The Textile Properties of Flowtron Tri Pulse Deep Vein Thrombosis (DVT) Garments

A factor in patient compliance with Intermittent Pneumatic Compression (IPC) Systems

Introduction & Clinical Context

Venous Thromboembolism (VTE) is a leading cause of inpatient death[1]. It is a condition in which blood clots usually form in the deep veins of the leg or pelvis (known as a deep vein thrombosis or DVT). A portion of the clot can break off and travel via the systemic circulation to the lungs to cause a pulmonary embolism (PE). Together, DVT and PE are known collectively as VTE. There are approximately 10 million cases of VTE reported worldwide each year[2] and these are associated with high economic and humanitarian cost[3]. As a result, significant focus in recent years has been placed upon the prevention and reduction of VTE rates.

One such preventative strategy includes the use of intermittent pneumatic compression devices that consist of special garments worn on the leg and attached to a pneumatic pump that causes the garment to intermittently inflate and deflate (Fig 1). This action squeezes the calf muscle pump, causing blood to move in the deep veins of the legs to help prevent venous stasis and subsequent clot formation.

The use of IPC as a prophylactic measure, requires the patient to wear the garments, continuously and for the recommended time periods, and this is vital to the success of IPC in reducing the risk of VTE formation. Increasing emphasis has therefore been placed on the comfort of VTE garments as an important aspect in improving wear time and overall concordance with IPC therapy. Better concordance is linked with reduced VTE event rates[4]. A randomised controlled trial evaluating patient compliance with IPC therapy demonstrated that a garment, which was more comfortable, was worn for longer periods[5].

Figure 1: Flowtron ACS900 with Tri Pulse Garments

This paper will examine some of the elements affecting the comfort of garments designed for IPC. In particular it considers the Tri Pulse garment range, marketed by Arjo (formerly ArjoHuntleigh) as part of the Flowtron Active

Compression Systems (ACS), and how their design for comfort in use can help to contribute to compliance to therapy in the hospital setting.

The Flowtron Tri Pulse Garment Range

Arjo's Tri Pulse garment range (Fig 2) provides a graduated sequential intermittent compression profile, designed for optimal anatomical fit and enhanced patient comfort. The Tri Pulse range consists of a calf or calf and thigh garment and is available in a variety of sizes including a bariatric option.

Figure 2: Flowtron Tri Pulse Garment Range

Improving Patient Comfort

One method of helping to improve patient comfort is to focus on the garments ability to allow the passage of heat, air or moisture vapour away from the skin and through the fabric. Key success metrics in developing a garment that is comfortable for patients to wear include:

- Ensuring garment fabric is of a low thermal rating
- Using a garment fabric that allows heat and moisture vapour to pass through the material
- Ensuring fabric dries rapidly

Assessing the breathability and heat transfer capabilities of Flowtron Tri Pulse garments

To demonstrate the Flowtron Tri Pulse garment properties, they were tested at an independent UKAS accredited laboratory, to assess heat, air and water vapour characteristics following recognised test standards:

- Water Vapour Permeability (WVP Index), BS7209: 1990 (1997)
- Ret Water Vapour Resistance, ISO 11092
- Thermal Resistance (TOG), BS4745

The same testing methods were used in previous work to assess the breathability and heat transfer capabilities of the Flowtron Uniform DVT Garment range[6].

