The use of dressings in pressure ulcer prevention: Unsafe practice or thinking differently?

The use of dressings in pressure ulcer prevention has previously been considered with a focus on their ability to reduce the single force – external pressure. More recent research reveals dressings may have a role to play in mediating the impact of other physical forces, such as friction and shear, and also in manipulating the local microclimate, both of which contribute to pressure ulcer prevention.

KEY WORDS
- Dressing
- Microclimate
- Pressure ulcer

In an era when the number of patients at high risk of developing pressure damage is escalating, yet health services are under great pressure to make financial savings, finding ways of preventing pressure ulcers is increasingly complex. Despite timely risk assessment and reassessment, implementation of preventative care underpinned by massive investment in specialist beds, mattresses, and chairs, many patients still develop pressure damage. Although the use of pressure relieving devices has made a significant impact on the number of patients developing pressure damage, it appears that the occurrence rates are now at a plateaux (Clancy, 2013). Thus, efforts to identify other intervention that may prevent pressure ulcers are underway.

The suggestion that dressings prevent pressure ulceration has been frowned on. The ability of dressings to "relieve pressure" is nonexistent; at best, they give a cushioning effect, at worst, the application of an adhesive dressing to an at-risk part of the anatomy could result in less frequent skin inspection leading to damage going undetected. In addition, vulnerable skin may be damaged during dressing removal.

However, since 2007, results from several trials have lead some to suggest that dressings may play a part in pressure ulcer prevention (Nakagami et al, 2007; Brindle and Wegelin, 2012; Chaiken, 2012; Cubit et al, 2012; Santamaria, 2013a). The authors of these studies are careful to point out that the foam dressings studied played little part in reducing pressure over at-risk areas – although it may redistribute pressure slightly, and give comfort to the wearer (especially over bony prominences). The suggested mechanism of action is the alteration of the other causative physical forces: friction and shear, and also managing local factors at the skin interface that may predispose the region to pressure damage (i.e. the local microclimate).

Microclimate management has also been a focus of mattress manufacturers, who are beginning to recognise the importance of the skin–mattress interface, as well as what is happening in the deeper tissues. They have realised that there is clear link between the damage caused by pressure and the physiological impact of managing the microclimate. (Wounds International, 2010; Clark and Black, 2011).

The inclusion of friction and shear as external forces that lead to pressure damage is not new. Indeed, the Braden risk assessment tool (Braden and Bergastron, 1994) highlights the importance of friction and shear, and moisture, as two of the six factors that make up the risk level. However, these factors are not explicitly acknowledged by the European Pressure Ulcer Advisory Panel–National Pressure Ulcer Advisory Panel in their definition of pressure ulceration (EPUAP–NPUAP; 2009):

> *[A] ... localised 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.*

Clark (2013) reviewed the evidence to support the inclusion of dressings within pressure ulcer prevention policies. His review addressed laboratory studies that identified how dressings may modify pressure and shear, then moved on to human volunteer studies, which supported the idea that wound dressings may supplement – but not replace

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– pressure redistributing beds, mattresses, and cushions in reducing the forces that cause pressure damage. Clark also reviewed studies that considered the question of whether wound dressings affect the microclimate at the skin surface, thereby contributing to pressure ulcer prevention. He concluded that, while the evidence to support of this activity was promising, it did relate to one specific silicone foam dressing, as opposed to dressings with a silicone-based wound contact layer in general. A similar conclusion was reached by Butcher and Thompson (2010), who reviewed the use of dressing materials in the prevention of pressure ulcers and concluded that there is a role for dressing materials in pressure ulcer prevention, but that further research is needed.

Recent research has attempted to address this gap by providing laboratory data to explain how manipulating the microclimate may prevent pressure ulceration, the role of dressings in this phenomenon (Call et al, 2013), and to test the theory in clinical practice with large scale RCTs such as that by Santamaria et al (2013a), who used dressings prophylactically in high-risk patients and dramatically reduced the incidence of pressure ulcers.

Therefore, in addition to the direct application of pressure, four other elements may potentiate the effects of pressure – friction, humidity/moisture, temperature, and shear – which are cross linked to each other in complex ways.

Friction

If the friction coefficient is high, the patient will not easily slide down the bed, however, high friction coefficients lead to high internal shear forces. If the friction coefficient is low, the patient will slide easily – reducing (though not eliminating) shear forces – but exposing them to superficial skin stripping or friction damage, particularly if is moisture present. The amount of moisture impacts the friction coefficient: moist skin has a higher friction coefficient than dry skin, while large amounts of moisture will result in very low friction coefficients. Very high and very low friction coefficients will result in an inflammatory response and the production of heat (Ohura et al, 2005).

