Effect of walking on pressure variations that occur at the interface between elastic stockings and the skin

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ABSTRACT
The aim of this work was to dynamically study pressure variations exerted by elastic compression stockings during walking. While study participants walked, the pressure variations at the interface between elastic stockings and the skin were measured dynamically. Three healthy individuals wearing 10/20 and 20/30 elastic compression stockings manufactured by Sigvaris® (Jundiai, São Paulo-Brazil) were requested to walk along a course for ten times at a constant speed. For every event, an apparatus specifically developed for the study and programmed to take readings at half-second intervals was used to measure the pressure exerted by the elastic stockings. The pressure exerted by the 10/20 stockings varied between 5 and 32 mmHg and for the 20/30 stockings it varied from 10 to 52 mmHg. Elastic stockings with larger pressures generate larger pressure variations during muscle activity (P-value < 0.001). In conclusion, muscle movements during walking cause the pressure exerted by elastic stockings on the leg to vary; thus, the pressure is not constant but has peaks and troughs according to the type of muscle movement and the gradient of the stockings.

Key words: Dynamic study • Elastic stockings • Walking • Working pressure

INTRODUCTION
Compression is a physical force which when applied on the skin using either elastic or non elastic materials exerts a pressure on internal structures of the body, including the macro- and microcirculation systems, and thus diminishes oedema and improves the functioning of the limb (1–3). Elastic stockings, which are simple to use, are a modern method of exerting compression. These stockings exert a constant external pressure on the leg, thus improving venous and lymphatic drainage (4–6). Pressure distribution and magnitude applied by graduated elastic compression stockings are significantly influenced by the location of testing points in terms of height and the face of the leg selected for measurement. Thus pressure measurements are influenced by specific anatomic structures and the shape of individual human legs, and are potentially affected by the type of pressure sensor and testing methods (4). Body posture may be one of the most important factors influencing the pressure applied by

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Effect of walking on pressure exerted by elastic stockings

Key Points

- Body posture may be one of the most important factors influencing the pressure applied by compression stockings.
- Appropriate changes in leg posture and exercising may improve the therapeutic effectiveness of graduated elastic compression stockings.
- The objective of this study was to dynamically evaluate pressure variations exerted by elastic stockings during walking measured at the interface of the stocking and the skin.

Methods

The effect of walking on the pressure at the interface between elastic stockings and the skin was evaluated in a dynamic study. Three apparently healthy individuals, a 42-year-old man, a 44-year-old woman and a 48-year-old woman, were selected to participate in the study. Each one was requested to walk at a constant speed for a total of ten events wearing 10/20 and 20/30 elastic stockings manufactured by Sigvaris® (Jundiaí, São Paulo, Brazil). During the walks, the pressure changes at the interface between the elastic stockings and the skin were measured for both legs.

An apparatus, developed specifically for the experiment by Godoy and Braile at Braile Biomedica, São José do Rio Preto, Brazil, was used to measure the pressure variations. The apparatus was programmed to take readings at half-second intervals in both dynamic and static studies. The apparatus was developed following the technical norms of the production of research equipment. In a pilot study, the medial region of the calf muscle was identified as the best site to place the pressure sensors. The size of the sensors is 5 cm wide and 6 cm long.

Initially, readings were taken in the standing position without movement to calibrate the apparatus, and then the individuals were asked to walk. The individuals walked at approximately 1.6 m/s for 6–7 minutes in all ten events.

The paired t-test was used for statistical analysis with an error alpha greater than 5% being considered significant.

This study was approved by the Research Ethics Committee of the Medicine School in São José do Rio Preto (FAMERP), Brazil.

Results

Walking caused changes in the pressure at the interface between the stockings and the skin. The pressure using the 10/20 stockings varied from 5 to 32 mmHg (P-value < 0.05; Figure 1), and for the 20/30 stockings it varied from 10 to 52 mmHg (P-value < 0.05; Figure 2). Elastic stockings with larger pressure graduations generate larger pressure variations during muscle activity (P-value < 0.001 between 10/20 and 20/30 elastic stockings).

Discussion

When the individual is not moving, elastic stockings exert a continuous pressure on the skin (the blue line on the graph) the magnitude of which depends on the region of the leg that the sensor is positioned. Muscle activity affects

![Figure 1.](image-url)
Effect of walking on pressure exerted by elastic stockings

Figure 2. Pressure variations during walking (in blue) at the interface between 20/30 elastic stockings and the skin measured at half-second intervals.

this as do changes in the gravitational pressure. Stockings are indicated both for the treatment of venolymphatic drainage diseases and for their prevention.

On reviewing publications in the PUBMED, Scopus and ISI electronic libraries, no scientific works were identified similar to this current study, in which pressure changes associated with the use of elastic stockings during walking were dynamically assessed. This type of evaluation is important to understand the mechanisms involved.

This study proves that the pressure exerted by elastic stockings is influenced by muscle activity. These variations in pressure also depend on the type of stocking used including the types of material used in their manufacture, the style and gradients. The higher the pressure exerted by the stockings, the greater are the pressure variations. During muscle movement, a reduction in the mean pressure exerted by the stockings on the skin is observed; the pressure is no longer constant but variable. Thus, elastic stockings cause a pulsating pressure at the interface with the skin during walking, thereby improving venolymphatic drainage. The use of elastic stockings should be encouraged specifically for patients with lymphovenous diseases, but care should be taken in relation to the contraindications.

CONCLUSION
In conclusion, muscle movement during walking affects the magnitude of pressure exerted by elastic stockings on the skin; the pressure changes from being constant to a pulsating pressure, which varies according to the type of muscle movement and the gradient of the elastic stockings.

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