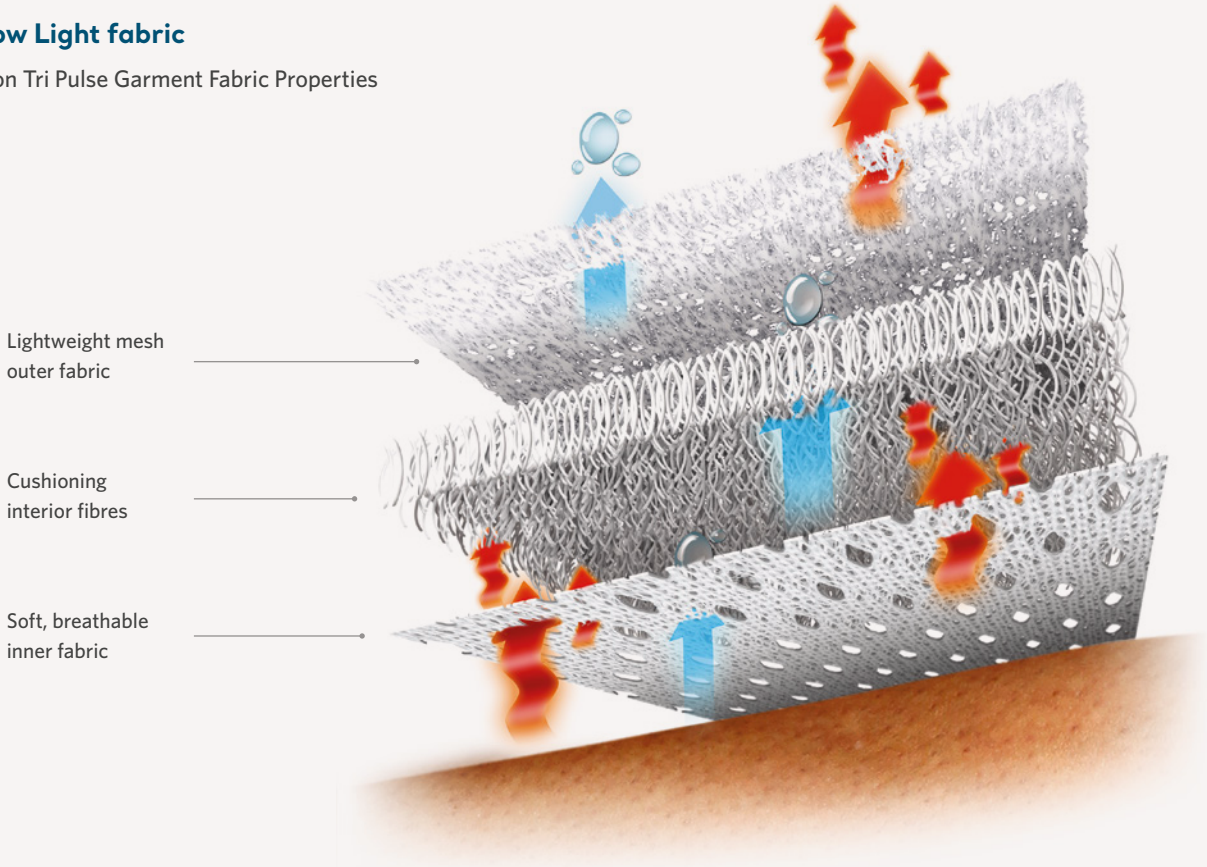
Water Vapour Permeability

The transfer of water vapour away from the patients skin is a critical factor in patient comfort – this process refers to a fabrics breathability. Water Vapour Permeability (WVP) and Resistance Evaporation (Ret) are measures that are used to evaluate the breathability of a fabric.

WVP measures the water vapour permeability of a fabric and therefore the degree of perspiration transported to the ▸

Airflow Light fabric

Flowtron Tri Pulse Garment Fabric Properties



outside air. The higher the value, the more breathable the fabric. Flowtron Tri Pulse garments achieved a result of 89.5% (dual layer) when compared to a known fully breathable fabric (Fig 3).

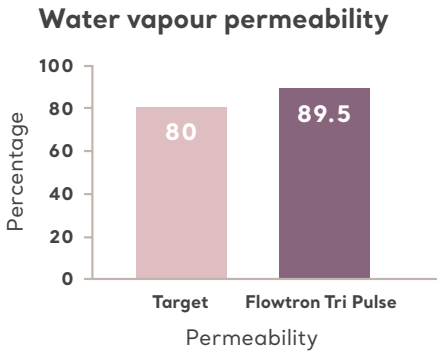


Figure 3: Flowtron Tri Pulse results of Water Vapour Permeability Testing dual layer[7]

Fabric Breathability

Ret measures the resistance to water vapour transmission through a barrier. Industry standards for high performance work wear state that a fabric which scores >40 m^2 Pa/W (Pascal Watts) is non breathable, 20–40 m^2 Pa/W is semi-breathable and <20 m^2 Pa/W is breathable. A good breathable work wear assemble with functional layers would be expected to have a Ret rating of <20 m^2 Pa/W (ISO 11092). The results for the material aspect of the Flowtron Tri Pulse garments tested as a dual layer material were in the region of 11 [m^2Pa/W][8] (figure 4). This indicates that the Flowtron Tri Pulse fabric is effective in transferring water vapour through the fabric and has good breathability that is unlikely to cause any additional discomfort when wearing due to overheating and/or sweating.

