Effects of a Lower-Body Compression Garment on Warm-up Time and Jump Performance

Jaekun Shim, Brandon K. Doan, Robert U. Newton, and Young-Hoo Kwon
Ball State University, Muncie, Indiana, USA

A new compressive garment made of neoprene (75%) and butyl rubber (25%) was used in this study to investigate its effects on the athletic performance. A total of 20 (10 male and 10 female) college varsity track athletes served as subjects. The performances were compare between two conditions: without garment (control condition) and with garment (experimental condition). Two-tailed paired T-test was performed to identify signicant changes in the performance factors due to the use of the compressive garment. Use of the compressive garment caused significant changes in the skin temperature (+1361.97%), muscle oscillation (anteroposterior: -35.30%, longitudinal: -48.71%), and maximum-effort jumping height (+5.21%). It was concluded from these findings that the new compressive garment has a potential to reduce the chance of injury through faster warm up and reduction of muscle oscilation, and to improve the athletic performance by mechanically assisting the athletes.

INTRODUCTION

The use of compression garments is becoming more popular in athletics and fitness activities. Early research on compressive garments focused on increased venous blood flow due to the compression and its positive effects on venous thrombosis in postoperative patients. Compressive stockings and tights caused a reduction of venous stasis in the lower extremities (Ghandhi et al., 1984; O'Donnell et al., 1979; Perlau et al., 1995; Sigel et al., 1975). Berry and McMurray (1987) conducted the first exercise-related research on compressive garments, finding lower blood lactate concentrations following maximal exercise when the stockings were worn during the exercise. A series of investigations of compression and Lycra-type compression shorts have noted athletic performance enhancement due to compression or compressive garments. Specifically, compressive shorts have been shown to enhance repetitive jump power (Kraemer et al., 1996; Kraemer et al., 1997; Kraemer et al., 1998).

Being much more compressive, elastic and impact-absorbing than previously studied compressive garments (spandex or Lycra compression shorts), the new compression shorts (Model 950 GH, Antibody Inc., Abdingdon, MD) used in this investigation has a potential to illicit different benefits to athletic performance. The garment consisted of 75% closed cell neoprene and 25% butyl rubber with the thickness being approximately 0.476 cm. The garment has sticky inner surface designed to maximize compression and elasticity by preventing the garment from sliding on the skin surface. The purpose of this investigation was to determine how these custom-fit compression shorts affect athletic performance.

METHODS

Subjects participated in this study included ten male (age 20.0 ± 0.9 yr; height 179.1 ± 7.2 cm; body weight 74.1 ± 8.3 kg) and ten female (age 19.2 ± 1.3 yr; height 168.9 ± 3.4 cm; body weight 60.2 ± 5.2 kg) college varsity track athletes specializing in sprint or jump ing events. The compressive garment was custom fitted based on the girth and inseam measurements of each subject's waist, hip, thigh, and knee. The garment was a 15 to 20% smaller representation of the subject's lower body, while the material would expand to almost 100% of the original measurements and compress tissues underneath.

Testing utilized the compression shorts as the experimental condition with loose fitting gym shorts being the control garment. Individual performance test means were calculated and compared within subjects for the conditions with and without compressive garment. Subjects performed a standardized warm-up protocol prior to each testing session.

Skin Temperature: Subjects pedaled on a bicycle ergometer for five minutes with 1.5 W/kg of bodyweight resistance. Two type-T copper-constantin thermocouples were secured under the compressive shorts and loose fitting control shorts with breathable tape (Kendall, Polyskin II, Mansfield, MA) 24 cm above the superior aspect of the patella. Temperature measurements were recorded using an Iso-Thermex (Columbus Instruments, Columbus, OH) system. Measurements were taken immediately before the warm-up protocol, once per minute during the warm-up and immediately following warm-up.

Muscle Oscillation: Subjects were videotaped performing counter-movement jumps to compare thigh muscle oscillation between with and without the compressive shorts conditions. One 60Hz video camera (Panasonic WV-D5100HS) positioned to record the sagittal plane view of each jumper. Three reflective markers were placed on the left leg over the greater trochanter, lateral epicondyle of the femur, and anterior-lateral aspect of the thigh which was midway between the anterior superior iliac spine and the superior aspect of the patella. Maximum anterior-posterior and longitudinal displacement of the thigh marker during a single-jump landing was calculated relative to the markers on the greater trochanter and lateral epicondyle of the femur.

Jump-Height: Maximal effort counter-movement jumps with hands on hips (Young, 1995) were performed. Jump heights were measured with a Celesco cable transducer (Celesco, CA) attached to the subject's waist and analyzed with Ballistic Measurement System (Innervations, Muncie, IN).

Means and standard deviations were computed for the conditions with and without the compressive garment shorts. Two-tailed, paired t-test was performed to identify whether the differences were significant. The criterion for statistical significance was set at $p < .05$.

