Management of shear, pressure and microclimate by foam dressings

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Introduction

It is widely recognised that pressure ulcers are caused by a number of contributing factors; of which not only pressure, but also shear and microclimate are significant.[1]

Much research has been conducted on the effect of pressure on the skin, and the damage that can be caused. Pressure is formed when force is applied perpendicular to the skin. Sustained or excessive pressure occludes capillaries in the skin and underlying tissues; depriving the area of nutrients and oxygen.

Shear stress occurs when force is applied parallel to the skin. This causes the tissues to move transverse to one another, resulting in distortion and damage by occlusion.[1]

Microclimate is the result of a combination of tissue temperature and humidity (moisture). If the skin is too dry or too moist, skin breakdown can occur, increasing the risk of pressure ulcer formation.

Assessment of the effect of dressings on all of the above factors has been conducted in order to ascertain whether all foam dressings are equal in their management of shear, pressure and microclimate.

Methods

Shear and pressure redistribution

Pressure and shear force redistribution were measured using a pressure sensing mat. A 1.75kg weight was applied to the pressure mat and the amount of pressure generated by the weight measured. The pressure gradient caused by the weight was also measured, which is a good indication of shear forces. To determine how the presence of a dressing affected the pressure and pressure gradient, a dressing was then applied between the weight and the pressure sensing mat, and the measurements repeated.

Microclimate

To measure microclimate, dressings were applied to the top of a chamber, in which a high humidity had been generated. The dressings were occluded with a non-breathable adhesive film in order to simulate a clinical situation in which dressings would be occluded by bedding, clothing or by the weight of a patient. The humidity was then monitored within the chamber over 500 minutes (8.3 hours) at a temperature of 37°C+/-1°C.

Results

Pressure redistribution

The application of dressings between the pressure mat and the weight reduced the average pressure at the dressing-mat interface. The dressings all performed differently; with Dressing A reducing the average pressure by the greatest amount. Figure one and graph one show the results from the pressure redistribution experiment.

