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Design of an Active Compression System for Treating Vascular Disease Using a Series of Silicone Based Inflatable Mini Bladders

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Abstract : Venous disease of human lower limb could range from minor asymptomatic incompetence of venous valves to chronic venous ulceration. The sheer prevalence of varicose veins and its associated significant costs of treating late complications such as chronic ulcers contribute to a higher burden on health care resources. In most of western countries with developed health care systems, treatment costs associated with Venous disease accounts for a considerable portion of their total health care budget, and it has become a high-cost burden to National Health Service (NHS), UK. The established gold standard of treatment for the venous disease is the graduated compression, where the pressure at the ankle being highest and decreasing towards the knee and thigh. Currently, medical practitioners use two main methods to treat venous disease; i.e. compression bandaging and compression stockings. Both these systems have their own disadvantages which lead to the current programme of research. The aim of the present study is to revolutionize the compression therapy by using a novel active compression system to deliver a controllable and more accurate pressure profiles using a series of inflatable mini bladders. Two types of commercially available silicones were tested for the application. The mini bladders were designed with a special fabrication procedure to provide required pressure profiles, and a series of experiments were conducted to characterise the mini bladders. The inflation/deflation heights of these mini bladders were investigated experimentally and using a finite element model (FEM), and the experimental data were compared to the results obtained from FEM simulations, which showed 70-80% agreement. Finally, the mini bladders were tested for its pressure transmittance characteristics, and the results showed a 70-80% of inlet air pressure transmitted onto the treated surface.

Keywords : finite element analysis, graduated compression, inflatable bladders, venous disease
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