DESIGN AND DEVELOPMENT OF A NOVEL DRESSING FOR HAND BURNS

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INTRODUCTION

Hands are the site of a large number of burn injuries[1], with partial thickness burns amongst the most frequent type of hand burn[2]. Treatment must be safe, minimise the risk of infection, be comfortable for the patient and enable the patient to maintain as much hand mobility and function as possible. Effective management of burn wound exudate, reduction in physiotherapy time and reduced number of dressing changes are all desirable features for a burn dressing.

A number of previous hand burn treatment alternatives have been proposed, each being used with specific burns problems in mind; however, none have inherent fluid management properties.

A new sodium carboxymethyl cellulose (CMC) burn dressing has been designed especially for hand burns to provide a solution to the above treatment issues and to also provide effective fluid management. The dressing, AQUACEL® Burn Glove was designed to be easy to apply and to be available in 5 sizes and in both a silvered version and a non-silvered version. The design contains Hydrofiber® technology reinforced with Nylon stitching and therefore forms a cohesive gel on contact with burn wound exudate, making it comfortable and soft for the patient to wear, whilst also being easy to remove in one piece.

METHODS

The new AQUACEL®Ag Burn was assessed by the following *in vitro* test methods and compared to an alternative silver burn dressing, frequently used for partial thickness burns, Acticoat™ dressings.

Absorbency and Retention:

Dressing samples of 5x5cm were cut out and weighed [W_1], then immersed into physiological saline (EN13726-1:2002 test solution A) and incubated at 37°C for 30 mins. Samples were then removed, re-weighed [W_2] and placed under a compression load (40mm Hg) for 1min and weighed again [W_3]. Percentage of fluid absorbed and retained were calculated by Equations 1 and 2 respectively. Each sample was tested in triplicate.

EQUATION 1. Absorption (g/cm^2) = $\frac{W_2 - W_1}{\text{Area } (cm^2)}$

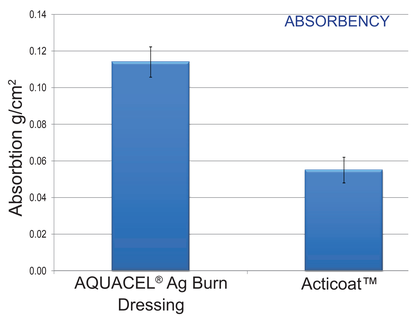
EQUATION 2. Retention (%) = $\frac{W_3 - W_1 / \text{Area (cm2)}}{W_2 - W1 / \text{Area (cm2)}}$

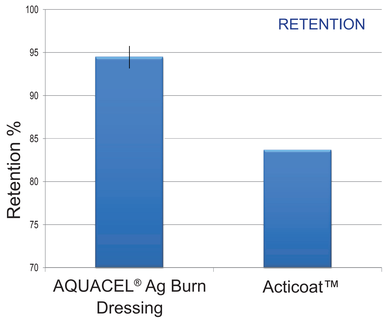
Bio Adhesion: An *in vitro* fibroblast cell adhesion model[3] was used to evaluate cellular adhesion to the dressings.

Lateral Spread of Fluid An *in vitro* study was designed to visualize the lateral spread exhibited by dressings. A cylinder of known diameter was pressed against each dressing; a known amount of horse serum was added from the top of the cylinder. After 1 minute, the remaining serum was removed. The spread of fluid beyond the cylinder area was captured in a digital picture and the area analysed for spread of fluid, a smaller area corresponding with low lateral wicking or spread of fluid.

RESULTS

Fluid Absorbency and Retention:





Figures 1 and 2: Fluid Absorbency and Percentage Retention (respectively) of the burn dressings tested.

Results show that AQUACEL® Ag Burn dressing for hand burn treatment has greater absorption capacity per unit area and percentage retention than the alternative burn dressing tested.

BioAdhesion:

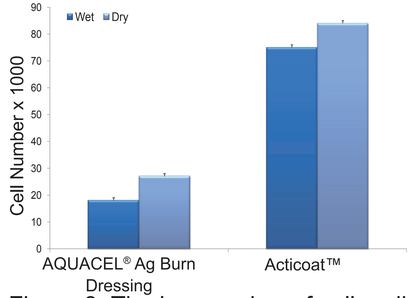
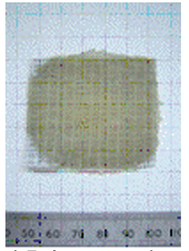
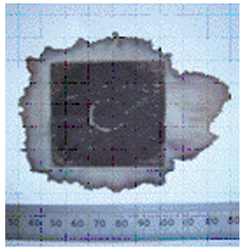


Figure 3: The low number of cells adhered to the AQUACEL® Ag Burn Dressing compared to that of the alternative dressing tested, predicts that the AQUACEL® Ag Burn dressing should be easily removed without tissue trauma which is particularly important for the treatment of hand burns.

Lateral Spread of Fluid:





Figures 4 and 5: Images showing the lateral spread of fluid for AQUACEL® Ag Burn dressing and Acticoat™ dressing when challenged with horse serum. The CMC containing AQUACEL® Ag Burn dressing locks the fluid within the fibres resulting in less spread of the fluid out of the fluid application area.

CONCLUSION

A new glove dressing made of CMC (Hydrofiber®) reinforced with Nylon stitching has been designed and developed to assist in the management of hand burns. *In vitro* data show that the fluid management is good, the dressing is able to gel, absorb and retain fluid, and minimise the spread of fluid laterally.

The dressing was designed to be easy to remove from a burn as demonstrated in the bio-adhesion test data which shows low adherence of the dressing in an *in vitro* cell model.

Minimal lateral spread over the dressing material should, in a clinical situation, keep the burn exudate locked within the dressing and prevent the spread of exudate onto the peri-wound skin thus assisting in minimising per-burn tissue maceration.

REFERENCES

1. Nugent et al ' Total Burn Care' Third Edition , Saunders Elsevier Chapter 53 (p687-700) 2007.
2. Caruso et al. 'AQUACEL Ag in the Management of Partial-Thickness Burns: Results of a Clinical Trial' J. Burn Care Rehabil. 2004;
3. Cochrane C, Rippon MG, Rogers A, Walmsley R, Knottenbelt D, Bowler P. Application of an in vitro model to evaluate bioadhesion of fibroblasts and epithelial cells to two different dressings. *Biomaterials*. 1999;20:1237-1244.