Humidity/moisture

If the skin is humid or moist it is more susceptible to skin damage and maceration. Maceration increases the friction coefficient of the skin, increasing shear forces. Moisture levels impact on skin elasticity and tensile strength affecting the skin's resistance to external forces and subsequent injury (Call et al, 2013). Dry skin also has an altered resistance to damage, with friction playing an important role in persistent erythema (Nakagami et al, 2007). Dry skin can lead to the loss of elasticity, cracking, fissures, and an increased risk of skin tears (Call et al, 2013).

Temperature

Increased temperature at the skin's surface results in increased sweating, which leads to a moist and clammy skin. Localised temperature increases may be due to inflammation, the first response to pressure, friction, and shear. Reduced temperature results in vasoconstriction and movement of blood away from the surface of the skin, narrower vessels are more easy to compress and therefore more susceptible to pressure and shear and, therefore, it is more likely that there will be a hypoxic effect – resulting in inflammation.

Shear

Shear is a difficult concept to explain. Where friction forces are high, they hold the skin in the same place until the body weight overcomes them and internal tissues are stretched and twisted, which may result in reduced blood flow and subsequent hypoxia. Reduction in surface friction forces can significantly reduce shear forces (Nakagami et al, 2006).

CAN DRESSINGS HAVE ANY IMPACT ON PRESSURE ULCER PREVENTION?

Call et al (2013) measured moisture trapped against the skin, moisture escaping through the dressing and heat trapped against the skin in a series of *in vitro* tests of eight different dressings. They identified differences in the way the dressings managed moisture (i.e trapping or transpiring fluid). They suggest that dressing products need to retain adequate moisture in the skin to optimise elasticity but minimise maceration, excoriation and skin stripping. The dressings they evaluated ranged to either side of this optimum therefore the performance characteristics of different dressings vary in use. Heat is also an important part of a dressing's function. When simply lying on a surface such as a pressure redistributing mattress heat is trapped between the

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skin and the surface, adding a dressing, particularly a foam dressing increases this temperature. This may be beneficial for healing as it is known both that the temperature within a wound is often lower that the surrounding area and also that optimal temperatures for healing are believed to be body temperature. Once the local temperature rises is initiates physiological responses; increased transpiration, increased perspiration, increased metabolic stress on cells, increased friction, which leads to increased shear and therefore increased likelihood of skin damage. Whilst it may seem that a dressing is therefore likely to raise temperature and cause ill effects in the studies performed by Call et al (2013) this was not the case. They also suggest that any small temperature rise is likely to be mitigated by normal bodily movement which would see patients at risk of damage being turned so the area with the dressing was no longer against the bed surface, allowing dissipation of heat and returning the area to room temperature. Based on the tests they performed measuring heat and humidity they concluded that the prophylactic use of a dressing does alter the skin microclimate.

Ohura et al (2005) and Nakagami et al (2006; 2007) examined the impact of dressing use on the physical forces of friction and shear using a range of hydrocolloid, hydrofoam, and hydropolymer dressings. Ohura et al (2005) measured the coefficient of friction between the outer layer of the dressing and the patient's clothes, the degree of adhesiveness of the dressing to the patient's skin, and the transmission of shear forces through the dressing. They suggested that shear forces between dressings and patients' clothes / bedding can be reduced or buffered by using a dressing with a slippery – almost frictionless – outer surface. They also identified that performance parameters varied when the dressing was fully saturated, therefore the absorption characteristics of the dressing are also important.

Nakagami et al (2006) applied dressings to the heels of 30 older patient and tested both the friction and shear forces generated when a bed sheet was pulled from underneath the heels; a pressure ulcer preventative dressing (Remois; ALCARE) and a film dressing (Multifix; ALCARE) were both tested. Nakagami et al's (2006) results suggest that the pressure ulcer preventative dressing was better able to mitigate local shear forces on patients' heels than the film dressing.

Nakagami et al (2007) evaluated the application of the same pressure preventative dressing to 37 bedridden older patients, randomly applying the dressing to either the right or left trochanter. They monitored the skin for erythema, hydration, and pH. A significantly lower incidence of persistent erythema at those sites that received the preventative dressing was found (P=0.007; relative risk, 0.18 [95% confidence interval: 0.05–0.73]). Furthermore, skin that had previously been identified as being dehydrated became well-hydrated during use, and following the removal, of the preventative dressing.

