Does friction play a role in the occurrence of pressure ulcers?

KEY WORDS
- Friction
- Pressure ulcer prevention
- Silk-like sheets
- Shear forces
- Static friction

This article looks at the importance of addressing pressure, shear and microclimate to prevent pressure ulcer formation. It particularly focuses on the friction which contributes to shear forces. Silk-like sheets and gowns can reduce this static friction that can add to the factors that cause pressure ulcer formation in at-risk patients. This article includes an overview of the literature that supports the use of silk-like sheets, gowns and heel protectors, and also discusses international guidance about pressure ulcer prevention that recommends that silk-like fabrics should be considered for use among people who are at risk of pressure ulcer formation.

There are a wide range of pressure ulcer prevention measures that should be employed and the use of equipment should not be restricted to pressure redistribution. The 2014 international guidelines (National Pressure Ulcer Advisory Panel et al [NPUAP], 2014) stress the importance of pressure, shear and microclimate as external factors which cause or contribute to the occurrence of pressure damage. When considering using equipment it is therefore importance to address all of these factors.

Traditionally when discussing equipment, the focus is on the mattress or chair cushion and how that performs. However, more recent discussion has included whole systems (Fletcher, 2015), for example a mattress is placed on a bed frame and is covered by linen and all three of these items contribute to the patient's experience of being in the bed, and each of them also contribute to pressure, shear and the microclimate.

The role of friction on pressure ulcer creation has not been included as an individual factor that causes pressure ulcer formation in the guidelines since 2009 (NPUAP/European Pressure Ulcer Advisory Panel [EPUAP], 2009; Antekol et al 2012). It still plays an important role as it is the amount of friction at the patient/surface interface that influences the shear stresses that occur deep within the tissues (Brienza et al, 2015). Lahmann and Kottner (2011) have suggested that the impact of friction may have a more significant role in superficial ulceration in the skin but this is not described as pressure damage.

Importantly Antokal et al (2012) describe two different types of friction: static and dynamic (*Box 1*) which play different roles in the causation of tissue damage. Static friction is relevant to the occurrence of pressure damage as it causes the skin to resist the relative motion between the body and the skin therefore increasing shear forces and dynamic friction. It is the slipping that occurs when the body overcomes the static friction and slides down the support surface. Static friction can occur between the skin and a surface, such as the bed, chair or linen, when the body is moving, typically when the patient is seated in an angled, semi-recumbent position (*Figure 1*). The resulting internal shear forces can cause

Box 1. Definition of the two types of friction (Antokal et al, 2012)

Static friction: the force resisting motion between two surfaces when there is no sliding. This is a component of drag.
Dynamic (or kinetic) friction: The force resisting relative movement between the two surfaces when they are moving relative to one another i.e. by sliding.

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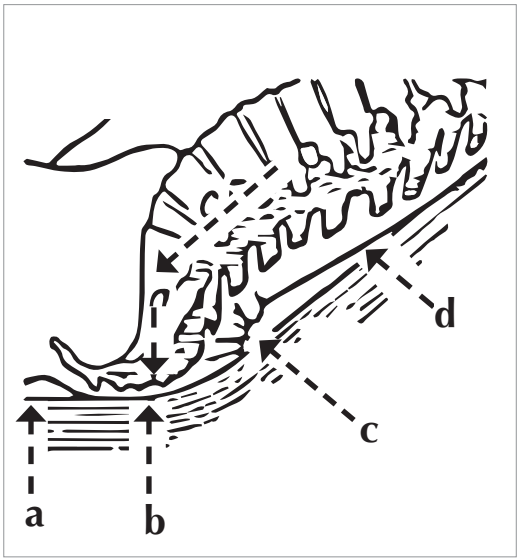

Figure 1. Static friction and shear. a=support surface b=high static friction c=area of high shear d=skin

tissue deformation that may result in the occurrence of deep category III and IV pressure ulcers if it is unrelieved. So while friction *per se* does not result in pressure ulceration it does increase the amount of shear force that the patient is subjected to, and the deformation of the tissues caused by shear forces do contribute to the development of pressure ulcers.