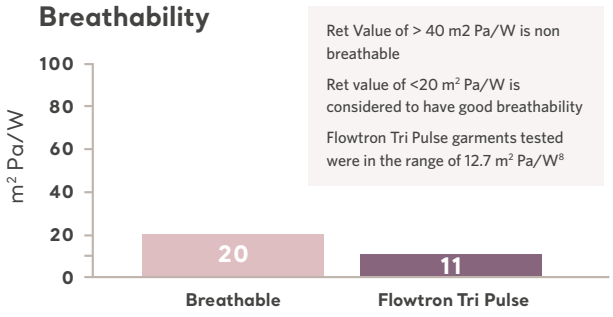


Figure 4: Flowtron Tri Pulse garment results of fabric breathability[8]

Drying Time

A fabric that remains wet and cold will draw heat from the body. The faster a material dries, the less likely the wearer is to experience heat loss and discomfort. To determine the drying rate of a saturated fabric, the dry weight of the sample weight is first recorded. Fabric is saturated in water at 20° C, and the wet weight is determined. A set airflow is created and timing is started. The weight of the dish is automatically recorded in set intervals. When the weight is constant for successive readings or when the fabric returns to its original weight, the final weight is recorded.

The Flowtron Tri Pulse samples dried to within 99% of their original weight within a six hour period[9]. The Tri Pulse garment fabrics also demonstrated a good liquid wicking rate; after 5 minutes, moisture moved 52.4 mm[10], showing that perspiration can be conducted from the middle of the garment to the edges quickly, helping to improve the speed of evaporation which helps to improve comfort.

Thermal Rating

To minimise the risk of perspiration or increased heat production during wear time, VTE garments should be non-thermal – this means they do not generate additional heat.

The thermal rating of a textile was measured using a single plate method with a dual layer material. This test can be used to determine the thermal resistance of the fabric. The results uses the same units which are used to indicate the thermal rating of a duvet known as the TOG rating.

The lower the TOG rating the less thermal the material will be. A rating of 1.0 TOG is considered to have negligible thermal properties. Flowtron Tri Pulse garments recorded low thermal ratings of less than 1 TOG as a dual layer material[11] (figure 5). This low thermal rating can be regarded as non-thermal, preventing normal heat loss from the body surface and should remain comfortable during wear time.

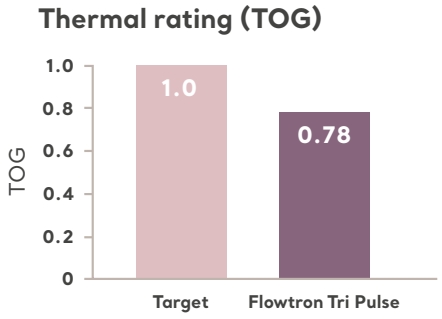


Figure 5: Flowtron Tri Pulse garments achieved a low thermal rating of less than 1 TOG as a dual layer material[11]

Conclusion

This short paper has covered the key factors which are important in the performance of the garment in promoting comfort and subsequent compliance with IPC therapy. The results of this independent testing demonstrate that overall the Flowtron Tri Pulse garments have been shown to be non-thermal in nature with excellent moisture management properties.

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8. Independent Material Test Data on File: Test Report Number E-023584: Flowtron Tri-Pulse Water Vapour Resistance (Ret) dual layer (no bladder), January 2022, Page 5

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10. Independent Material Test Data on File: Test Report Number E-023584: Flowtron Tri-Pulse Liquid Wicking Rate (Mean Capillary Rise, mm), single inner layer (no bladder), January 2022, Page 7

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Arjo AB • Hans Michelsensgatan 10 • 211 20 Malmö • Sweden • +46 10 335 4500

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