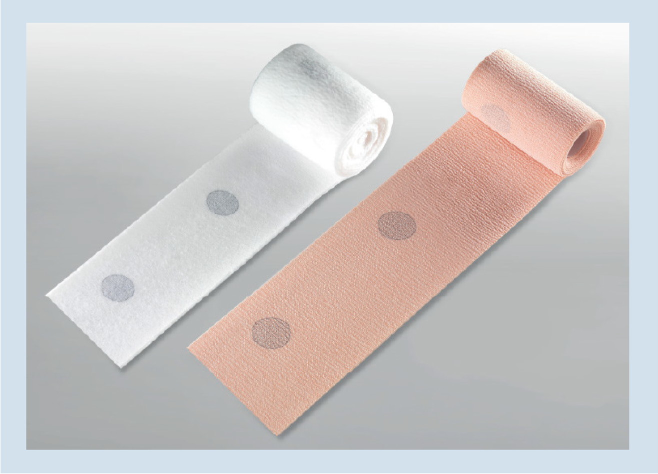
Warp Weft and Loft Interact to Create 3-D Stiffness Structure of Two-layer Compression Wraps

EVAN CALL[1] MS, CSM (NRM); SANDRA GUZMAN[2] PHD; CRAIG OBERG[1], PHD RANDY JONES[2], MBA
1. WEBER STATE UNIVERSITY 2. EC SERVICE, CORP.

INTRODUCTION

When two elastic layers of a compression wrap are applied, they are compressed into each other, this creates a 3-dimensional entangling that adds rigidity to the new multilayer assembly of fabric that would not be rigid by itself. This intermeshing creates a "scaffold-effect", a mechanical structure that traps and maintains tension between layers or against the skin.

Performance studies indicate that dual compression wraps where the two layers are elastic and contribute to compression, maintain the working pressure comparable to 4-layer wraps, and have a higher tolerance rate due to comfort.



** UrgoK2 Dual Compression System*
Urgo Medical North America, Fort Worth, Texas

PURPOSE

This bench analysis is intended to explore the design characteristics responsible for the performance of dual compression system (DCS)*, and it was compared with a traditional two layer wrap (TLB)**.

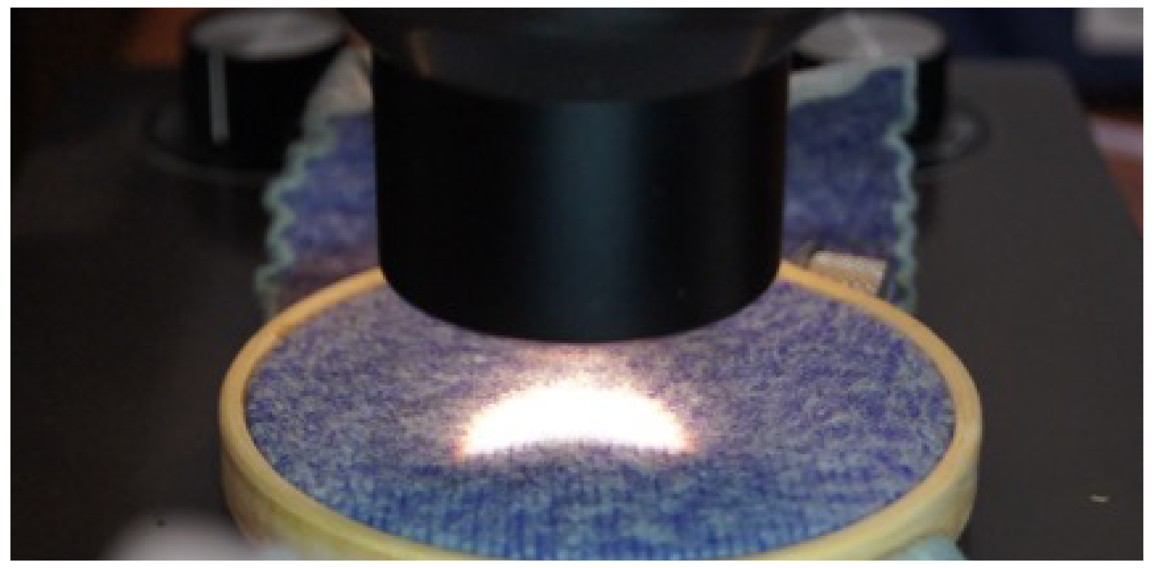


Fig. 1 Dyed Layer 1 of DCS under microscope.

METHODS

A sample dual compression system (DCS) was wrapped on a variable edema leg model to create an assembled compression that was bound with microscopic fixative. Photographic microscopy is used to observe the intermeshing of the layers (Fig. 1). Layers were dyed to differentiate the fabrics.

Additionally, the variable edema leg model was inflated to a circumference of 35cm, and then the bladder was wrapped. A PicoPress sensor was used to verify the pressure of 40±5mmHg. A clamp was attached to the end of the wrap with both layers clamped. Tensile test was used to measure the force required to generate 1cm of wrap slippage. Following which, the simulated leg circumference was reduced by 1 cm, simulating edema reduction, the tensile test was performed again. This procedure was repeated from 35cm to 31cm with three samples of each product.

