Assessment of Antimicrobial treatment on Cotton and Polyester Compression Bandages

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Statement of Purpose: Compression therapy is recommended for the control of swelling, and the promotion of healing, regeneration and rehabilitation in the cases of lymphedema and burn patients with deep wounds. The continuous generation and retention of exudates in these wounds creates a challenge for patients with edema and diabetes if left untreated [1,2] causing infections due to bacterial adherence and other complications. Dressings that apply pressure to these wound sites ensure epithelialization and reduction in scar formation while allowing for the volume of exudate and venous fluids to be reduced. The objective of this study was to address this problem by developing a three dimensional (3D) antibacterial knitted fabric and to evaluate its *in vitro* antibacterial performance compared with commercially available compression dressings such as ACE™ and Coban™ bandages.

Methods: A three dimensional (3D) knitted spacer fabric was developed in the Knitting Laboratory at the College of Textiles, NCSU by utilizing textured 150 denier polyester (PET) multifilament yarn. The two-needle bed warp-knitting machine had a gauge of 24 needles/inch and was knitted with spacer yarns in a crisscross orientation. This NC State spacer fabric referred to as ProTexion™ was treated with 3 different antimicrobial agents as well as a combination, and its antibacterial activity was tested against commercial products such as ACE™ Elastic Anti-microbial Bandage and Coban™ Two Layer Compression System. The 3 antimicrobial agents included a quaternary ammonium compound dendrimer (QAC) (supplied by CCL Biomedical Inc.), a silver salt solution called Silver Clear™ (supplied by TransTex Technologies Inc.) and a chitosan solution, which were padded onto the compression bandage for controlled pick-up (Figure 1).

Samples

Sample Name	Image	Fiber Type	Antibacterial Agent	Manufacturer
ProTexion™		PET	QAC dendrimer	CCL Biomedical, Inc
SilverClear™		PET	Silver	TransTex Technologies Inc.
SilverClear™ & Chitosan		PET	Silver, Chitosan	TransTex Technologies Inc. & NCSU
Chitosan		PET	Chitosan	NCSU
PET bandage		PET	None	NCSU
ACE™ Elastic Bandage Antimicrobial		Cotton, Spandex	Unclaimed	3M
Coban™ 2 Layer Compression System		Cotton, Spandex	None	3M

Figure 1: Samples and antibacterial agents applied to the knitted compression dressings.

Antibacterial activity was assessed by the AATCC 147-2011 standard test method "Antibacterial Activity Assessment of Textile Materials: Parallel Streak Method" against Escherichia coli *(E.Coli)* bacteria, which were incubated on agar for 24 hours.

Results: The QAC dendrimer, the SilverClear™ and the chitosan treated samples all inhibited bacterial growth and demonstrated stronger bacteriostatic activity than the combination sample that was treated with both chitosan and SilverClear™ together (Figure 2). The untreated PET spacer fabric was able to inhibit some bacterial growth, and was marginally more effective than either the ACE™ or the Coban™ commercial products. In fact the ACE™ Antibacterial Elastic Bandage performed equally poorly as the non-antibacterial Coban™ sample.

Figure 2: Zone of inhibition measuring the antimicrobial activity of the different samples.

Time of Flight Secondary Ion Mass Spectroscopy (TOF-SIMS) was performed to determine the uniformity of the four antimicrobial coatings on the polyester (PET) spacer fabrics. The QAC dendrimer finish gave the most uniform coverage compared with the SilverClear ™ and chitosan treatments as well as maintaining the porosity of the knitted structure.

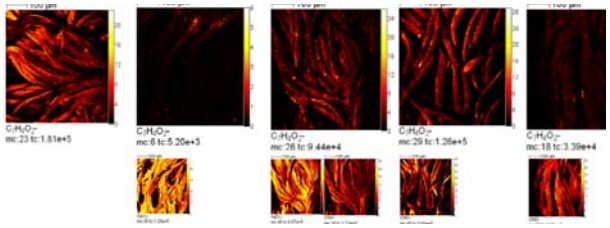

Figure 3: TOF-SIMS scanned images showing the distribution of the antimicrobial agents on the PET fibers.

Conclusions: From this initial study it can be concluded that the treated PET spacer fabric has potential to be used as an antibacterial bandage. The use of a QAC dendrimer, SilverClear™ and chitosan all showed effective anti-microbial activity against Gram negative *E.Coli* bacteria. The QAC dendrimer and SilverClear™ provided a more uniform coating onto PET fibers than chitosan. Future studies we will test the effective-ness of the QAC dendrimer agent against Gram positive bacteria, as well as assessing the reasons why combining the different agents did not achieve superior antimicrobial performance.

References:

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