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Advanced smart medical stockings using stress-memory polymeric filaments for chronic disorders

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Severely damaged veins in the human body leads to development of phlebological and lymphatic diseases such as venous ulcers, edema, and deep vein thrombosis (DVT). Compression stocking is considered as gold standard in the conservative treatment of chronic venous disorders i.e. compression therapy. It has always been a great challenge for both health practitioners and manufacturers to maintain the desired level of compression pressure in the stockings. At present, there are several shortcomings such as different class of stockings needed for different legs, different class of stockings, no massage benefits, leading to patients' noncompliance and in effective compression therapy. There is a need of any scientific approach to solve such real problems by discovering any smart material whose internal pressure can be controlled externally. In line with this, a novel phenomenon of stress-memory was discovered in a semi-crystalline memory polyurethane filaments, whose stress can be programmed, stored, and retrieved reversibly upon an external heat stimulus. Stress-memory filaments were integrated into a smart flexible textile structure to make a medical stocking and its structure was varied with different knitting parameters and optimized to achieve the maximum interfacial compression pressure results. The optimized smart stockings were studied for the effect of physical parameters such as temperature, strain, and leg radius. Further smart stocking structures were investigated for the dynamic pressure (massage) test and selected the best one which gives maximum massage benefits and sustenance. The massage effect on the blood flow was also confirmed by Doppler ultrasound scanning. The interfacial pressure of the stockings can be varied via temperature, number of stress memory filaments, structure design externally on a human leg unlike conventional ones. Multifunctional smart medical stockings would revolutionize the way of compression therapy by providing static and massage functions, easy wear ability, and selective pressure control.

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