THE EFFECTS OF ADIDAS POWERWEB COMPRESSION SHORTS ON MUSCLE OSCILLATION AND DROP JUMP PERFORMANCE.

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Adidas compression garment with PowerWeb technology was used in this study to explore the effects on athletic performance and influence on muscle oscillation during a drop jump task. Six male subjects performed 3 drop jumps under 2 conditions, bare leg (control condition) and PowerWeb compression shorts. Three dimensional kinematic data were collected using Vicon Motus software sampling at 500 Hz and force data with a Kistler force plate using Bioware software sampling at 500 Hz. Two-tailed paired sample t-test's were conducted to discover significant differences in muscle oscillation, maximum peak ground reaction force (GRF), peak vertical loading rate (PVLR) and jump height. Wearing PowerWeb compression shorts showed an improvement in jump height with an increase of 6.9 mm, although subjects experienced an extra 1 BW of force during landing.

KEY WORDS: Compression, drop-jump, muscle, oscillation, shorts.

INTRODUCTION: Compression technology is engineered to create a compression gradient within a body molded garment which involves wrapping muscles in tight-fitting fabric (Duffield and Portus, 2007). Recently this technique has been used to improve performance in sport and exercise and provide athletes with benefits such as increased comfort, improved performance and improved blood lactate removal (Kraemer *et al*., 1998; Doan *et al*., 2003). Research has suggested one of the benefits that a compression garment can have is focusing the direction of the muscle fibres by reducing muscle oscillation, which can hinder the alignment of muscle fibres when moving, reducing the function of the muscle (Kraemer *et al*., 1998). Therefore reducing the oscillation of a muscle could help improve technique and maximize the ability to recruit muscle fibres, which in turn can enhance performance (McComas, 1996).

Adidas PowerWeb compression garments aim to improve upon these suggested benefits by introducing powerbands at the rear of the garment. Thermoplastic Urethane (TPU) was selected for the bands as it was a material which would allow a spring like response but did not affect the comfort, or be detrimental to the performance of the garment. The theory is that as an athlete goes through a range of movement there is storage of energy in the elastic element (TPU), which is then delivered back to the athlete as they propel themselves along, as well as stabilising the muscles to reduce muscle oscillation to a greater degree than normal compression garments.

Studies to date have concentrated solely on the performance benefits, however, muscle mechanics suggests that changing the movement patterns of the muscles by wrapping them in tight fabric may have negative aspects. It is suggested that oscillation is a muscular mechanism to help dampen a force which has been applied to it (Herzog, 2000). Computer modelling has investigated this theory by comparing rigid segments model to segments with added wobbling mass. Both Gruber *et al*. (1998) and Pain and Challis (2006) have found that at the point of impact a wobbling mass independent from the skeleton plays an important role in dispersing energy with peak force significantly greater in the rigid model.

Therefore, the aim of this investigation was to explore the effects of PowerWeb compression shorts on athletic performance and influence on muscle oscillation using a drop jump task.

METHODS: Six males (age 28.67 ± 5.24 years; mass: 84.17 ± 6.88 Kg) volunteered for the study. All were free from injury and able to perform the task efficiently with no health problems. Informed consent was obtained and the subjects were free to withdraw from the study without prejudice at any time. The study had received University ethical clearance.

Subjects performed 3 drop jumps under 2 conditions, bare leg (control condition) and PowerWeb compression shorts. The compression shorts used were Adidas PowerWeb shorts, with the size of the shorts worn by the subjects decided by waist and inseam measurements as advised by Adidas. For the control condition ordinary gym shorts were used with the shorts of the limb being taped above the hip leaving the leg bare for analysis. Three retro reflective spherical markers (19 mm in diameter) were used with spotlights (Hedler). Figure 1 illustrates how the markers were attached to the dominant leg. Marker 2 was placed between the greater trochanter and lateral condyle of the knee. The girth was measured and then marker 1 and 3 were placed 12.5% to the posterior and anterior side of marker 2. This measurement system allowed there to be control over marker placement as anatomical landmarks were unable to be used. The measure of 12.5% also allowed the markers to be visible in both camera views during the performance.

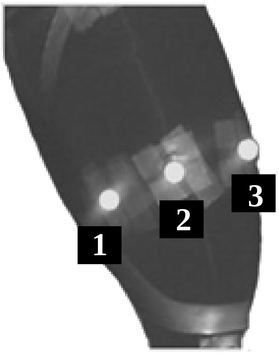

Figure 1: Marker system, 1) 12.5% to the posterior side of the mid-thigh marker, 2) mid-thigh and 3) 12.5% to anterior side of the mid-thigh marker.