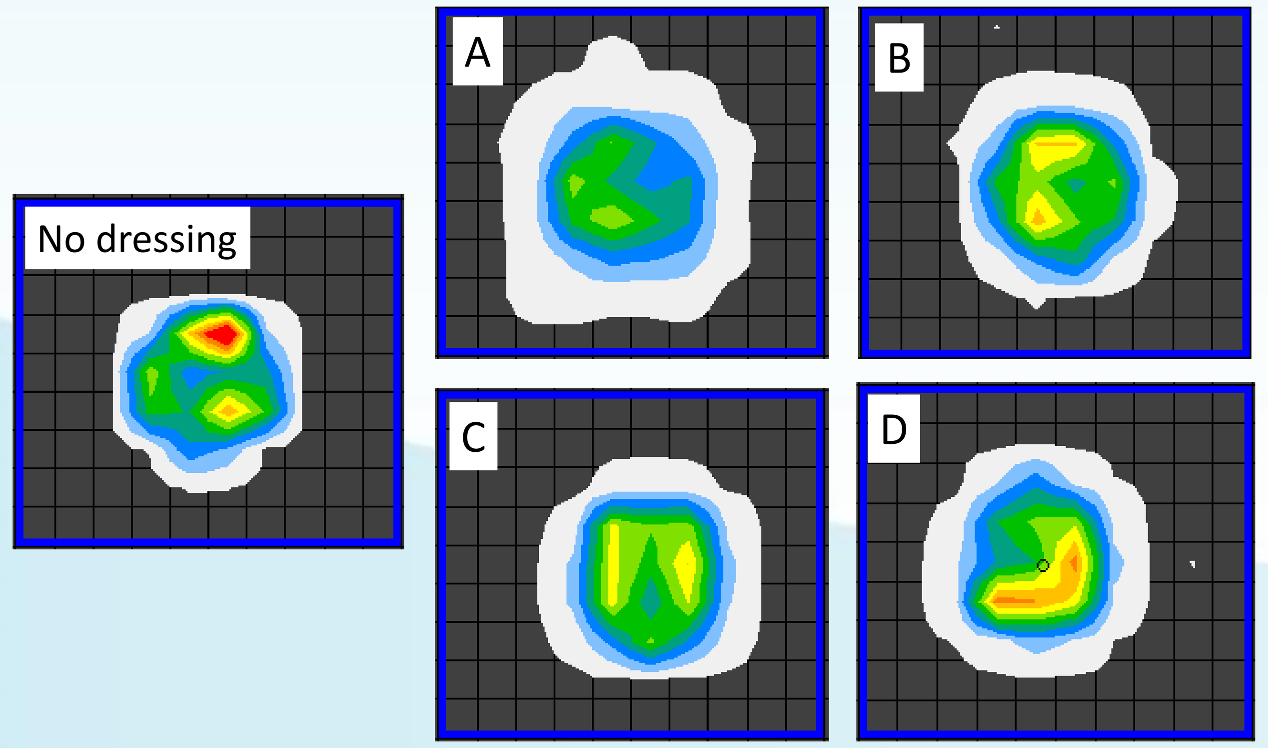
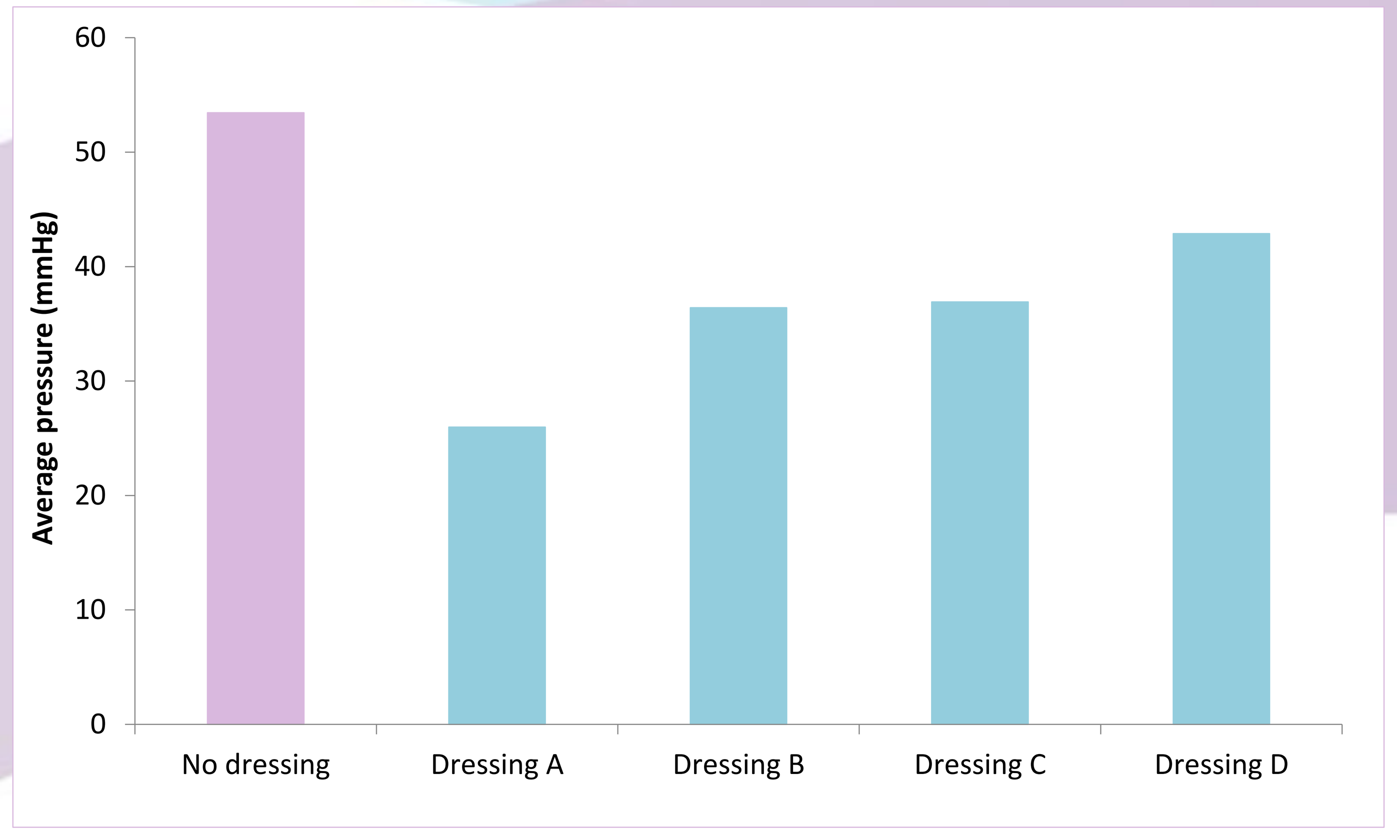


Figure one – Images of the pressure profiles recorded when a weight was applied with and without a dressing to a pressure mat.
Red = high pressure, white = low pressure.