The amount of static friction is influenced by many factors including pressure, hydration of the skin (or surface roughness) and the ability of the support surface to deform. In relation to a patient at risk of pressure ulcers this would relate to their weight distribution, the angle at which they are positioned, the condition of the skin, the local microclimate (temperature and humidity) (Clark and Black, 2011; Regan et al, 2010) and the roughness of the surface that the skin (or clothing) was in contact with. The 2014 international guidelines (NPUAP et al, 2014) include a recommendation to 'consider the use of silk-like fabrics rather than cotton or cotton blend to reduce shear and friction.' This recommendation is supported by level B evidence (*Box 2*) and has a one thumb recommendation (weak positive recommendation: probably do it), yet this recommendation does not appear to have been widely implemented.

Box 2: Strengths of evidence (NPUAP et al, 2014)

The recommendation is supported by direct scientific evidence from properly designed and implemented clinical series on pressure ulcers in humans (or humans at risk from pressure ulcers providing statistical results that consistently support the recommendation.

It is suggested that silk-like bedding and garments could reduce static friction because of their smooth surface which reduces the friction coefficient and therefore the amount of static friction and also because the materials they are constructed from influence the local microclimate by wicking away moisture and helping to reduce body temperature (*Figure 2*).

Several authors have investigated the use of these new fabrics on the occurrence of pressure ulcers (Smith and Ingram, 2010; Coladonato et al, 2012; Twersky et al, 2012; Smith et al, 2013; Gleeson 2015). There is a range of products that use this material including bed sheets, patient gowns, bootees and pants, and the papers reviewed in *Table 1* demonstrate very positive results, all showing reduced occurrence of pressure ulcers. Smith and Ingram (2010) also demonstrated cost savings (*Table 1*). However, the new silk-like fabrics have their disadvantages, for example some patients who have increased movement/agitation may find the bedding slides more easily from the bed and patients who are returning to full mobility may feel reduced confidence as lifting themselves up from slippy surface may seem more challenging.

Despite these issues, there is clearly a very strong link between friction and shear and this should not be forgotten. In addition to the reduction in static friction forces, the makers of the synthetic silk-like sheets and gowns (DermaTherapy®) also suggest that the fabric assists in promoting a better microclimate. The material has micro-channels that encourage moisture to be wicked away from the skin allowing it to dry quickly with evaporation taking place from the fabric rather than the skin. The yarn that the fabric is made from is also non-hydroscopic, meaning it does not have a tendency to absorb moisture from the air. This in itself will

