COMPRESSION THERAPY: IN VIVO ASSESSMENT OF THE EFFECTS OF POSTURE, ACTIVITY, AND COMPRESSION TEXTILE ON INTERFACE PRESSURE DELIVERED BY DIFFERENT COMPRESSION APPLICATIONS IN HEALTHY SUBJECTS

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Abstract

Introduction:
Compression is a decisive and established therapeutic tool utilized for the management of edema of multiple origins, chronic venous disease (CVD), and venous leg ulcers (VLUs). However, beyond expected dosage (interface pressure =IP) of a compression device at the time of application, there is limited information provided to the clinical user about the dynamic properties of different compression textiles with change in position or following short bouts of activity. The objectives for the in vivo assessment was to analyze the effects of posture, activity, and compression textile on IP and gradience.

Methods:
A piezoelectric sensor (Fig. 1) was used to measure the IP at the ankle and calf under three compression applications: longitudinal elastic stockinette, 2-Layer cohesive compression system, and combination of the two; in two different positions: standing and supine; at two different time points: immediately after applications and after a 10-minute walk on a treadmill for 40 healthy subjects. (Fig. 2 & 3) Paired sample T-tests with Bonferroni correction factors were performed to determine if the differences between local pressure averages at each position and material combination.

Results:
Statistically significant variation in IP was observed between compression applications assessed by location, subject position, and textile type. (Fig. 4, 5.1 & 5.2) Mean IP ± SD measured at the ankle in supine for longitudinal elastic stockinette, 2-layer cohesive compression kit, and combination application was 10.82 (±4.18), 28.48 (±28.5) and 38.34 (±8.89) mmHg respectively. IP increased with movement from supine to standing and with activity. However, significant change in IP was not observed for all compression conditions. Static stiffness index (SSI) varied by compression textile, location, and time assessed. (Table 1) Although gradience was observed, there was not a statistically significant variation in IP distal to proximal for any of the compression applications assessed. (Fig. 6.1-6.3)

Conclusion:
Significant variations in IPs were observed between compression textiles of different physical properties with change in position and activity. Compression gradience, a commonly held assumption of a compression application was not observed. Knowledge of a compression textiles comprehensive compression profile, dosage as well as static stiffness, has the potential to provide the clinician with insight into the hemodynamic potential. Additional research is warranted.

Methods

Sensor Type	Matrix Height [mm]	Matrix Width [mm]	Resolution
6300	33.5mm	264.2mm	2288 sensels

Figure 1 – Tekscan 6300 sensor specifications and sensor placement on medial aspect of right lower extremity

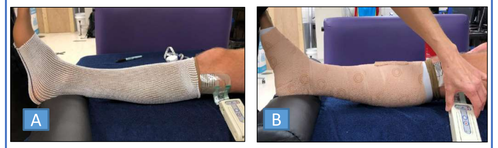

Figure 2 – Compression Applications Assessed
(A) Longitudinal elastic stockinette application, (B) 2-Layer cohesive compression system, and (C) Combination (A) and (B) (not shown)

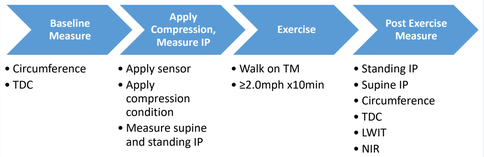

Figure 3 – Study Protocol

Results

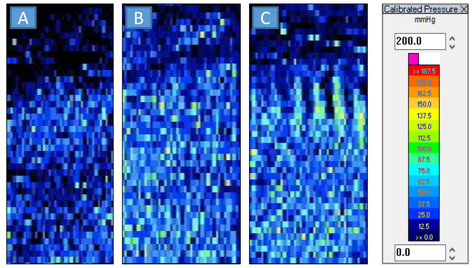

Figure 4 – Pressure Distribution Maps Post Compression Application
(A) Longitudinal elastic stockinette application, (B) 2-Layer cohesive compression system, and (C) Combination (A) and (B)

Results (cont.)