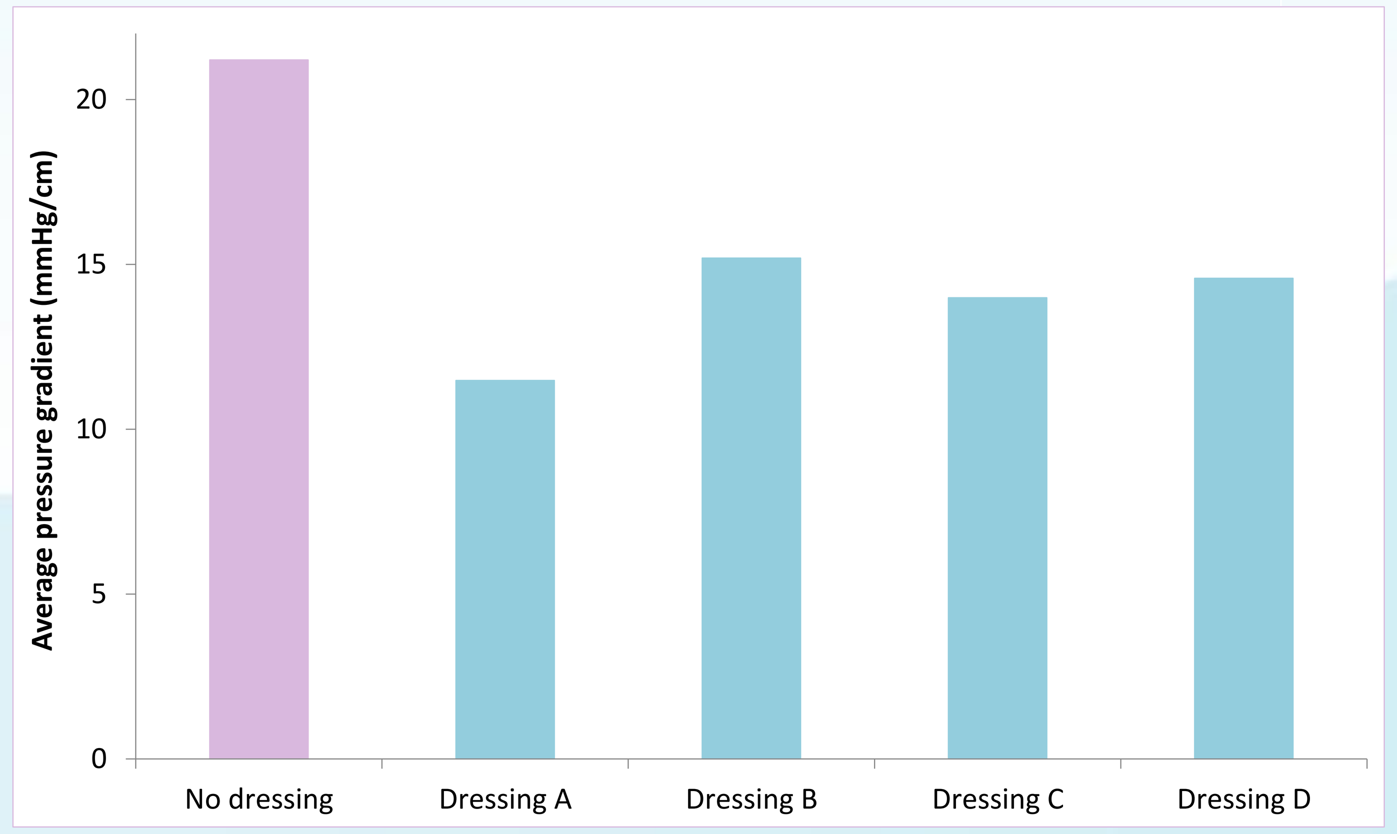


Graph one – Average pressure recorded when a weight was applied with (n=6) and without (n=10) a dressing to a pressure mat

Shear force redistribution

When dressings were applied between the pressure sensing mat and the weight, a reduction in the average pressure gradient was seen for all dressings tested, see graph two. The lower the pressure gradient, the smaller the shear strain at the surface of the mat.