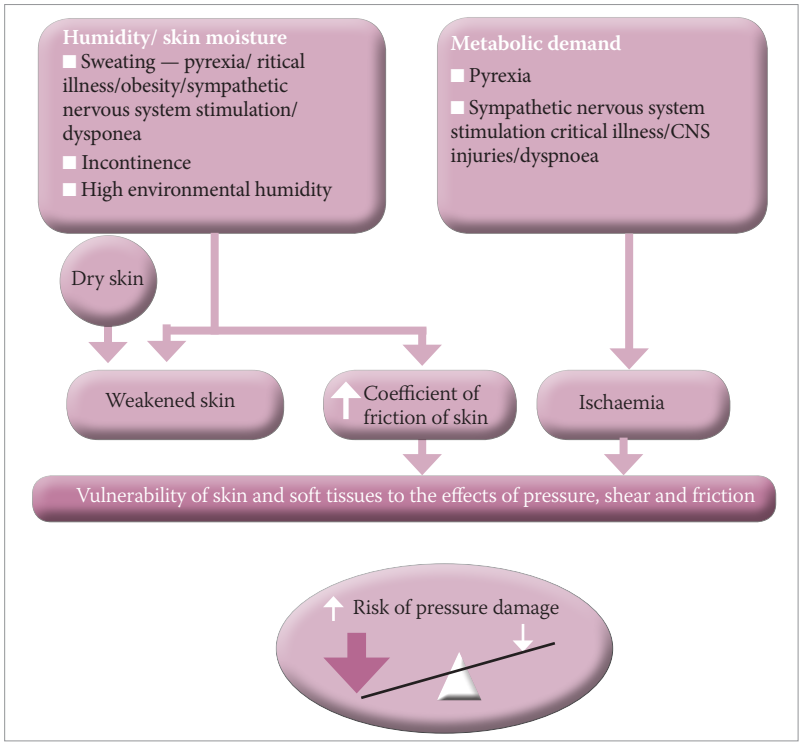

Figure 2. Microclimate and the risk of pressure damage (adapted from Skin IQ Microclimate Manager Made Easy, Wounds International)

contribute to changes in the amount of friction (and therefore shear) as skin moisture content and surface wetness increase the coefficient of friction (Reger et al, 2010).

While the sheets and garments may play an important part in the reduction of friction it must also be remembered that they are only one part of the equipment. Appropriate use of the bed frame can also assist in reducing friction and shear. The international guidelines (NPUAP, EPUAP, PPPIA 2014) and the consensus document *Pressure, Shear, Friction and Microclimate* (Wounds International, 2010) caution against incorrect use of the back rest with angles of head elevation above 30 degrees being detrimental, resulting in high levels of static friction and a high force pushing the patient down the bed which equates to high shear and a high risk of deep tissue damage. When helping the patient to sit up from a supine position, care must be taken to support the heels to ensure that they are not being forced across the bed (Fletcher, 2015) causing friction and shear damage. Equally when repositioning the patient into any side-lying position (including 30 degree tilt) consideration should be given to shear forces if the patient is not adequately supported.

CONCLUSION

Shear — and more importantly the contribution of friction and moisture to the occurrence of shear forces — appears to be both poorly understood and managed. The change in emphasis in newer guidelines to the rapidly occurring damage from shear should encourage clinicians to think more broadly about the equipment they use when trying to prevent the development of pressure ulcers. The mode of action of specialist mattresses is no longer the main focus and the impact of the surface (which will be a linen rather than the mattress cover) and the bed frame should also be considered. WUK

DECLARATION

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Table 1. Details of studies regarding use of silk-like textiles to reduce the risk of pressure ulcers.

Authors	Number of patients	Type of study	Intervention	Control	Results	Comments / Limitations
Colanodato et al (2012)	582 (307 from a medical renal unit; 275 from surgical intensive care unit)	Prospective, non-randomized controlled trial	Silk-like synthetic bedding and patient gowns	Conventional cotton blend products currently used at the facility	Incidence of new ulceration was 12.3% in the control group and 4.6% in the intervention group (p=0.07) in the renal unit and 7.5% control and 0% in the intervention group (p=0.01)in surgical intensive care	
Gleeson (2015)	All adult patients scored as at risk over two years	Evaluation against historical control	Low friction bootees	Standard care	Decline in heel ulcers of 78%	
Smith and Ingram (2010)	165 patients met the criteria during the period when the garments were evaluated	Evaluation against a retrospective control	Low friction undergarment or bootees	Usual care	In patients at risk of PU there were 41% developed PU in the control and 25% in those using the low friction garments.	Also includes a cost analysis
Smith et al (2013)	1427 (659 patients control, 768 intervention)	A retrospective, non-randomized, before and after study	Synthetic silk like bedding and patient gowns	Standard cotton hospital linens	68 (10.3%) of patients in the control group and 19 (2.5%) of the intervention group developed one or more PU (p<0.001)	
Twersky et al (2012)	46 men in nursing home care	A randomized controlled study	Silk-like textile linens and high absorbency incontinence briefs	Standard linens and incontinence briefs	Number of new pressure ulcers was 6 in the control group and 20 in the intervention group.	The intervention group were followed for a shorter duration (average 75.6 days and control average 95.6 days). There was a higher withdrawal in the intervention group (13:8). The authors acknowledge this may represent participants inability to tolerate the intervention.

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