All data acquisition was conducted on the same day with several familiarisation trials prior to performance. The drop jumps were performed by stepping off a box (60 cm) onto a 0.6 x 0.4 m piezoelectric force platform (Type 9851, Kistler, Alton, UK). The participants were instructed to keep their hands on their hips as a control construct. The subjects were asked to perform the jump naturally but also to be aware that the knee flexion should be approximately 90° and to keep trunk flexion to a minimum (Kollias *et al*., 2004) As the jumps were maximal each jump was separated by a 3 minute rest period.
The performed task was captured using 2 high speed (500 Hz) video cameras (TroubleShooter HR, Fastec Imaging, San Diego, US), genlocked, positioned 5 metres from the centre of the platform with an inter camera angle of approximately 110°. The cameras shutter speed was 1/5000 and each had a resolution of 640x480 pixels. The performance area was calibrated with a 17 point three dimensional calibration frame (Peak Performance Technologies, Englewood, USA).
Image digitisation and analysis were performed by Vicon Motus 9.2 software (Vicon, Los Angeles, California, USA). All trials were digitised at 500 Hz using a 3 point model. Acceleration data were chosen to analyse muscle oscillation as it provided greater sensitivity with regard to the movement velocity associated with the jump studied during this investigation. The velocity data were used to break the vertical jump into eccentric and concentric phases of the maximal jump. The present study was only interested in the concentric/propulsive phase of the jump as during this phase the muscles were contracting and it was at this point when a reduction in muscle oscillation could influence performance. This phase started when the velocity was at its lowest point, i.e. the bottom of the jump. Force data were collected with Bioware 3.21 software at a sampling rate of 500 Hz. This allowed the maximum peak ground reaction force (GRF), peak vertical loading rate (PVLR) and flight time to be calculated. Flight time was used to calculate the jump height. Once all data had been processed the 3 trials per condition for each subject were averaged. To establish whether there were any significant differences between the 2 conditions two-tailed

paired sampled *t*-tests were used on the means with the statistical significance set at $p \leq 0.05$.

RESULTS AND DISCUSSION: Table 1 shows the results of the acceleration data. There were no significant differences in muscle oscillation accelerations between the conditions (mid thigh: $t_{(5)} = 1.220$, $p > 0.277$; anterior: $t_{(5)} = 0.469$, $p > 0.659$; and posterior: $t_{(5)} = .437$, $p > .680$), which disagrees with the majority of the literature. However, although there was no significant difference at the mid-thigh marker there was a 7.9% decrease in muscle oscillation.

Table 1: Means (±SD) for peak accelerations and percentage difference.

Marker position	Bare Leg Condition	PowerWeb condition	% difference of PowerWeb condition compared to bare leg condition
Mid-thigh ($m.s^{-2}$)	85.8 ± 22.1	79.0 ± 22.6	↓7.9
Anterior ($m.s^{-2}$)	84.2 ± 24.7	82.7 ± 17.3	↓1.8
Posterior ($m.s^{-2}$)	86.6 ± 22.7	84.0 ± 18.4	↓3.0

The performance test of the garment with the PowerWeb condition produced on average a 0.69 cm higher jump compared to the bare leg condition (Table 2) ($t_{(5)} = -2.711$, $p < 0.042$). The difference in height may appear minimal but to increase an athlete's performance by only a slight margin just by wearing a pair of shorts is noteworthy. Such findings are supported in the literature by Doan *et al*. (2003) who found that wearing compression shorts increased jump height by 2.4 cm. This does suggest that by wearing compression garments an athlete's performance maybe improved, however whether this due to muscle oscillation being reduced by allowing the muscle fibres to be optimally positioned or down to other factors such as the psychological influence wearing the shorts can have (Doan *et al*., 2003) remains uncertain.

Table 2: Means (±SD) for Jump Height, Maximum Peak Ground Reaction Force (GRF) and Peak Vertical Loading Rate (PVLR). (Significant differences p<0.05 denoted by *).

Measure	Bare Leg Condition	PowerWeb condition
Jump Height (cm)	29.67 ± 4.95	*30.36 ± 5.08
Maximum Peak GRF (BW)	6.2 ± 2.2	7.2 ± 2.4
PVLR ($BW \cdot s^{-1}$)	123.7 ± 80.8	128.2 ± 75.3

Maximum peak GRF and PVLR were derived from ground reaction force data. A suggested role of the PowerWeb shorts is to support and stabilise the muscle during movement and these force measures were used to indicate whether this caused any negative effect for the athlete. No significant differences were found between the 2 conditions (maximum peak GRF ($t_{(5)} = -0.578$, $p > 0.588$) and PVLR ($t_{(5)} = -0.578$, $p > 0.588$)), although were still of interest. The average maximum force for the bare leg condition was 6.2 BW compared to 7.2 BW in the PowerWeb condition. Also the PVLR shows the subjects on average experienced an extra 4.5 $BW \cdot s^{-1}$ during the PowerWeb condition. If an athlete was wearing the garment during training and for competition this extra force, over time, may lead to injury for sports that experience heavy impacts (Candau *et al.*, 1998). The results follow that of Pain and Challis (2006) who compared a simulated model with a wobbling mass compared to a rigid structure and found that when performing a drop jump the force at the ankle was 7.2 $BW \cdot s^{-1}$ greater with the rigid model than that of the model with wobbling mass.

CONCLUSION: Adidas PowerWeb compression shorts provided a trend for increased jump height performance. Performance improvement could be down to the reduction of muscle oscillation although the present study found this not to be significant. However, further research of a larger population is required. This study has highlighted that there maybe a negative aspect to wearing the compression shorts as it has been suggested that the area covered by the garment may have its ability to disperse energy suppressed, which may be the reason for higher forces and loading rates being experienced while wearing the garment.

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