These studies demonstrate the physiological responses initiated by use of the pressure ulcer preventing dressing, however none of them measured the occurrence of pressure ulcers. Studies by Brindle (2010), Brindle and Wegelin (2012), and Santamaria et al (2013a) and others, report the outcomes of implementing prophylactic dressings in very high-risk patients.

Brindle (2010) developed a tool for identifing specific criteria in an intensive care population that put them at greater risk than the already high-risk norm for critical ill patients. He recruited 41 of these high-risk patients and prophylactically applied a sacral pressure ulcer preventative dressing (Mepilex Border Sacrum). These patients had high insensible fluid loss, perspiration, obesity with large skin folds, turning and repositioning difficulties, and a need to maintain the angle of the head of the bed at >30°, with most previous pressure damage having occurred on the sacrum or along the gluteal fold/coccyx. The staff reported the dressing to be easy to apply and remove for skin inspection. During the 3 months of the study, no high-risk patient developed a pressure ulcer.

Brindle and Wegelin (2012) performed a study similar to that of Brindle (2010) in cardiac surgery patients. Fifty-six patients were assigned to the intervention group (prophylactic dressing; Mepilex Border Sacrum) and 39 to standard care. Patients in the intervention group had the dressing applied to the sacrum and removed daily for skin inspection and then reattached, the dressing was replaced every 3 days. By study end, eight pressure ulcers developed in four of the 35 patients receiving standard care, while only one pressure ulcer developed in the 50 patients in the intervention group. The authors are careful to point out that the overall incidence of pressure ulcers was lower than anticipated in the group as a whole, and suggest that this may be due the implementation of an evidence-based care bundle as part of the study. The sample size was not sufficient to achieve statistical significance.

Similar studies were performed by Chaiken (2012) also in intensive care patients, and Cubit et al (2012) who commenced dressing application in the emergency department for high-risk medical patients. Of the 51 patients in Cubit et al's (2012) intervention group, only one developed a grade 2 sacral pressure ulcers, while six of the 58 patients from the retrospective control developed damage.

Santamaria et al (2013a) carried out the first large-scale RCT, and also carried out an analysis of the costs (Santamaria et al, 2013b). Of 440 trauma and critically ill patients in an emergency department, prophylactic dressings were applied to both the sacrum and heel (Mepilex Border Sacrum and Mepilex Heel, respectively) to 219 (the intervention group). All patients received standard care including the use of high-risk pressure redistributing equipment. Patients in the intervention group had the dressings in place throughout their intensive care unit stay, including during theatre visits and medical imaging. The authors report that the intervention group developed significantly fewer pressure ulcers than the control group (5 vs 20; P=0.001). This represents a 10% reduction in pressure ulcer incidence, which suggests that for every ten patients treated with the prophylactic dressing, one pressure ulcer was prevented.

The cost analysis of this intervention (Santamaria et al, 2013b) reviewed marginal costs and within trial pressure ulcer costs. The introduction of the preventative dressings into the pressure ulcer prevention protocol for use on high risk patients at the point of admission to the emergency department admission led to cost savings for the hospital. Based on the findings of this study, the hospital mandated the use of these dressings for all patients at high risk of pressure ulceration.

Although the majority of studies focus specifically on the sacrum and heel, several smaller studies and reviews look at the potential role of preventative dressings with relation to medical device-related pressure ulcers (DRPUs). DRPUs pose particular and specific challenges as the devices in question (e.g. oxygen masks, tracheostomy tubes) are frequently essential for the maintenance of life, need to be securely positioned in order to function, and frequently used on patients who are systemically unwell and, therefore, may be clammy and have localised oedema – both of which increase the risk of skin damage (Fletcher, 2012).

Hsu et al (2010) looked at the issues associated with maintaining both a good mask seal and patient comfort when using noninvasive positive-pressure ventilation masks (NIPPVMs). They identified that patients using these devices frequently developed pressure damage on the bridge of the nose or cheeks; in their unit, 47 of 797 patients using NIPPVMs developed pressure damage (incidence rate of 5.90%) between January and October 2006. Due to illness, many of these patients are also unable to communicate their discomfort. In such cases, Black et al (2013) recommend the use of a dressing to redistribute pressure, improve comfort, and absorb moisture, however they reiterate the importance of being able to lift and replace the dressing to allow for inspection of the skin beneath.

