currently understood about microclimate? Microclimate refers both to skin temperature and the humidity or skin surface moisture at the interface between the body and the support surface (10). A raised body temperature has been identified as a risk factor for pressure ulceration (11,12). When the body temperature is raised it increases the requirement for oxygen and energy in the tissues, with 1°C increase in temperature raising metabolic activity by 10% (13). The outcome is that tissue perfusion will be impaired and pressure damage occurs even with less pressure over a shorter time than if the body temperature is at normal levels.

The other aspect of microclimate is skin surface moisture and will likely be an issue if there is excessive moisture or excessive dryness. Excessive moisture may be in the form of sweat, urine or wound/fistula leakage. In any form it will increase the coefficient of friction and increase shear forces, and will also cause maceration of the skin, which has the effect of weakening the crosslinks in the dermis and softening the stratum corneum (10). The impact of maceration is that it reduces stiffness in the tissues and makes it more vulnerable to shear stresses. In contrast, excessive dryness is found when there are reduced lipid levels, water content and tensile strength (10). Predominantly, dry skin is found in older adults as part of the ageing process and it is more vulnerable to shear stresses.

## Individual risk factors

Effective pressure ulcer prevention depends on health care professionals identifying those individuals who are particularly vulnerable to pressure damage because of specific risk factors. There is variable evidence to confirm the precise risk factors, but a recent systematic review (14) of all the evidence determined that there is sufficient proof to confirm the following as risk factors:

- Impaired mobility
- Alterations in skin status
- Poor nutrition
- Impaired perfusion
- Skin moisture
- Impaired sensory perception

The International Pressure Ulcer Guidelines recommend a structured approach to risk assessment, which may be achieved through the use of a risk assessment scale in combination with a comprehensive skin assessment and clinical judgment (5). The assessment can then be used to focus pressure ulcer prevention strategies appropriately.

## Pressure ulcer prevention

Prevention strategies can be considered in terms of pressure and shear reduction and potentially the management of the microclimate. It is impossible to remove pressure from all the bony prominences at once. The challenge is to ensure that pressure is maintained either at presumed safe levels or for a safe period of time. This is generally achieved by pressure redistribution in terms of either manually relieving the pressure or through either 'spreading the load' so that more of the body surface is in contact with the support surface using either envelopment or immersion or limiting the time that any body site is in contact with the support surface (active therapy).

Traditionally, pressure relief has been achieved by regular repositioning of patients, either by the patient themselves or with assistance from the nursing staff. The frequency can be adjusted according to individual need, based on monitoring the skin carefully for the presence or absence of persistent erythema over bony prominences. However, not all patients can tolerate this level of movement; for example, those with chronic respiratory problems may need to remain in an upright position. Critically ill patients also may not tolerate repositioning or may be so poorly perfused that even low pressure for short periods can cause pressure damage. In these circumstances, it is difficult for nurses to monitor the skin adequately and to be certain that they are indeed providing adequate pressure relief.

Since the mid-1980s, specialised beds, mattresses and overlays have been widely used to provide pressure redistribution. Mattresses replace the existing mattress on a bed, whereas overlays go on top of a mattress. A wide number of these support systems work by immersion and/or envelopment and are sometimes referred to as reactive support surfaces (15). Immersion occurs on a support surface where the body sinks into it, allowing more of the body surface area to come into

contact with the support surface, thus redistributing pressure over a wider area and reducing pressure over bony prominences. Envelopment is the term used to describe how well the support surface conforms to the contours of the body. Examples of support surfaces that function using immersion and envelopment are foam mattresses, gel and air systems and air fluidised systems. Alternating pressure mattresses and overlays provides active pressure relief because of their mode of action. The cells inflate and deflate in a cyclical manner allowing pressure relief over an area where the cells are deflated. There is much less variation in materials in these active systems compared with reactive systems although there is more variation in terms of cycle time in inflation pressures.

Consideration also needs to be given to seating as most patients do not remain in bed at all times. In general, hospital chairs and armchairs may not provide appropriate support as many have a reclining back of between 15° and 40°, which puts the patient into a semi-reclining position, increasing the risk of creating shear and friction forces (16). The ideal chair reclines no more than 10°, ensuring good posture and enabling the patient to rise to standing more easily (17). Pressure redistributing cushions have been developed primarily for use in wheelchairs; if using in an armchair, care should be taken to ensure that the patient's feet still make contact with the floor. Selection of the most suitable cushion for long-term wheelchair users should be made by a therapist with specialised skills in this area.

Skin assessment is essential not only to identify early signs of pressure damage but also to determine vulnerability to pressure damage. There is limited evidence to identify the most appropriate methods of skin care, but care should be taken to avoid excessive rubbing or the use of rough materials when cleansing or drying the patient (18). Dry skin can be cared for by using emollients both during bathing and as creams applied to the skin. One small randomised study showed that a cream containing hyperoxygenated fatty acids was more effective than a placebo in reducing pressure ulcer incidence (19). Similarly, a small study of the before and after effect of introducing a simple skin protectant within a wash cloth for the buttocks and perianal area also showed a reduction in pressure ulcers (20). The other aspect of skin care is the management of excessive moisture. Obviously, the first step is to identify the moisture and determine the problem. Barrier creams may be used to protect the skin from moisture (21). Care must be taken with the use of incontinence or other pads as they may have an impact on microclimate and they may also affect the local performance of the support system in use. Depending on the materials, pads can cause excessive heat or pooling of moisture over the skin, although newer materials are able to effectively wick moisture away from the skin surface (22). There are also growing numbers of reports of the use of specific dressings to protect the skin surface from excessive moisture and potential tissue loading.

So far, this article has described pressure ulcer prevention in general terms, but there are areas of the body that may need additional prevention strategies. The heels are often a cause for concern particularly in the immobile. Peripheral perfusion may be affected by the patient's condition, resulting in pressure damage occurring at low levels of pressure. The

International Pressure Ulcer Guidelines recommend the use of a pillow or other devices to lift the heel clear of the bed (5). This is sometimes referred to as a floating heel. Care should be taken to ensure that the weight is spread evenly along the calf so that there is no excessive weight over the Achilles tendon (5). However, this type of prevention method does not work for all patients. Agitated patients or those with 'irritable' limbs will not keep their legs in same position for any length of time and those with heavy casts may find it impossible to float their heels. Recently, there has been interest in the use of dressings as an alternative method to protect the heel.

There appears to be an increasing problem of device-related pressure injuries. One survey of 2079 patients with an overall pressure ulcer prevalence of 5.4% found that nearly 35% of pressure ulcers were device related (23). Many of the standard prevention strategies do not reduce device-related damage. For example, a pressure redistribution mattress will not prevent pressure damage on the nose from a poorly placed nasogastric tube. Dressings are widely used to protect the skin from the impact of medical devices, particularly around the nose and the ear, but correct use and positioning of the device are also essential.

## Discussion

So why have the above strategies failed to significantly reduce the prevalence of pressure ulcers? Are there additional strategies that have to be considered? The use of dressings as a pressure ulcer prevention strategy in specific cases has already been mentioned, but is there a wider role for them? While it is possible to see that modern dressings can have an impact on microclimate, could they really further reduce pressure or shear? The rest of this issue will consider the existing evidence on dressings for pressure ulcer prevention, use laboratory evidence to understand the impact of dressings on pressure, shear and microclimate and provide the results from new clinical research. It will conclude with clinical practice guidance based on the presented evidence and practical advice on implementation. Do we have enough evidence to use dressings as an additional prevention strategy? The authors believe so – but the reader must decide!

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