# COMPRESSIVE ORTHOPAEDIC SUPPORTS FOR THE ELDERLY

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## ABSTRACT

Europe is the oldest continent in terms of population age. Due to rapid ageing and decreased physical activity of society, particular attention should be paid to encourage physical activity. Due to ageing and reduced activity emergent arthralgia and coordination disorders are a common cause of further lower activity. Development of orthopaedic supports with optimal variable compression in combining with the muscle strength and aerobic endurance training is a cost-effective tool for healthy ageing. The orthopaedic support is defined as a corrective or orthopaedic item intended to grip or support any movable part of the body in the correct position and allows movement of that body part. Obtained results clearly demonstrate that stress-strain relaxation phenomenon must be taken into account, especially in designing of orthopaedic supports for the elderly.

**Key Words:** compression, orthopaedic support, knitting, elastomeric structure

## 1. INTRODUCTION

The area of design of medical textile products requires high accuracy. It is not surprising that the quality of products for healthcare have to be very high. Recently, control of object of human health or its well-being is more and more increasing. Raising of consumer awareness, the desire to live healthier, more sustainable and more environmentally friendly, promotes the development of various research. In this case, the field of medical textiles, as the object of health or prevention, is analysed in various aspects. Over the last few decades, the areas of use and production volumes of compression medical textiles have significantly increased.

The efficiency of compression garments is affected by garment construction, fabric properties, garment fit and positioning on the body. All these factors play a significant role on the predictive pressure value generated by the compression garment and may undermine its functionality [1-3].

Nevertheless, all of the properties of knitted products such as mechanical, functional, esthetical and other has to be improved or at least maintained during stabilization. It is important to notice that a different geometry of knitted structure generates different mechanical properties that are strongly related to the fabric structure, yarn properties and fabric direction [4,5].

Compression products are worn repeatedly many times; accordingly, the properties of resilience are equally important as elastic properties. The main goal of this research was to investigate the influence of stress relaxation on the compression alteration over the time.

## 2. RESULTS AND DISCUSSION

In this research, complete knitted compression products (with corresponding additional non-compressive elements) and knitted samples with different inlay yarn insertion density were investigated. Experimental specimens were knitted in combined laid-in pattern with elastomeric inlay-yarns and with rigid elements that are equal in relative area but differ in shape. One-cycle tensile tests up to fixed stress values and short-term (300 s) stress relaxation in the top stretched point were performed using ZWICK/Z005 (adapted clamps, speed – 100 mm/min; pretension – 2N, sensor – 5 kN). Complete equipment for such research and stretching machine was operated by the *testXpert®* software. Number of elementary tests for one experimental point was 10. Compression of the orthopaedic supports tested was calculated by the Laplace formula [4].

In the previous investigations of the authors [2], it was found that compression level of the orthopaedic support gradually decreases over the time of wearing. Compression decrease over 36,000 s was 8.4 mmHg and this coincides with the ranges of one full compression class. Moreover, it was observed that the highest changes in compression level occurs during the first 100-200 s of relaxation. Compression at the initial time of strain compared with compression at the time after 120 sec stress relaxation demonstrated significant difference [2].

Tendency of the short-term stress relaxation process of the specimens with different inlay yarn insertion into the knitted structure density remains similar, regardless of the elastomeric inlay-yarn insertion density, i.e. 88.6 - 91.7 % of the total tensile force (and respectively compression) decrease was observed during the first 100 s. It was found that higher inlay-yarn insertion density determines lower relative compression loss during short-term relaxation (in the investigated case, up to 3.4%). Obtained results are presented in the Figure 1.
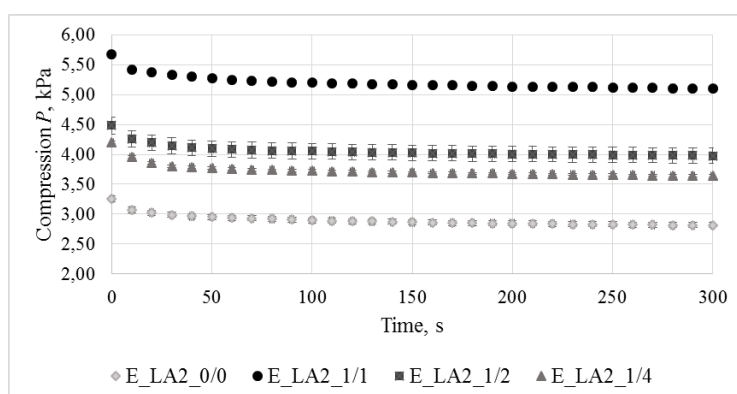


**Figure 1.** Compression alteration during short-term (300 sec) stress relaxation (E_LA2_0/0 – knitted structure without inlay yarn; E_LA2_1/1 – inlay yarn is inserted into each course; E_LA2_1/2 – inlay yarn is inserted in each second course; E_LA2_1/4 - inlay yarn is inserted in each fourth course

Also, the tendency of the stress relaxation process remains similar, regardless of the shape of the rigid element: the alteration of the tensile force between the analysed sample groups after relaxation process was only 1.02 - 1.55 %, depending on the sample group and the moment of relaxation process (Fig. 2). It was observed that even 83.45 - 85.49 % of the total tensile force loss occurs during the first 100 s, depending on the group of samples.
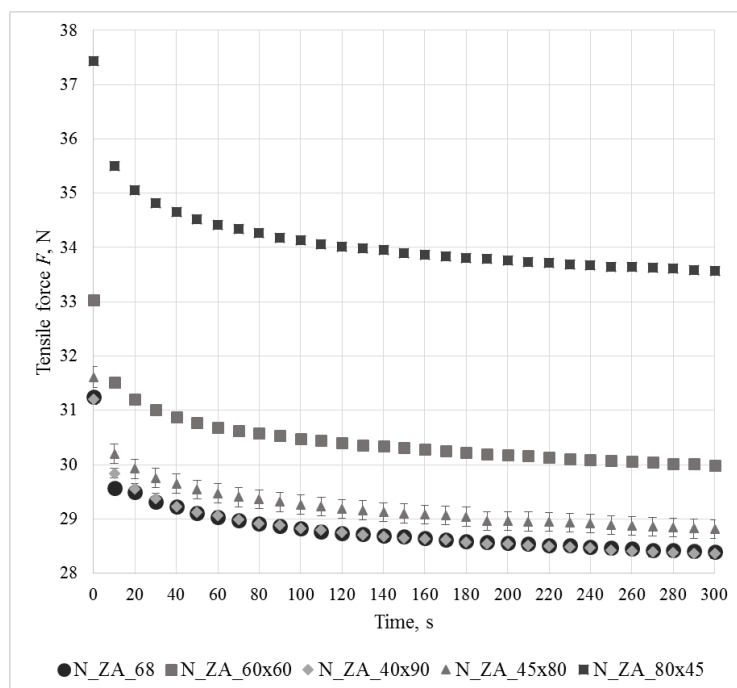
**Figure 2.** Compression alteration during short-term (300 sec) stress relaxation (N_ZA_68 – specimen with circular rigid element; N_ZA_60×60 – specimen with square rigid element; N_ZA_40×90 and N_ZA_45×80 – specimens with horizontally oriented rigid element; N_ZA_80×45 - specimen with vertically oriented rigid element

The proposed methodology of compression estimation, evaluating changes of the tensile force during not less than 120 sec of stress relaxation, is suitable for different structure compression supports, and may be used in the compression product design algorithm, it can be applied to evaluate compression at different stages of the product.

## 3. REFERENCES

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