Journal of Fiber Bioengineering and Informatics 7:4 (2014) 527–533
doi:10.3993/jfbi12201406

Effect of Compression Tights on Performance During Intense Pedalling Exercise ⋆

Xiaoqun Dai [a,*], Juanjuan Cai [a], Guodong Wang [b], A-ming Lu [b]

[a] *College of Textile and Clothing Engineering, Soochow University, Suzhou 215006, China*
[b] *College of Physical Education and Sports Science, Soochow University, Suzhou 215006, China*

Received 23 November 2013; accepted (in revised version) 30 October 2014; available online 17 December 2014

Abstract

The purpose of this study was to investigate the effect of wearing tights on performance while pedalling at high intensity. Eight male undergraduates majored in sports science volunteered to participate in the experiments. Subjects wearing Gradient Compression Tights (GCT) or loose pants as control condition (CONT), pedalled on the power bicycle-ergometer at 180W/60RPM till exhaustion. Surface EMG was recorded at the surface of Rectus Femoris (RF), Vastus Lateralis (VL), Biceps Femoris (BF) belly, Tibialis Anterior (TA) belly and Medial Gastrocnemius (GM) and the heart rate was also monitored. It was confirmed that the GCT exerted gradient pressure distribution on the surface of lower limbs. Such gradient pressure helped to increase the venous return and the heart output, resulted in relatively lower heart rate and longer pedalling duration. The EMG analysis showed significant effect on the average EMG (aEMG) and the Mean Power Frequency (MPF) caused by GCT. Based on a pattern of motor recruitment with the recurrent inhibition, it was speculated that the pressure might enhance the activity of inhibition interneurones, more Motor Units (MU) of low thresholds were inhibited. Due to the less contribution of low-frequency components, the aEMG was lower and the MPF was higher.

Keywords: Compression Garments; Pedalling; Pressure; EMG; Heart Rate

1 Introduction

Compression garments have been used as compression therapy tools in clinical areas [1]. However, a dramatic increase has occurred in the use of compression garments in sports. Graduated elastic compression garments such as tights and stockings are widely used for the improvement of sports performances as well as the prevention of lymphatic and venous disorders. Compression garments have been reported to assist peripheral circulation [2], tissue oxygenation [3], reduce blood lactate accumulation following exercise [4], and improve post-exercise clearance of muscle damage markers

⋆Project supported by the Priority Academic Program Development of Jiangsu Higher Education Institutions.
*Corresponding author.
Email address: daixqsz@suda.edu.cn (Xiaoqun Dai).

such as creatine kinase [5]. In theory, the pressure exerted by compression garments increases the intramuscular pressure, consequently the cross-section of the veins is decreased and the blood flow is accelerated [2, 6]. Therefore, it has been speculated that compression garments can reduce venous stasis at rest and facilitate the venous return to the heart during exercise by increasing the efficacy of the muscle pump [7]. If compression garments improve the peripheral circulation by enhancing muscle pump, muscle fatigue should be reduced by wearing such garments during fatiguing exercise.

Wearing compression stockings during and after an exhaustive running exercise has been shown to lower blood lactate levels [8], but this effect was not evident when wearing compression tights [9]. The authors hypothesised that the pressure exerted by tights was too low compared to compression stockings and was not sufficient to increase venous return. Higher pressure exerted by compression garments could have both positive and negative effects; greater improvement for the peripheral circulation and restriction of the number of venous capillaries within the muscle. In general, the size of the pressure exerted by compression garments on body surface has rarely been investigated and the effect of pressure on muscle activity remains unclear. In this study, the aim was to investigate the pressure exerted on lower limbs by compression tights and its effect on performance during pedalling exercise. The muscle activity was also studied by sEMG analysis and the compression mechanism was also discussed.

2 Methods

2.1 Subject and Materials

Eight healthy male undergraduate students majored in sports science with no history of orthopedic and neuromuscular disorders volunteered to participate in this study. Their mean age, height and weight were 21 ± 1 years, 176 ± 3.5 cm and 69 ± 4.5 kg. Each subject was asked to visit the laboratory to get acquainted with the experimental equipments and be familiar with the strength testing procedures before the experiment. The Graduate Compression Tights (GCT) were made of specially developed nylon fiber, loose pants made of the same fabric were used as the control (CONT) condition.

2.2 Measurements

Surface EMG was recorded with a myoelectric measurement system (Biovision Inc., Germany) at a sampling frequency of 1000 Hz. Surface electrodes were placed on the belly of Rectus Femoris (RF), Vastus Lateralis (VL), Biceps Femoris (BF), Tibialis Anterior (TA) and medial gastrocnemius (GM) along the alignment of muscle fibers, and the reference electrode was placed on the surface of the right side of patella. Before the electrodes were fixed on the surface, all the placement locations had been shaved, abraded with sandpaper and cleaned with ethanol, to avoid impedance mismatch and movement artifact.

Heart rate was recorded by using Polar RS400 (Polar Electro Oy Inc., Finland). Pressure under GCT was measured by using a clothing pressure measurement system (AMI Inc., Japan). The airbag pressure sensors were placed on the surface of RF, BF, TA, GM and Ankle.