How effective are silicone/gel sheets at protecting bony landmarks from pressure damage?

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Introduction:

Silicone and gel sheets are used within various seating applications and beyond for protection of pressure injury [1,2]. Health professionals are increasingly using silicone sheets as part of pressure ulcer prevention solutions, to protect vulnerable spines for example.

This study examines the present knowledge on the performance of thin substrate materials and explores ways to measure their performance [3,4] for pressure distribution and skin protection. It presents a fundamental testing approach and conducts comparative bench testing of various substrates using load testing.

Aim - to provide insight for the clinical use of silicon/gel sheets in protection of skin damage under bony landmarks.

Figure 1 – Dermis Plus Gel (200mm x 200mm x 12mm)

Method:

The compression test was chosen as the testing technique, necessitating the creation of a container, using evazote and 3D printed PLA, to hold the gel. Moreover, to simplify the process of measuring compression displacement using callipers, a specially constructed mount was used. A programmed actuator was used to exert a pre-determined force on each gel that we examined.

A 30mm radius semi-sphere indenter was 3D printed to simulate an elbow or ischial tuberosity.

Intended loads of 100, 200, 300, 400, 500 N were applied, representing ~15-70% of a typical body weight (70kg). Actual loads were recorded by the in-line load cell.

A range of substrates and thicknesses were tested.

Figure 2 – Testing set-up showing the rig, container, mount and actuator

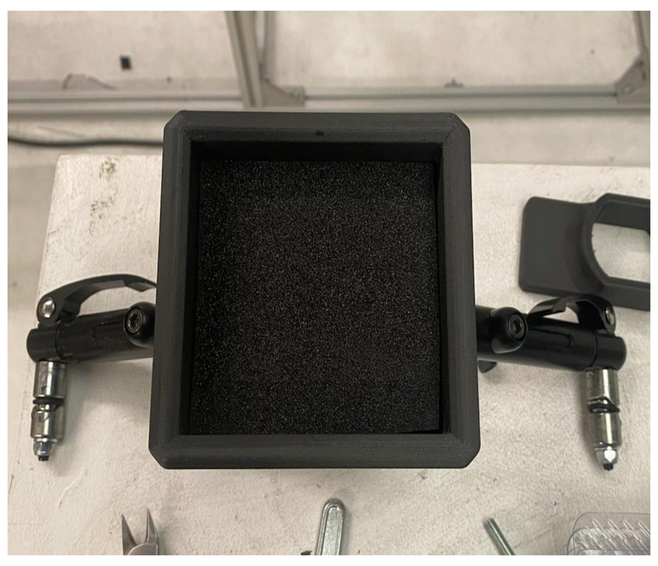


Figure 3 – Custom designed mount to hold gel

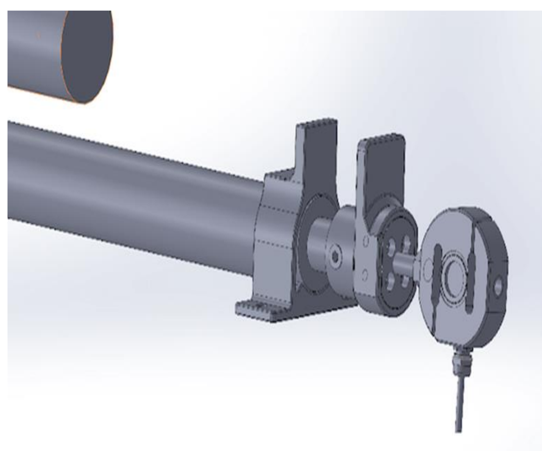


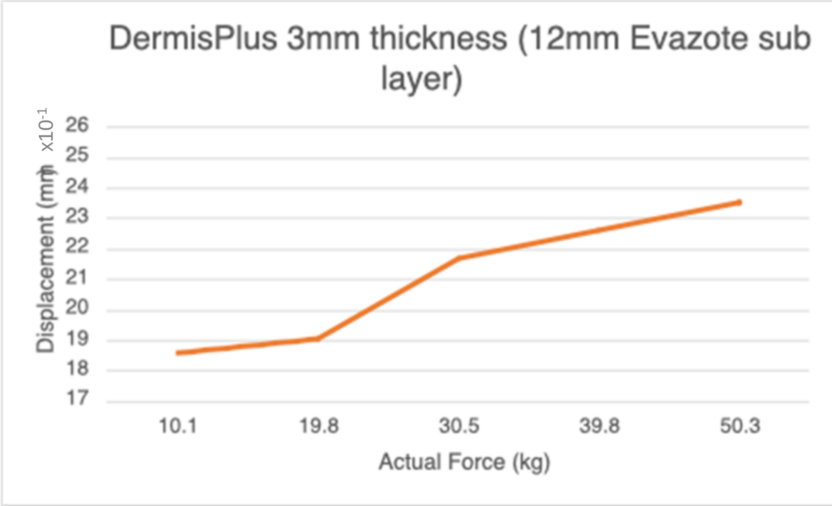
Figure 4 – Custom made mount to measure the change in displacement design

