An *in-vitro* Pressure Mapping Evaluation of Fuzzy Wale Compression with Multi-Layered Compression

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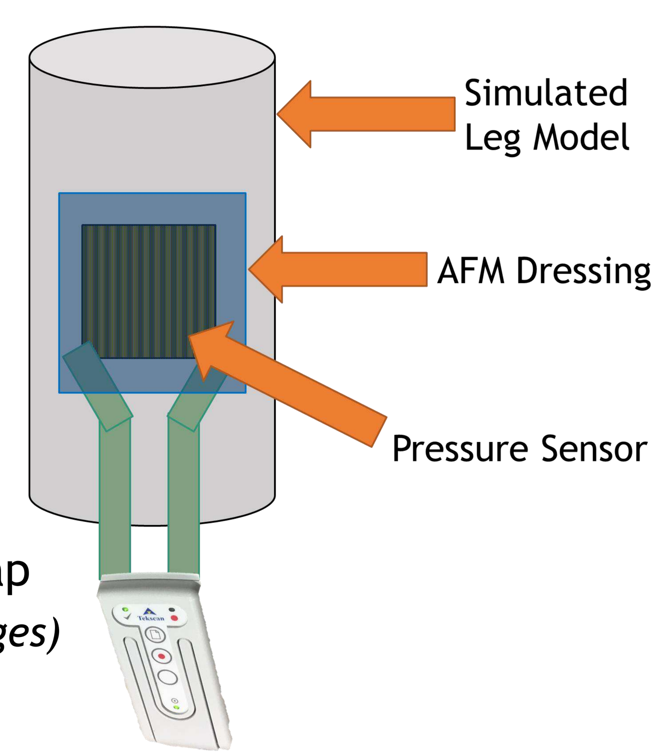
BACKGROUND

Compression therapy products range from elastic stockings to multi-layered wraps and are designed to provide therapeutic levels of compression to reduce venous hypertension.[2,3] To date, a majority of the compression research has focused on the effect different types of compression products have on the large vasculature structures (macro-circulation).[4] There has been minimal research looking at the impact of different forms of compression on the micro-circulation of the skin and the function of the lymphatics. It has been documented that bandages that create greater pressure variations are superior for wound healing and edema management.[4]

Active Fluid Management® (AFM) dressings have shown to be an effective moisture management dressing under compression. Fuzzy Wale Compression (FWC) elastic stockings have been shown to produce alternating areas of low level static compression. The combination of the FWC stocking and AFM dressing has shown improvement of healing for previously recalcitrant wounds.[5] We hypothesized that alternating areas of different levels of static compression may have an enhanced effect on the micro-circulation of the tissue.

MATERIALS

- Simulated Leg Model
- Pressure sensor*
- AFM dressing
- FWC stocking
- 2-Layer Compression *(two types)*
- 4-Layer Compression
- Multi-Component Lymphedema Wrap
  (Open Cell Foam + Short Stretch Bandages)