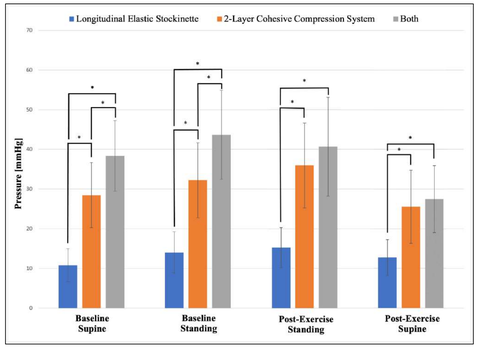

Figure 5.1 – Interface Pressure Local Averages at the Ankle

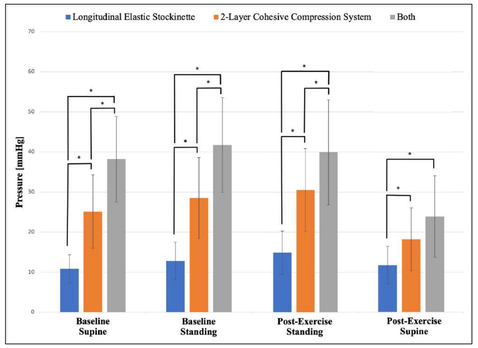

Figure 5.2 – Interface Pressure Local Averages at the Calf

Measurement Location	Compression Application	Baseline SSI	Post Exercise SSI
Ankle	Longitudinal elastic stockinette	3.21	2.5
	2-Layer cohesive compression system	3.72	10.10
	Combination	5.11	13.30
Calf	Longitudinal Elastic Stockinette	1.96	3.13
	2-Layer cohesive compression system	1.95	11.61
	Combination	3.15	14.88

Table 1 – Static Stiffness Index (SSI) Before and After Exercise
SSI = Standing IP – Supine IP

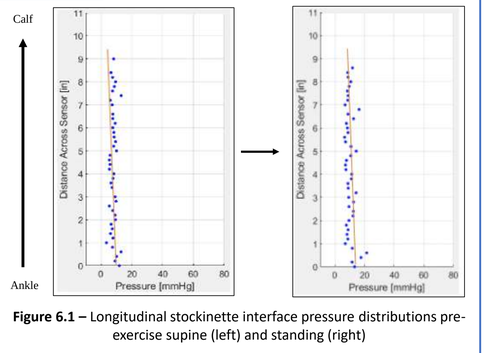

Figure 6.1 – Longitudinal stockinette interface pressure distributions pre-exercise supine (left) and standing (right)

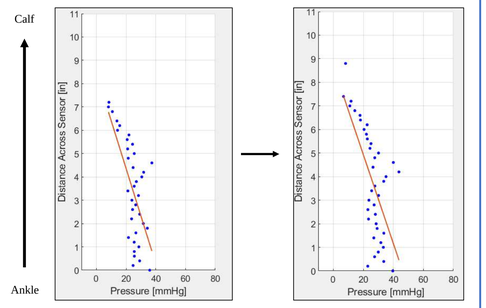

Figure 6.2 – 2-Layer cohesive compression system interface pressure distributions pre-exercise supine (left) and standing (right)

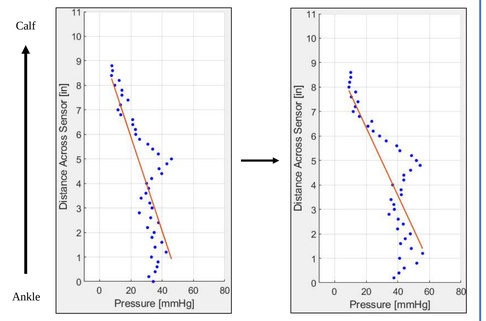

Figure 6.3 – Combination interface pressure distributions pre-exercise supine (left) and standing (right)

Conclusion

Dosage (mmHg) and SSI of a compression application varied by textile composition.

- Clinical Implication: Changing the textile composition impacts dosage.
- The layered textile had the greatest dosage.

Dosage (mmHg) varied with change in position and after a period of wear.

- Clinical Implication: Dosage under a compression is not static.
- Change in IP was not uniform across compression applications

Although gradience was observed, there was not a statistically significant change in dosage from the distal to proximal aspect of the limb.

- Clinical Implication: Gradience of a compression application is the theoretical and has not been formally established.
- Textile composition impacts gradience observed

References

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Acknowledgements

Research reported in this publication was supported in part by unrestricted educational grants from Milliken Healthcare Products and Compression Dynamics to Clemson University. The funders played no role in the design, conduct, or reporting of this study.

2-Layer Cohesive Compression System assessed was CoFlex® TLC (Milliken Healthcare Products, Spartanburg, SC, USA)

Longitudinal Elastic Stockinette assessed was EdemaWear® (Compression Dynamics, Omaha, NE, USA)