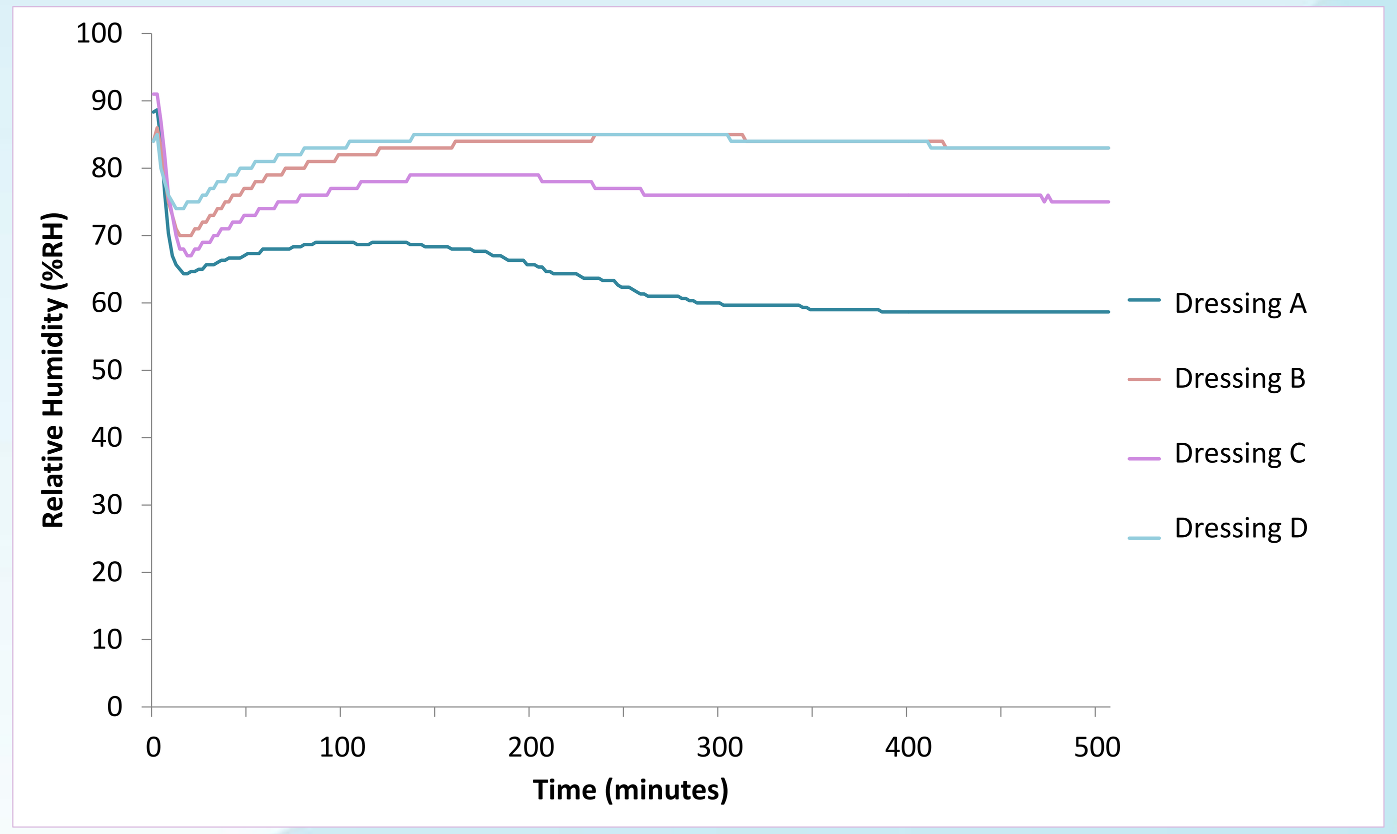
It can be seen that dressings each reduced the average pressure gradient at the pressure mat by varying amounts, with Dressing A reducing the shear forces to the greatest extent.



Graph two – Average pressure gradient recorded when a weight was applied with (n=3) and without (n=10) a dressing to a pressure mat

Microclimate

All of the dressings tested initially decreased the humidity in the microclimate test chamber. After a number of hours on the model, the humidity underneath each dressing plateaued. After the eight hour test period, Dressing A had reduced the humidity to 58%RH, Dressing C to 75%RH, Dressing B to 83%RH and Dressing D to 83%RH, see graph three.



Graph three – Relative humidity measured underneath dressings over 500 minutes

Discussion

Reduction of pressure over a wound is important in protecting the area from further damage. This study has shown that not all dressings are capable of reducing shear and pressure at the skin-dressing interface to the same extent. Figure one shows the level to which the dressings tested in this study spread the pressure of the weight, with a larger image indicating a greater redistribution of pressure.

If a dressing is also able to maintain a favourable microclimate at the skin, this further reduces the risk of tissue breakdown. Excessive moisture at the skin surface can damage cross links between dermis collagen, and also increase skin friction.[1] Conversely, excessively dry skin has a reduced tensile strength and flexibility.[1] A dressing needs to be able to reduce the humidity of a wound to create a favourable microclimate, without completely removing moisture from the area. This study has shown that the dressings tested all controlled the humidity in the test chamber to differing amounts, with Dressing A reducing the humidity significantly more than the other dressings tested. None of the dressings tested reduced the humidity to an extent where the drying out of skin would occur.

Conclusion

Dressing A redistributed pressure and shear forces generated by the weight more successfully than the other dressings tested.

All dressings had an effect on the humidity in the microclimate test chamber, however, the greatest reduction in humidity was seen by Dressing A, thereby generating a more favourable microclimate underneath the dressing.

References:
1. *International review. Pressure ulcer prevention: pressure, shear, friction and microclimate in context. A consensus document.*London: Wounds International, 2010.

Dressings: A=KerraFoam Gentle Border (Crawford Healthcare Inc).; B = Allevyn™ Gentle Border (Smith & Nephew Inc.); C = Mepilex™ Border (Mölnlycke Healthcare); D = Aquacel™ Foam (ConvaTec Inc.)