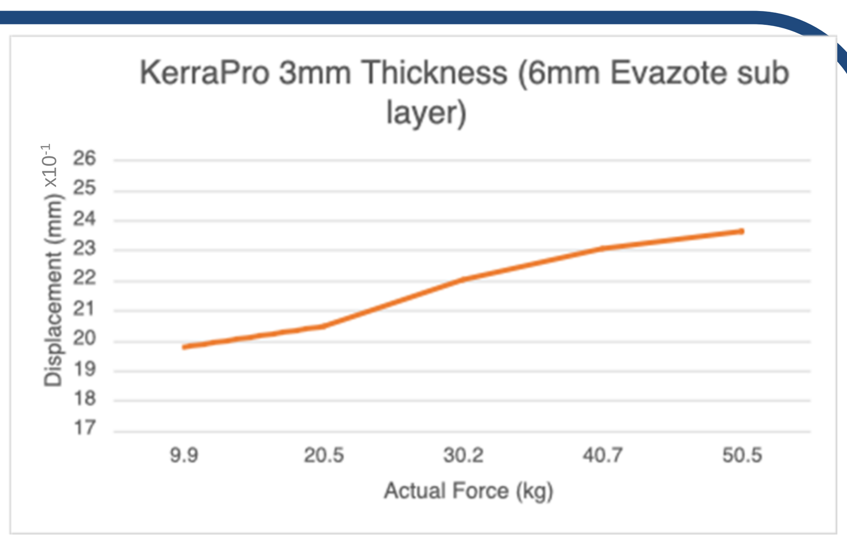
Results:

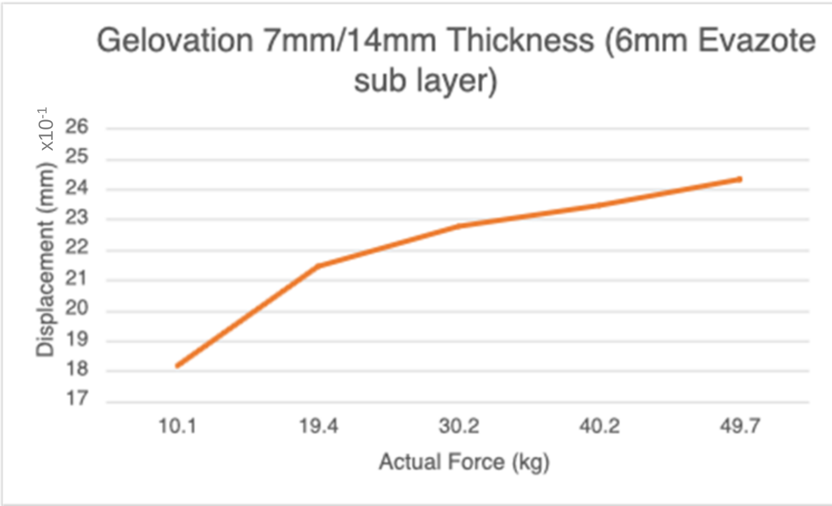
Preliminary tests considered different sublayers and ensured they had a negligible impact on the observed level of immersion.

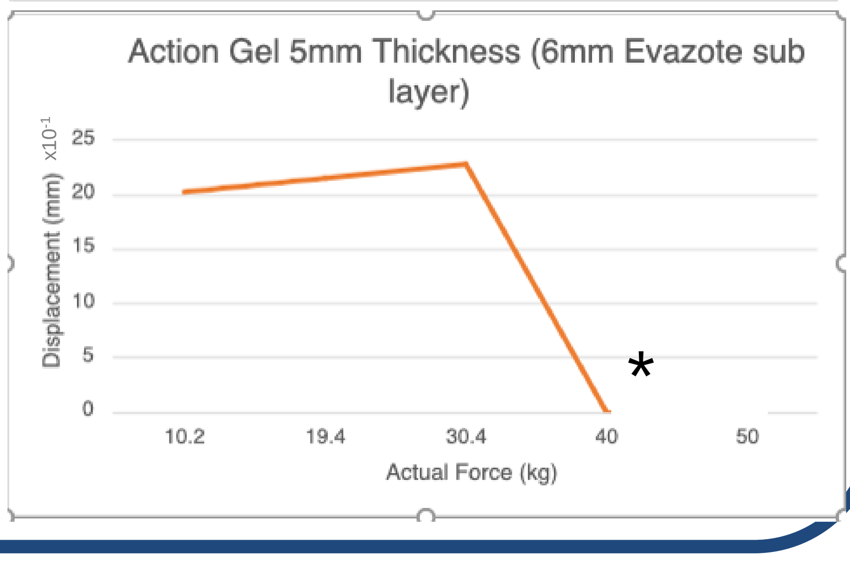
- The immersion plateaus at a maximum depth of 2.3mm for the 3mm silicone sheets.
- 3mm Kerrapro exhibited more displacement than 3mm Dermisplus when subjected to the same forces (10, 20 kg).
- Unsurprisingly, the 12mm kerrapro exhibited a higher level of immersion as compared to the 3mm kerrapro.
- Gelovation and Action Gel exhibited more compliance compared to the silicone sheets, which might be attributed to their increased thickness and/or a more viscous material.

* Action gel showed particularly effective immersion at the lower loads, then failed at 40 kg.









Conclusions:

All materials behaved as anticipated under load, with only subtle compression differences between them. They all demonstrated performance to their primary goal; maximum immersion without failure ('bottoming out') at loads expected in use. The data supports a premise that silicone/gel is an effective offloading solution where limited thickness is practical.

This protocol can be used for repeat testing, more detailed discovery and for different substrates types and format.

When it comes to materials, we may anticipate that the stiffness (compliance) will rise as the displacement (immersion) increases. This was clearly noticeable in the majority of the materials, but the presence of measurement error could have obscured this effect in certain cases.

Implications for practice Compression testing gives a beneficial methodology for ensuring performance, including that of silicone/gel sheets. Further testing can support decisions in prescribing substrates for pressure redistributing purposes in sitting and lying, for individuals impacted by various neurological and orthopaedic conditions.

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Design & Manufacturing team, Swansea REU

PUPIS team, Swansea REU

Swansea Rehabilitation Engineering

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