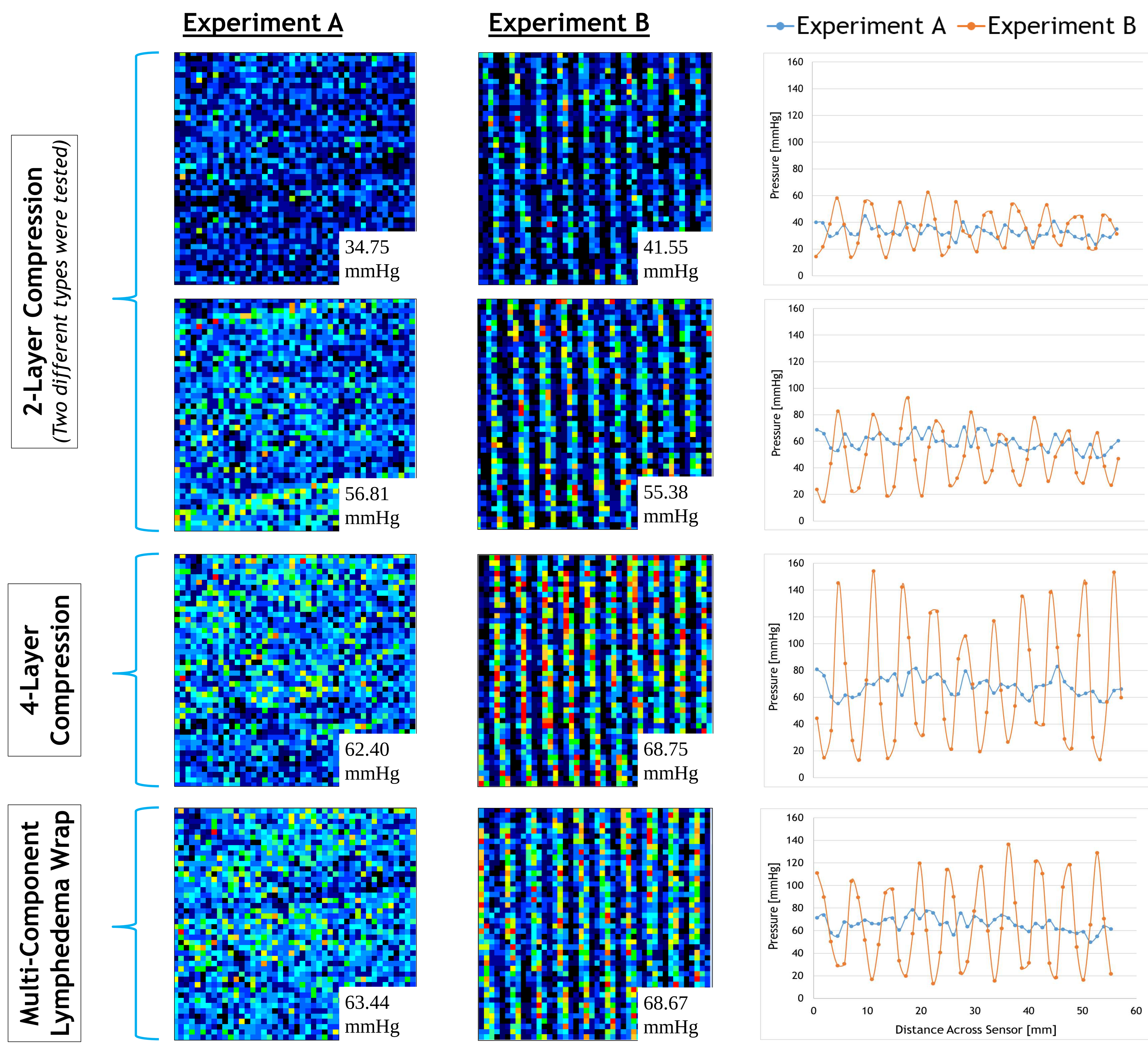
METHOD

Laboratory experiments were performed to demonstrate the pressure profile difference with the AFM dressing under the FWC stocking for 4 compression systems. A calibrated pressure sensor was used to capture static pressure maps for all samples (n=5 iterations for each sample). During each experiment, the pressure sensor was placed in between the simulated leg model and the AFM dressing, the wound contact dressing.

Experiment A involved applying each compression wrap to the simulated leg model with the AFM dressing. **Experiment B** involved adding the FWC stocking, it was placed between the AFM dressing and the compression wraps. Pressure data was analyzed using a custom MATLAB code that determined the peak, minimum and average pressures along each crossing point or sensing element (Sensel).

RESULTS

Figure 1. Representative pressure maps and pressure profile graphs from each of the compression wrap systems for Experiment A and B. Both the pressure maps and graphs show the effect that the FWC stocking has on the peak and minimum pressures experienced underneath the compression wrap systems. The average pressure recorded across all sensels for each wrap system is reported on the bottom right corner of each pressure map.



Standard deviations ranged from 3.12 mmHg to 5.12 mmHg for all compression systems tested.

Figure 2. Photos of Experiment B setup for each compression system tested overtop of the AFM+FWC layers.

Left to right: Two 2-layer compression systems, 4-layer compression and multi-component lymphedema wrap.

DISCUSSION

As expected, all compression wrap systems provided ≥34.75 mmHg, which falls within the range suggested for compression wraps. Of the 4 compression wrap systems tested, one of the 2-Layer compressions resulted in the lowest pressures across the wraps (Figure 1). The average pressure across the 4-layer compression, the other 2-Layer compression and the multi-component lymphedema wrap were not significantly different from each other. No significant differences were seen in the overall averages across all Sensels.

The addition of the FWC compression stocking in Experiment B increased the formation of an alternating pattern of high and low pressure regions and increased the difference between minimum and maximum pressure values for each wrap system. This was a result of the lower surface area that the FWC stocking presents. The AFM dressing was found to not affect the compression profiles or the alternating pattern within the pressure mapping due to its low profile design.

