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EFFECT OF LOWER BODY COMPRESSION GARMENT IN RUNNING MECHANICS

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The aim of the research was to determine if compression shorts affected running mechanics. Eight active male participated in the study ([mean ± SD] age 25.6 ± 10.3 years; height 177.9 ± 2.9 cm; weight 71.9 ± 7.4 kg). Three conditions were evaluated, compression shorts, standard Lycra shorts and underwear. Movement mechanics was evaluated using 2D videography of a progressive running test with initial velocity of 10km/h and increments of 1km/h every minute. The increase of velocity affect knee and hip maximum and minimum extension angles which is translated to an increase of stride length. Compression reduced hip and knee flexion angle during recovery. Nevertheless, changes in movement mechanics did not interfere with length or frequency of stride indicators of running efficiency.

KEYWORDS: athletic performance, videography 2D, kinematics.

INTRODUCTION: The use of compression garments has become popular in sport and fitness. Apart from being fashionable, there is also the popular belief that they help to increase performance. This is supported by a few studies, Doan et al (2003) observed that the use of compression enhances vertical jump height, Kraemer et al (1996, 1998) found improvements in repetitive jump power and Higgins et al (2009) obtained that high-speed increased in short displacements. In contrast, other researches did not find any improvement in performance (Eckert, 2009; Duffield & Portus, 2007; Duffield et al, 2008).
A few is known whether compression affects movement mechanics. If compression shorts are designed following functional bandage principles, then they should restrict range of movement (ROM) while allowing normal functional movement (Verhagen et al, 2001). Doan et al (2003) found a decreased hip flexion angle during sprinting and a lower squat depth during a vertical jump. These results are supported by Bernhardt and Anderson (2005) who observed decreased active ROM during vertical jump execution.
The purpose of the study was to determine if compression shorts affected the mechanics of running. This investigation was the biomechanical approach of a coordinated multidisciplinary project focused also on the physiological benefits of a compression garment on muscular soreness and pain.

METHODS: Eight active male participated in the study ([mean ± SD] age 25.6 ± 10.3 years; height 177.9 ± 2.9 cm; weight 71.9 ± 7.4 kg). None of the subjects suffered from muscular-skeletal injury at the moment of the test. The study was approved by the Ethical Committee of the Catalan Sports Council. Subjects were fully informed of the purpose and risks of participating in this investigation and signed an informed consent document prior to testing.
In order to compare the mechanics of running when wearing different types of short garments, all subjects performed a running test with a compression shorts, a standard Lycra shorts and underwear as a control. The three conditions were tested on the same day using a balanced, randomised design. The compression shorts (Colibri®, Puntiblond, Spain) are composed by Warp knitted fabric 57% Pa (polyamide) 43% Elastan and are designed following functional brace principles.
The running test in the treadmill started at 10 km/h and the velocity was

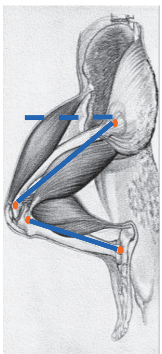


Figure 1: Markers position.

increased 1 km/h every minute until the velocity of 13 km/h. Ten seconds of running at every stage were recorded with a high-speed camera (Basler) at a frequency of 100Hz. Four markers were placed on the left leg as indicated in Figure 1. The angle of the hip with respect the horizontal, the knee angle and the frequency and length of stride were calculated by means of a 2D analysis (Vicon Motus, Peak Performance).
An ANOVA analysis was applied to detect biomechanical changes among the three conditions. A significant level of $\alpha = 0.05$ was required. Statistical analysis was applied on mean minimum and maximum knee and hip angles and stride frequency and stride length within the eight subjects.

RESULTS: It is possible to define a pattern of angular displacement in the hip and knee joints (Figure 2).

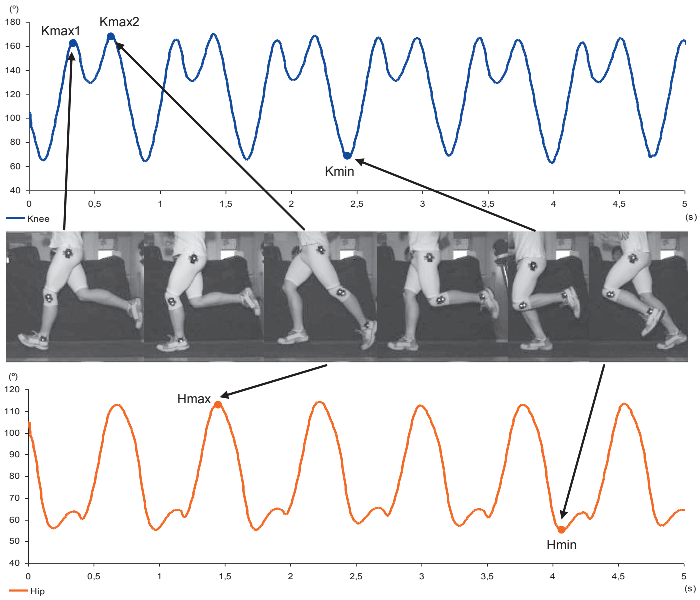
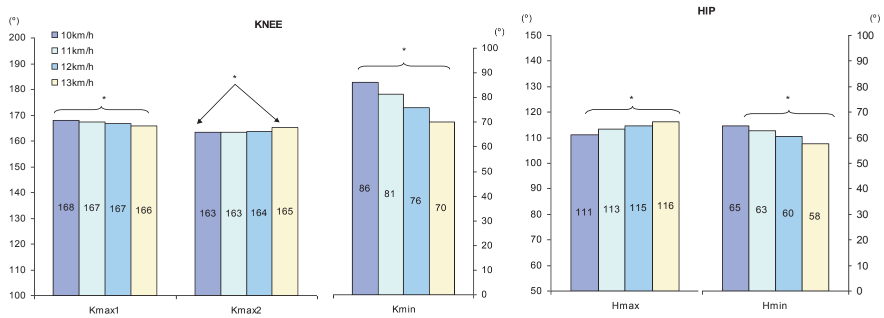