RESULTS

The Knit of DCS layers are observed in Fig. 2. The design is in part responsible of the interaction of both layers to sustain compression pressure over time, this design was not observed in TLB, Fig. 3 and Fig. 6 b).

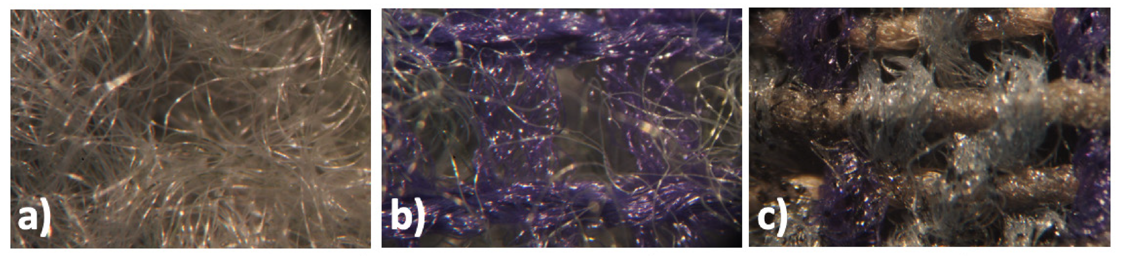


Fig. 2 DCS stretched a) Layer 1 inside, b) Layer 1 outside, c) Layer 2

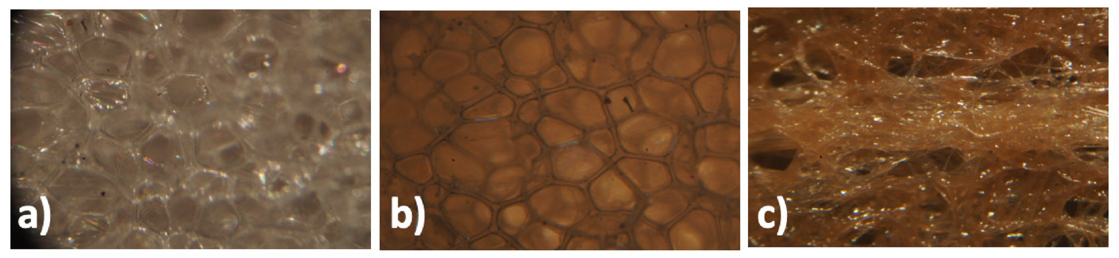


Fig. 3 TLB stretched a) Layer 1 inside, b) Layer 1 outside, c) Layer 2

The reduction in circumference resulted in the TLB wrap no longer conforming to the leg shape, resulting in a reduction in resistance of the force required to generate slippage (p=0.06). On the other hand, DCS had no significant differences in the load after cicumference reduction and the wrap continued conforming to the simulated leg, Fig. 4 and Fig. 5. Moreover, after a reduction of 2cm, TLB had significantly lower pressure than DCS as observed in Fig. 7.

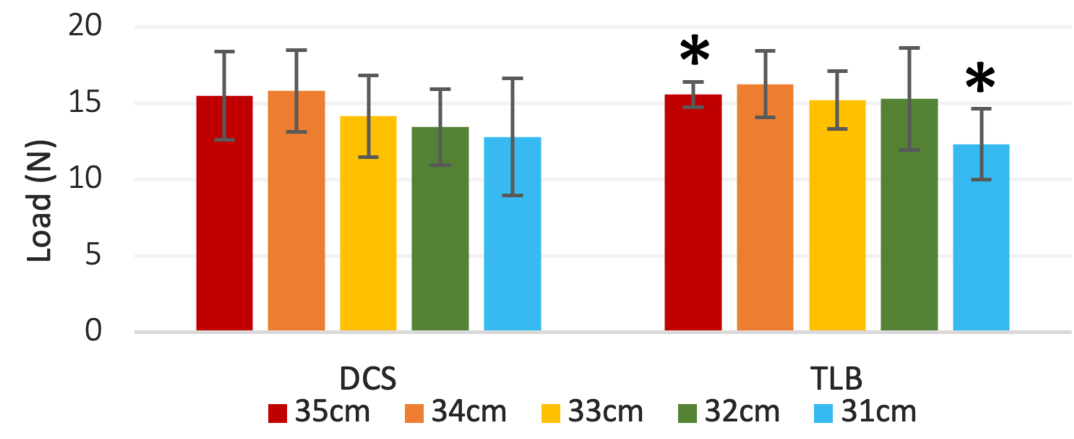


Fig. 4 Load at pull after circumference reduction.
Error bars represent 95% confidence interval. *p=0.06

