The Measurement of Negative Charges in a Highly Charged Fiber Dressing that Supports the Debridement of Slough

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INTRODUCTION

Fiber dressings are widely used in wound care for managing wound exudates. This exudate management is an important step in healing and some traditional dressings (such as alginates and others) can, during use, also adhere to wound debris, aiding in it's removal. Fiber dressings are made from various types of chemical polymers, including synthetic, semi-synthetic, and natural materials. These polymers have names such as carboxymethyl cellulose (CMC, a highly gelling fiber), alginates, polyvinyl alcohol and cellulose ethyl sulfonate.

A new category of fiber dressings based on Highly Charged (negatively) Fiber (HCF) technology has been launched. These Highly Charged Fiber (HCF) Dressings, when contacting the wound, may lead to electrostatic interactions between the negative charges between the HCF dressings and slough components allowing an efficient and remarkable degree of slough removal via physical forces. Carboxyl and carboxylate groups which are negatively charged, are the source of negative charges in the unique HCF dressing.

Negative charges are also present in some other dressings such as alginates and CMC based dressings. The charge densities of these dressings are likely related to their ability to remove slough or debris via physical forces. In this work, we measure the carboxyl and carboxylate density of different dressings as that factor will highly impact desloughing properties.

METHODS

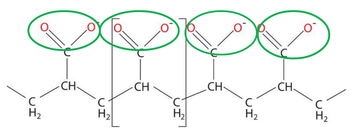
The content of carboxylic and carboxylate groups is determined by titrimetric analysis. The dressings are either ground or cut into small pieces before being immersed, under magnetic stirring, in an aqueous sodium chloride solution at 5g/liter. The titration with a base begins when the pH is stable. This protocol is repeated on a new sample, but the titration is carried out with an acid.

The results of the two titrations are combined to create a titration curve that quantifies the carboxylic and/or carboxylate groups present in the different dressings. The result is expressed in milimole per 10 cm X 10 cm dressing, a common size.

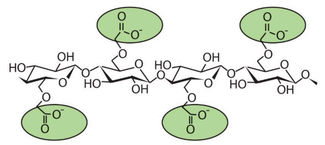
RESULTS

Figure 1 A (Highly Charged Fiber (HCF) dressing), 1B (carboxymethyl cellulose dressing) and 1 C (alginate dressing) are schematic chemistry drawings of the polysachharide polymers that some of our test dressings are made of. The negative charges are clearly shown (COO- groups, enclosed in colored or bordered ovals). In these schematic drawings, one can easily see that the negative charges in the HCF dressings are likely much closer, and thus much higher in measurable density, than in the alginate or the carboxymethyl cellulose dressings, which are also charged but likely at much lower charge density levels.

(1A) Highly Charged Fiber (HCF) dressings



(1B) Carboxymethyl Cellulose (CMC)



(1C) Alginate

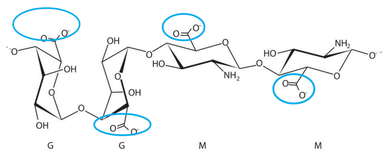


Figure 1A, B, C Schematic Chemical Structures of Dressing Fiber Polymers with Negative Charged Zones shown

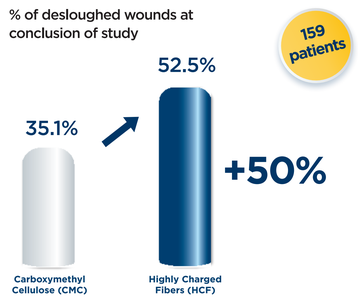


Figure 2

Actual measurements (Table 1) described in the methods section show that a much higher density of negative charges in the unique Highly Charged Fiber (HCF) dressing based on polyacrylate technology compared to several others, including the highly gelling CMC dressing and alginates which are traditional wound care products having been used for decades.

Table 1

Product	Negative Charge in mmole units per 10 cm x 10 cm dressing
Negatively Charged Fiber Dressing	1,25
Alginate Dressing A	0,17
Alginate Dressing B	0,07
Carboxymethyl Celluluse gelling dressing	0,21
Polyurethane dressing	0,13
Poly Vinyl Alcohol, PVA dressing	0,03

CONCLUSION

The new HCF dressing is supported by clinical data[1-4] including one randomized controlled trial (RCT) which studies amongst other factors, the comparative desloughing properties. The charge measurement study presented here explains the most likely reason why it is such a superior product with respect to desloughing compared to other dressings. It is likely due to the much higher charge density in the HCF dressings, compared to the other dressing materials, that inherently possess much lower charge levels. This higher engineered charge in HCF likely translates to a higher ability to remove via physical attraction at a larger quantity of slough compared to less charged dressings (e.g alginate and CMC dressings) as seen in empirical observations and RCTs.

Our method effectively differentiates between various dressings by evaluating the potential for non-chemical, physical electrostatic interactions between different fibrous materials and slough, which contributes to efficient desloughing. A randomized Clinical Study[3] confirms this observation clinically, in showing that the HCF dressing is significantly superior to the CMC dressing in terms of desloughing the wound. This superiority observed in the RCT is described in Figure 2 and is in line with the experimental observations reported here on the relative charge differences between the HCF and the Carboxymethyl cellulose dressings.

REFERENCES

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HCF: UrgoClean and UrgoClean Ag.
The authors are employees of Urgo Medical.