CONCLUSION

The application of a prophylactic dressing that allows removal and reapplication so that the skin can be regularly examined without causing pain or trauma, appears to offer significant benefits as part of an holistic pressure ulcer prevention strategy. While the use of a dressing may offer specific benefits, it cannot replace good nursing care and the use of pressure redistributing devices.

The focus on the additional components of friction, shear, humidity, and temperature (microclimate) should encourage clinicians to think more holistically about the risks experienced by patients, particularly in acute care environments. The research to date has been on one specific dressing product and, therefore, may not be transferable to other products as the makeup and components vary and it may be specific elements of the product studied that result in the positive patient outcomes. Wuk

REFERENCES

Black J, Alves P, Brindle CT et al (2013) Use of wound dressings to enhance prevention of pressure ulcers caused by medical devices. *Int Wound J* Jul 1 [Epub ahead of print]

Braden BJ, Bergstrom N (1994) Predictive validity of the Braden scale for pressure sore risk in a nursing home. *Res Nurs Health* 17(6): 459–70

Brindle C (2010) Outliers to the Braden scale: Identifying high – risk ICU patients and the result of prophylactic dressing use *WCET Journal* 30(1): 2–8

Brindle CT, Wegelin JA (2012) Prophylactic dressing application to reduce pressure ulcer formation in cardiac surgery patients. *J Wound Ostomy Continence Nurs* 39(2): 133–42

Butcher M, Thompson G (2010) Can the use of dressing materials actually prevent pressure ulcers: presenting the evidence. *Wounds UK* 6(1): 119–24

Call E, Pedersen J, Bill B et al (2013) Microclimate impact of prophylactic dressings using in vitro body analog method. *Wounds* 25(4): 94–103

Chaiken N (2012) Reduction of sacral pressure ulcers in the intensive care unit using a silicone border foam dressing. *J Wound Ostomy Continence Nurs* 39(2): 143–5

Clancy M (2013) Pressure redistribution devices: what works, at what cost and what's next? *J Tissue Viability* 22(3): 57–62

Clark M (2103) *Evidence Review. Defining the Role of Wound Dressings Within Pressure Ulcer Prevention.* Mölnlycke Health Care, Dunstable

Clark M, Black J (2011) *Skin IQ™ Microclimate Manager. Made Easy.* Available at: http://bit.ly/15R6oMv (accessed 15.10.2013)

Cubit K, McNally B, Lopez V (2012) Taking the pressure off in the emergency department: evaluation of a prophylactic application of a low shear, soft silicone sacral dressing on high risk medical patients. *Int Wound J* 10(5): 579–84

European Pressure Ulcer Advisory Panel–National Pressure Ulcer Advisory Panel (2009) *Pressure Ulcer Prevention: Quick Reference Guide.* Available at: http://bit.ly/10cLro (accessed 17.10.2013)

Fletcher J (2012) Device related pressure ulcers made easy. *Wounds UK* 8(2): 1–4

Hsu M-Y, Chung H-C, Tang MT et al (2010) Avoiding pressure damage when using ventilators. *Wounds International* 1(2): 22–4

Nakagami G, Sanada H, Konya C et al (2006) Comparison of two pressure ulcer preventive dressings for reducing shear force on the heel. *J Wound Ostomy Continence Nurs* 33(3): 267–72

Nakagami G, Sanada H, Konya C et al (2007) Evaluation of a new pressure ulcer preventive dressing containing ceramide 2 with low frictional outer layer. *J Adv Nurs* 59(5): 520–9

Ohura N, Ichioka S, Nakatsuka T, Shibata M (2005) Evaluating dressing materials for the prevention of shear force in the treatment of pressure ulcers. *J Wound Care* 14(9): 401–4

Santamaria N, Gerdtz M, Sage S et al (2013) A randomised controlled trial of the effectiveness of soft silicone multi-layered foam dressings in the prevention of sacral and heel pressure ulcers in trauma and critically ill patients: the border trial. *Int Wound J* May 27 [Epub ahead of print]

Santamaria N, Lui W, Gerdtz M et al (2013b) The cost-benefit of using soft silicone multilayered foam dressings to prevent sacral and heel pressure ulcers in trauma and critically ill patients: a within-trial analysis of the Border Trial. *Int Wound J* Oct 06 [Epub ahead of print]

Wounds International (2010) *Pressure Ulcer Prevention: Pressure, Shear, Friction and Microclimate in Context. A Consensus Document.* Wounds International, London