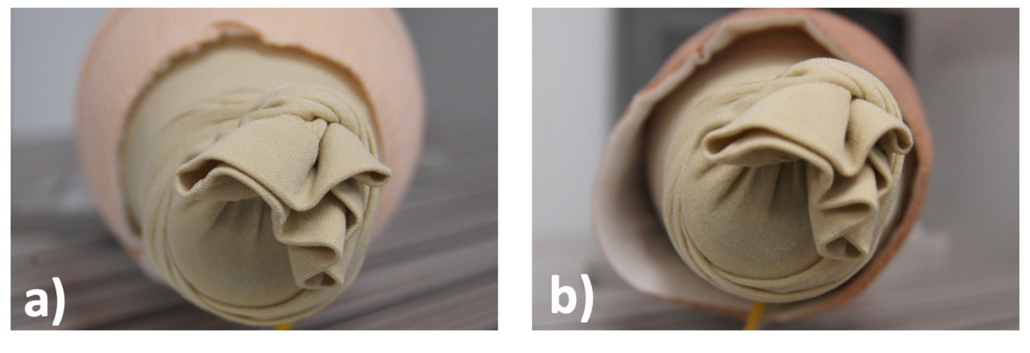


Fig. 5 Wraps after 4 cm reduction a) DCS b) TLB

The intermeshing of one layer into the second layer of DCS seen in Fig. 6 provides interlocking generating the scaffold effect (see red line). Note that in the TLB, the interface between the layers is completely flat leaving the two layers free to slide against each other.

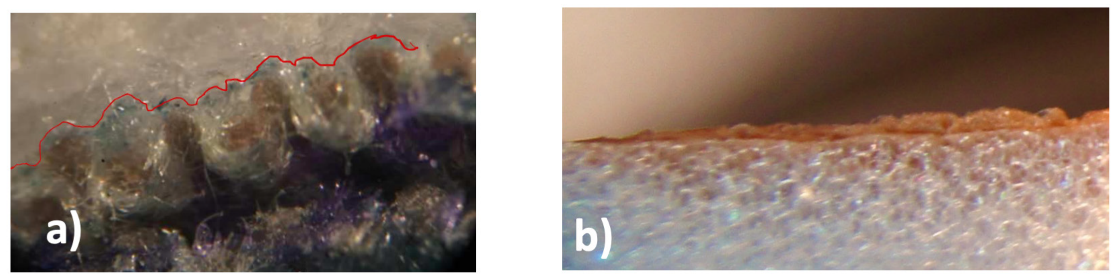


Fig. 6 Intermesh of layers in a wrap a) DCS b) TLB

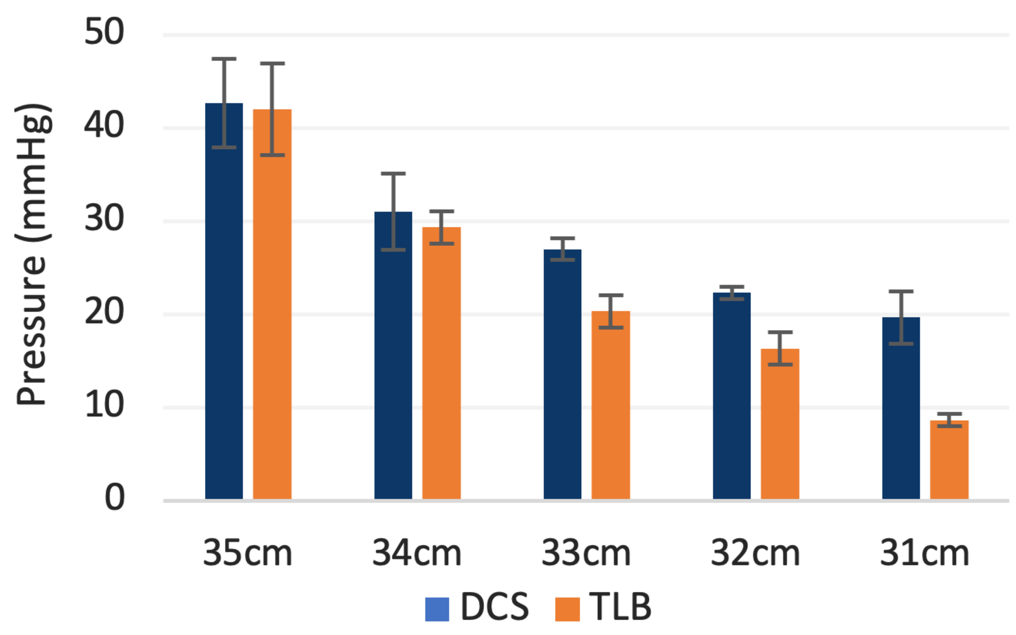


Fig. 7 Pressure after circumference reduction.
Error bars represent 95% confidence interval.

DISCUSSION

Tension applied to the wrap generates compression and then friction. Proper friction, compression, intermeshing, and the resulting 3-dimensional structure creates continuous, consistent and comfortable compression. This consistency in wrap compression, creates the "scaffolding" structure that resists loosening or sliding and functions in ambulation and supine position.
The DCS which uses two stretch layers becomes even stiffer, providing a consistent and resilient structure making compressive performance optimal over 5-7 days and under demanding flexure conditions seen in real life mobility, supporting the previous reported studies using DCS.

REFERENCES

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