Figure 2: Angular displacement pattern of knee and hip. Maximal knee extension is given during the first contact of the feet on the ground (Kmax1) and during the final impulse (Kmax2) while maximal knee flexion (Kmin) is produced during recovery. Hip maximal flexion (Hmin) is found at the end of the recovery and maximal extension (Hmax) during the final impulse of the leg on the ground.

With respect to the running velocity, maximum and minimum angles of hip and knee were significantly different. At higher velocities, hip (Hmin) and knee extension (Kmin) decreased during the recovery phase and maximal extension (Hmax, Kmax1, Kmax2) increased during the final phase of impulse, which matches with an increment of stride length (Figure 3).
With respect to the garments used, significant differences in Kmax1, Kmin, Hmin angles during the recovery phase were also observed, nevertheless neither frequency nor length of stride were affected by the shorts (Figure 4).

DISCUSSION: In order to determine whether compression shorts affected running mechanics, subjects performed a running test on a treadmill. Results made evident that running mechanics changed depending on the velocity of running. It was observed that when velocity increased, length of stride also increased as a result of a raise in the ROM during running, while stride frequency remained nearly constant. Cavanagh and Kram (1989) observed similar results, with an increase of 28% in stride length and a constant stride frequency as speed increased.



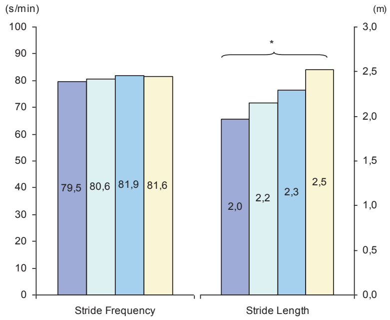
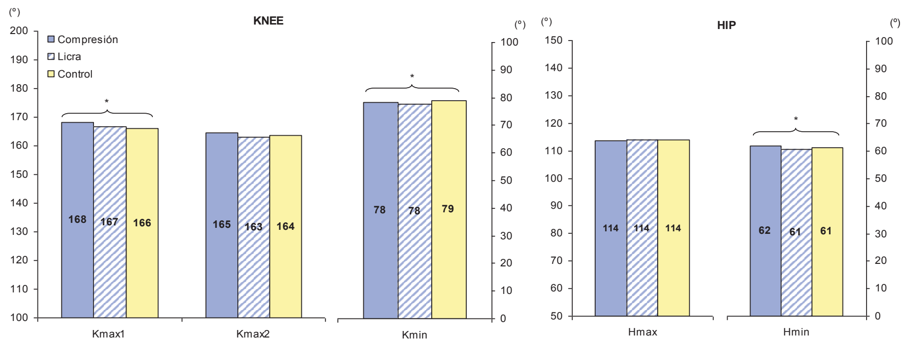


Figure 3: Knee and hip maximum and minimum extension angles and mechanical parameters of the stride with respect to increases of velocity. (*) Indicates significant different $p < 0.05$.



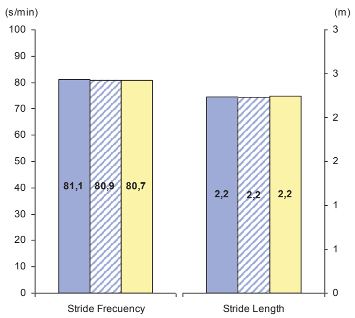


Figure 4: Knee and hip maximum and minimum extension angles and mechanical parameters of the stride with respect garment used. (*) Indicates significant different $p < 0.05$.

When compared the results of running mechanics variables among garments a significant restriction of ROM was found with both compression and Lycra, primarily due to a reduction in maximal hip and knee flexion angle during the recovery phase of the stride. These results are consistent with other researches that found a decreased hip flexion angle during sprinting and a lower squat depth during a vertical jump (Doan et al, 2003; Bernhardt & Anderson, 2005). Doan et al (2003) suggested that reduction of ROM may cause a rise in stride frequency but we have observed that lower ROM did not affect neither frequency nor length of the stride, in other words although hip and knee angles are affected by the use of compression shorts, efficiency of the running is not altered. This reduction of the ROM could explain why Kraemer et al (1998) observed enhanced joint position sense when flexing the hip joint. Therefore, restriction of ROM may have a prophylactic effect over joints being beneficial in preventing injury while allowing functional movements.

CONCLUSION: The use of compression shorts produced a decrease in the ROM of hip and knee joints but did neither affect nor stride frequency nor stride length, indicating that running efficiency is not altered and that functional movements are allowed. Limited ROM may have a prophylactic effect in terms of preventing injuries when suddenly exceed the individual's end ROM.

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