RESULTS

A significant reduction in anterior-posterior musculature oscillation with the garment was noted (overall: 35.30%, women: 32.24%, and men: 38.88%) (Table 1). A significant decrease in longitudinal oscillation was also found (overall: 48.71%, women: 46.55%, and men: 51.51%). Single maximal counter-movement vertical jump height significantly increased from 46.08cm to 48.48cm (5.21%) for the pooled group of subjects. Squat depth in the single maximal counter-movement vertical jumps increased significantly from 27.75cm to 29.96cm (7.49%) for men, and 27.03cm to 28.83m (6.65%) for the pooled subject group. The garment also caused a significant increase in skin temperature (total: 1361.97%, women: 651.26%, and men: 1111.21%) when compared to loose fitting gym shorts during a 5-minute warm-up session.

TABLE 1. Summary of the effects of the compressive garment shorts (mean ± SD)

	Group	Without Garment	With Garment	Difference
Skin temperature change (°C)	Total*	0.07 ± 0.30	1.04 ± 0.49	0.97 ± 0.50
	Women*	0.13 ± 0.31	0.96 ± 0.41	0.83 ± 0.35
	Men*	0.08 ± 0.31	0.96 ± 0.60	0.88 ± 0.63
Muscle oscillation (A-P) (cm)	Total*	1.12 ± 0.44	0.72 ± 0.29	- 0.40 ± 0.32
	Women*	1.07 ± 0.52	0.73 ± 0.33	- 0.34 ± 0.31
	Men*	1.18 ± 0.35	0.72 ± 0.27	- 0.46 ± 0.34
Muscle Oscillation (L) (cm)	Total*	0.66 ± 0.32	0.34 ± 0.13	- 0.32 ± 0.26
	Women*	0.65 ± 0.40	0.35 ± 0.16	- 0.30 ± 0.29
	Men*	0.66 ± 0.20	0.32 ± 0.10	- 0.34 ± 0.24
Maximum jump height in countermovement jump (cm)	Total*	46.08 ± 8.35	48.48 ± 8.47	2.40 ± 3.48
	Women	41.69 ± 4.99	43.14 ± 4.22	1.45 ± 2.48
	Men	51.73 ± 8.65	54.54 ± 7.61	3.71 ± 4.36
Maximum Squat depth in Countermovement jump (cm)	Total*	27.03 ± 7.68	28.83 ± 7.12	1.80 ± 2.87
	Women	26.39 ± 6.93	27.97 ± 6.23	1.62 ± 1.66
	Men*	27.75 ± 9.02	29.96 ± 8.50	1.57 ± 3.63

* A significant ($p < .05$) difference was observed between without- and with-garment conditions

DISCUSSION

From the performance test results of this study we observed a few possible positive enhancements the customized compression garment may contribute to athletic performance. An initial increase in skin temperature may translate into increased athletic performance and reduced chance of injury. Bergh and Ekblom (1979) found that performance in short term, power-related athletic events, such as jumping and sprinting, was decreased at below normal and enhanced at above normal muscle temperature. Maximum dynamic strength increased and the force–velocity curve shifted causing a higher velocity of shortening at a given load as a function of muscle temperature (Bergh & Ekblom, 1979; Sargeant, 1987). Studies have also noted that skin temperature is related to blood flow and muscle temperature (Isaji et al., 1994). Muscle function has been proven to be optimal at 38.5°C (Astrand & Rodahl, 1977). According to the results of this study, the garment will decrease warm-up time to this optimal temperature, thereby enhancing muscle performance. Additionally, studies have shown that increased musculotendinous temperature may reduce injury potential (Agre, 1985; Kujala et al, 1997).

This investigation found significantly reduced longitudinal and anterior muscle oscillation upon landing from a maximal vertical jump. Similar results have been reported for Lycra-type compression shorts and the reduction in oscillation was speculated to be a contributing factor to increases in repetitive jump performance by enhancing technique and reducing fatigue (Kraemer et al., 1998). The proposed ergonomic mechanism is that a reduction in the oscillatory displacement of the muscle may optimize neurotransmission and mechanics at the molecular level (McComas, 1996).

Counter-movement vertical jump height increased with the use of the garment in this study. Previous studies have found single maximal vertical jump power output was not affected by compressive shorts composed of varying percentages of Lycra® content (Kraemer et al, 1996). The compressive shorts used in this study however, consisting of neoprene and butyl rubber, are much thicker and may provide significant elastic force aiding in single maximal jump performance. In fact, according to the counter-movement vertical jump test results from this study, the maximum jump heights of the athletes under the compressive garment condition was significantly higher than the control condition. The elastic energy reserved from downward movement may have increased the propulsive force of jump and result in a higher jump. Because this investigation found a significantly lower squat depth with the garment, the mechanical support of the garment may have allowed a more optimal (lower) squat depth to be performed, resulting in a greater impulse in the concentric phase of the jump. Additionally, previous studies have shown an increased proprioception with compressive garments (Barrack et al., 1983; Kraemer et al., 1998; Perlau et al., 1995), which may improve jump technique**.**

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