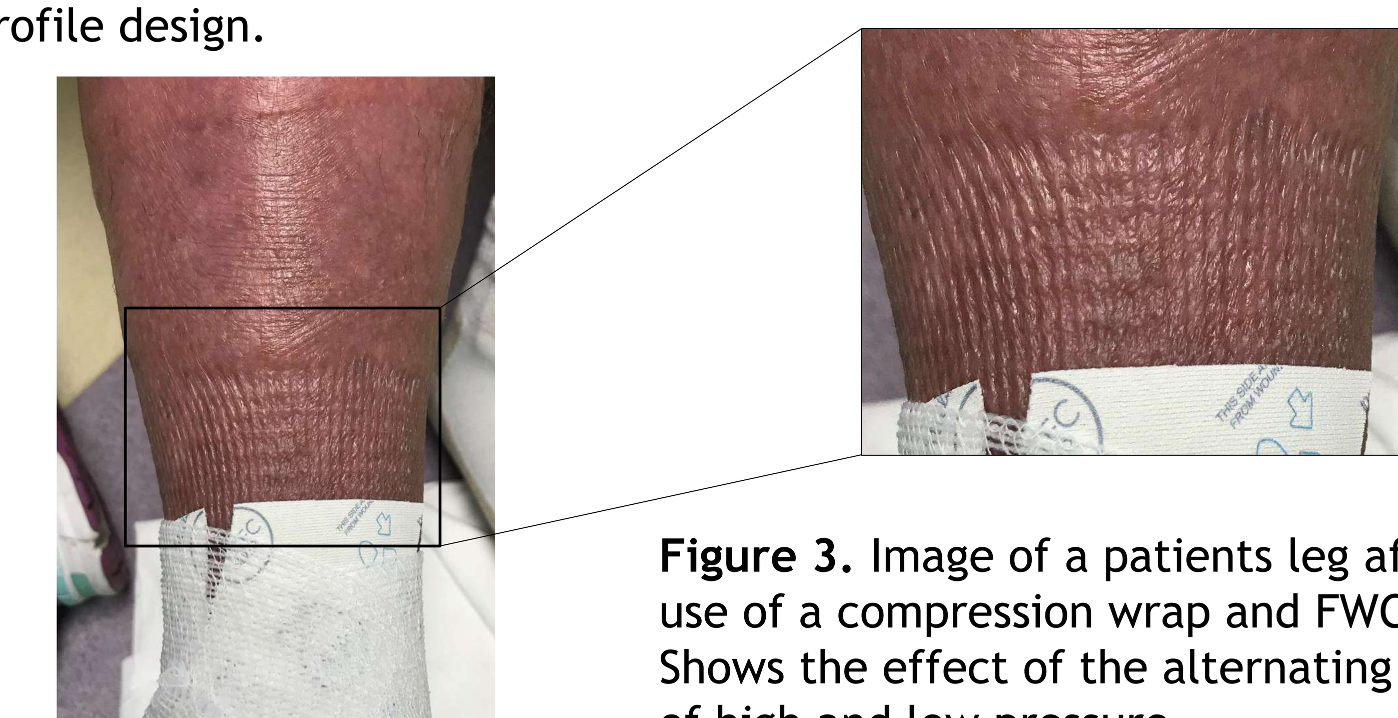


Figure 3. Image of a patients leg after the use of a compression wrap and FWC stocking. Shows the effect of the alternating pattern of high and low pressure.

CONCLUSION

Differential pressure readings were recorded both visually and numerically, providing a pressure map at the simulated skin interface for each compression application. Addition of compression bandage layers produced greater pressure differentials; however, the alternating compression profile remained. Having peak differentials instead of tourniquet effect allows areas of skin to have lower pressure, where the lymphatic and venous vessels can remain open. By adding different compression systems over AFM+FWC, we are able to provide a system that manages moisture, has overall moderate compression and encourages lymphatic flow. Compression paired with extremity motion is believed to create pressure changes and act as a pump for lymphatic vessel and small veins under the skin. Further testing to be done to demonstrate the impact of extremity motion with a simulated exuding wound is under way to study the moisture management of wound dressings under compression.

FOOTNOTES

*Tekscan, Inc. I-Scan System Model 5051 Pressure Sensor
AFM: Milliken Healthcare Products TRITEC™ 4" x 5" Dressing
FWC: Compression Dynamics EdemaWear® Small Stocking
2-Layer (in order):
Andover Healthcare CoFlex® TLC 2-Layer Compression Kit
3M™ Coban™ 2 Layer Compression System
4-Layer: S&N PROFORE Multi-Layer Compression System
Multi-Component: BSN Medical 10cm Comprifoam® and 10cm Comprilan® Short Stretch.

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