

Measuring tensile strength to better establish protective capacity of sacral prophylactic dressings over 7 days of laboratory aging

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INTRODUCTION

- Sacral prophylactic dressings protect from external forces that may damage the skin, including shear, compressive loading, tensile forces, and/or moisture.
- The protective endurance of a sacral prophylactic dressing is relative to the nature of its composition, shape, and architecture and how these structural features are influenced by the retained fluids.

AIMS

- To further understand the protective effect of sacral prophylactic dressings in alleviating tissue deformations in the sacral region through the course of typical application.

METHODS

- A method previously developed by the same research group (Burton et al. Adv Skin Wound Care 2019;32(75 Suppl):S14-S20) was used to simulate dressing aging (including the addition of moisture to the dressings, mechanical loading, and repetitive sliding-induced shear) to compare protective endurance over time.
- Four different dressings were tested (Allevyn Life Sacrum, Smith & Nephew; Aquacel Foam Pro, ConvaTec; Mepilex® Border Sacrum, Mölnlycke; Optifoam Gentle with Liquitrap, Medline).
- Macroscopic changes in the dressings were observed by an unblinded technician after 5 days of simulated use/aging and scored with a 5-point Likert-type scale, ranging from 0, no effect to 4, extremely noticeable.
- Tensile testing was performed post-aging for each dressing sample to evaluate yield and axial stiffness at 100% strain (80mm extension). Dressing were evaluated using tensile testing in the vertical direction of the dressings (direction of the spine) and in the hip-to-hip direction (lateral direction of the buttocks). Five trials were performed for each dressing, in both directions. Testing was performed on dressings aged 0 and 5 days for hip-to-hip and for days 0, 1, 3, 5, and 7 for spine.
- The dressings were further evaluated for compressive stiffness, by being subjected to a vertical force. Strain, load, extension, and stiffness were all recorded during both loading and unloading of the dressings.
- A multidimensional analysis of variance was used to measure the effect of interactions between dressing, days of exposure, amount of moisture applied etc.

RESULTS

- Several macroscopic effects of aging were noted: embossing film texture, wrinkles, fluid loss under compression, separation of layers, rolling or adhesive release, and conformability (Table 1)
- The various materials used in the dressings' construction responded to moisture exposures differently. Overall, moisture resulted in swell and separation of the layers as well as changes in elasticity that were unique to each dressing.

Table 1: Macroscopic effects of aging on dressings

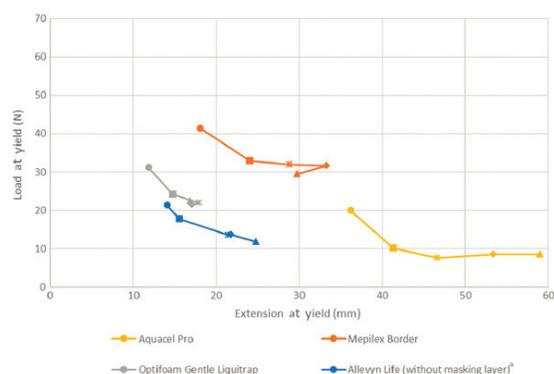
Aging effect	Description of effect	Optifoam Gentle with Liquitrap	Allevyn Life Sacrum*	Aquacel Foam Pro	Mepilex Border Sacrum
Embossing removal	Original outer texture changed	4	2	0 (no embossing present)	4
Wrinkling and bunching on surface	Visible wrinkles and deformation on the dressing surface	3	2	3	4
Fluid leakage	Solution leaking from inner layers of the dressing	3	4	4	4
Layer separation	Visible space between layers of the dressing	4	3	0	1
Rolling	Adhesive releases from the test indenter and rolls up from indenter	4	4	4	4
Conformability	Takes the shape of the indenter or lifts off due to stiffness	3	4	3	1

Changes in dressing properties observed after 5 days if simulated use / aging indicated with a 5-point Likert-type scale: 0 = no effect, 1 = mildly noticeable, 2 = somewhat noticeable, 3 = mostly noticeable, 4 = extremely noticeable *Because of different materials, construction, and architecture and a resulting need to grip samples differently to test them, Allevyn Life represents a different failure mode and a different risk to patient mode, which is not considered in the data for the table

Spine direction tensile results:

- There was a significant decrease in load at yield (or break) in all tested dressings during the first day of aging; at both day 0 and at the end of 7 days use, Mepilex® Border Sacrum demonstrated the highest axial stiffness.
- The maximum load at yield (or break) decreased noticeably during day 1 of aging for all tested dressings; this decrease was more gradual from day 1 to day 7.
- The authors noted that, whilst the performance of all the tested dressings declined over the 7 days of testing, a higher initial capacity will yield a higher end capacity (the protective capacity for some dressings at the end of 7 days is still higher than the beginning point for others).
- Due to the different materials, construction, and architecture, and resulting need to grip samples differently to test them, Allevyn Life was a significant outlier and thus testing was repeated excluding the outer masking layers.

Figure 1: Changes in spine direction load at yield and total extension at yield of dressings



As dressings were aged, the load required to obtain a yield (or break) in the dressing decreased. At the same time, the maximum extension at time of yield increased as dressings aged. These differences indicate aging-related loss of material properties. With aging, the dressings become more elastic (greater extension at yield) and lose tensile strength (decreased load at yield). The slope of the line indicates the magnitude of the change and the effect. A shallow slope between points indicates little or no change.

Hip-to-hip direction tensile results:

- Non-significant increases in load at yield (or break) were observed for Allevyn Life and Optifoam Gentle from day 0 to day 5.
- Aquacel Pro demonstrated a significant decrease in load at yield (or break).
- Mepilex® Border Sacrum demonstrated a minor but significant decrease.
- All dressings except Optifoam Gentle demonstrated an increase in extension at yield (or break) from day 0 to day 5; Optifoam Gentle demonstrated a significant decrease in extension at yield (or break) from day 0 to day 5.

Compression:

- Aged sacral prophylactic dressings and the dressing layers had significantly higher load at 50% compression.
- The authors commented that this is likely attributable to the addition of moisture to the dressings.

CONCLUSIONS

- All four tested sacral prophylactic dressings' yield strength was decayed at day 1, while the continued loss in performance slowed over the 7-day simulated aging process.
- Of the tested dressings, Mepilex Border Sacrum demonstrated the highest load at yield (or break), indicating the highest protective endurance during the test period..

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