INFLUENCE OF A FULL BODY COMPRESSION SUIT ON TRUNK CONTROL DURING CUTTING MANEUVERS

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The purpose of this study was to evaluate the influence of a full body compression suit on trunk control and knee joint moments during cutting maneuvers. Female athletes performed unanticipated cuttings with and without the tested apparel, while 3D kinematics and ground reaction forces were measured. Higher trunk lateral flexion was measured while wearing the compression suit ($p < 0.001$), whereas knee joint moments were not significantly different between the two conditions. It seems that participants relied on the compression suit to support their trunk, but as the apparel failed to limit the trunk range of motion, subjects had a higher trunk lateral flexion. However this trunk position was not associated with increased knee joint loading during cutting maneuvers.

KEY WORDS: core stability, lateral trunk lean, knee abduction moment.

INTRODUCTION: During cutting maneuvers, the athlete performs a complex dynamic task to operate a quick change of movement direction while controlling his balance. The control of the trunk during lateral movements is of interest as increased knee joint loading possibly stems from higher lateral trunk motion (Hewett & Myer, 2011).
It has been showed that compressive and elastic garments could reduce the range of motion of the joint (Bernhardt & Anderson, 2005; Doan et al., 2003) and relief the activity of the muscles surrounding the joint supported by the garment (Chaudhari, Jamison, McNally, Pan, & Schmitt, 2014). Therefore, apparels, through their compression and elasticity properties could be used to support body segments and articulations during various tasks.
The purpose of the present study was to evaluate the influence of wearing a full body compression suit on trunk control and knee joint loading during cutting maneuvers.

METHODS: 12 female athletes (body height = 171 ± 4 cm; body mass = 59 ± 4 kg; age = 22 ± 2 years), who were familiar with lateral movements (soccer, basketball and handball) participated in the study after having given their written consent.
The participants performed the tests under two different apparel conditions, either while wearing a customized Full Body Compression Suit with 2x thermoplastic polyurethane layers (FBCS) or with a standard sport short and bras (Control). The FBCS (mean compression level of 5.2 mmHg) was designed in order to provide support for the trunk over the pelvis segment in 3 dimensions and therefore increase core stability. The two conditions were randomly assigned over all participants.
Participants were asked to perform unanticipated cutting maneuvers to 45° to the right with an approach running speed of 4 ± 0.2 $m.s^{-1}$ (Figure 1). The task was performed on a force plate (AMTI, Watertown, USA) while 3D kinematics of the trunk and lower limb segments were recorded (Vicon, Oxford, UK). Kinematic data for the trunk and knee joint moments were analyzed at the time of the peak knee abduction moment (PKAM) during the cutting maneuver. Trunk lateral flexion was defined as a trunk lean to the left while cutting to the right direction.

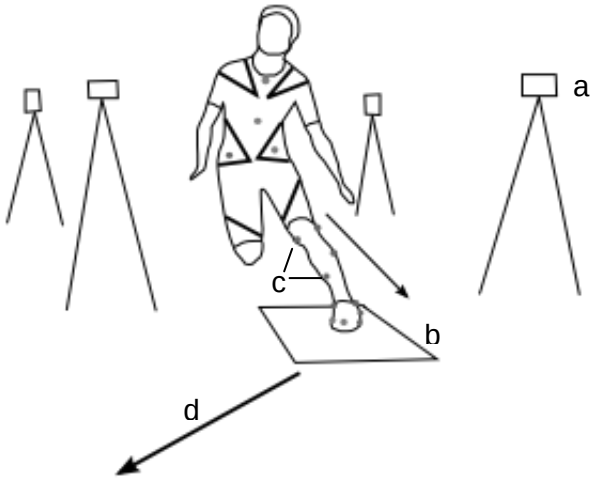

Figure 1: The unanticipated cutting maneuver performed with the FBCS. Timing gates (a), force plate (b), reflective markers used for the kinematical recording (c) and the cutting direction to 45° (d) are represented on the figure.

The selected parameters were averaged across eight trials. The influence of the apparel condition (FBCS vs. Control) on the dependent variables was analyzed using paired two-tailed Student's t-tests. The level of significance was set at 0.05.

RESULTS: At the time of PKAM, trunk flexion and rotation were not influenced by the apparel condition, while trunk lateral flexion was significantly increased by FBCS ($p < 0.001$). Knee joint moments, especially knee abduction moment, were not influenced by the apparel condition (Table 1).

Table 1
Full Body Compression Suit effects on trunk control and knee joint moments

Variable	Control	FBCS	Effect (p)
Trunk flexion (°)	12.6 ± 7.8	13.9 ± 5.6	0.21
Trunk lateral flexion (°)	-5.1 ± 3.7	-8.7 ± 5.0	<0.001
Trunk rotation (°)	-8.5 ± 8.4	-7.8 ± 7.5	0.61
Knee flexion moment ($Nm.kg^{-1}$)	0.16 ± 0.65	0.20 ± 0.75	0.74
Knee abduction moment ($Nm.kg^{-1}$)	1.31 ± 0.46	1.20 ± 0.46	0.30
Knee rotation moment ($Nm.kg^{-1}$)	0.13 ± 0.11	0.16 ± 0.12	0.42

DISCUSSION: Despite a suit design possibly enabling range of motion limitations, a full body compression suit could not reduce trunk positioning at the time of PKAM. On the contrary, trunk lateral flexion was significantly higher when performing the cutting maneuver while wearing FBCS. This was especially true for five out of 12 subjects, whose values reached about 15°. It is possible that these subjects would rely on the support of the suit according to the compression and elasticity properties felt by the participants, and therefore reduced their active trunk muscle control. But the lack of apparel support would bring participants to this trunk position. However, this possibly worse trunk position had no deleterious influence at the knee level, as joint moments remained comparable to the control condition.
Increasing the compression level of the suit to further support body segments, i.e. by reaching typical values of compression socks, does not seem possible without reducing the comfort level. Therefore, providing external passive support of the trunk during lateral movements classically encountered during team sports seems difficult with apparels only. However, this might be combined to an active core stability and strength training.

CONCLUSION: Even if compression and elasticity properties were combined with this customized full body compression suit, trunk kinematics were not influenced. Achieving external support of the trunk by female athletes through apparels seems to be difficult during unanticipated lateral movements. Beside these movement control aspects, perceived benefit and enhanced comfort were often reported by participants in the present study as elsewhere in the literature when wearing compressive garments (Cipriani, Yu, & Lyssanova, 2014). This could be of interest for coaches and athletes wishing to improve performance. Future studies should evaluate physical and physiologic variables to confirm these perceptions.

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