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THE EFFECT OF THE USE OF ANKLE BRACES ON THE GROUND REACTION FORCES IN THE VERTICAL JUMP, DURING EXERCISE AT THE INTENSITY OF BASKETBALL MATCH

[1]Alex Castro, [1]Márcio Fagundes Goethel, [1]Pedro Vieira Sarmet Moreira, [1]Lucas Lorenzato Villaça Oliveira, [1]Antônio Francisco de Almeida Neto, [1]Adalgiso Coscrato Cardozo, [1]Mauro Gonçalves
[1]Laboratório de Biomecânica – São Paulo State University/Rio Claro; e-mail: ax.castro@yahoo.com.br

INTRODUCTION

The ankle injuries are the most incident in basketball and its cause is the landing phase of a vertival jump, which is responsible for about 45% of these occurrences [1].

Presently, one of the main preventive methods to minimize the severity and occurrence of these injuries is the use of ankle braces, which assist in maintaining the ankle neutral position during the landing of a jump, minimizing the exposition of the ligaments to high external loads during the ground contact [2]. However, the effective contributions of the braces on the biomechanical variables which are manifestations of overload on the musculoskeletal system are still controversial. Thus, the effect of the braces on the conservation of the ankle funcionality during the sport practice, its use as an injury prevention strategy in this joint and the decrease of external overloads applied to the locomotor system during actual basketball match situations require further scientifical investigation.

For the above the aim of the present study was to analyze the effects of the ankle braces use on the dynamic variables of the vertical jump performed during a specific basketball match intermittent exercise protocol.

MÉTODO

Eleven highly skilled basketball athletes (age: 17 ± 0,00 years; height: 183,27 ± 8,69 cm; bodyweight: 75,66 ± 9,00 Kg; fat mass percentage: 9,41 ± 4,21 %), without serious ankle injuries in the past six months and without mechanic or functional instability in this joint, participated in this study.

The volunteers performed a specific basketball match intermittent protocol [3], characterized by two distinct situations, with (Braced) and without (Unbraced) the use of lace-up ankle braces (Horse Jump®, Franca, BRA). The tested conditions were randomly performed with a 48-72h interval.

The test was composed by a succession of intense and brief physical efforts on the ground and on a treadmill, equally distributed in four 10 minutes periods each. The objective of this protocol was represent the mechanical and physiological demands imposed to an athlete during a complete basketball match, considering the running intensities, the total distance traveled in these intensities, the time of actions performed with the ball possession in game, the pauses time, the number of jumps and changes of direction, the heart rate and the blood lactate concentration, [3]. Therefore, each volunteer performed, in each condition, 48 rebound jumps (12 on each period) and traveled 6397m, with average values of heart rate and blood lactate concentration of 161,5±9,3 bpm and 4,3±1,8 mmol/L, respectively.

Furthermore, a rectangle was drawn on the ground, on which was performed the sprints, lateral displacements and change of direction. After a sound signal the volunteer started the test running on the side 1 (3m) e 2 (4m) of the rectangle, and laterally displacing, on the diagonal (5m) of the rectangle, the fastest as possible. After returning to the starting position, 3s of rest was considered followed by a sound signal and restart of the course in opposite direction of the one performed before. This procedure was performed consecutively during 40s, followed by 30s pause. Immediately to the end of the pause, started a succession of treadmill running (Inbramed®, Gravataí, BRA) with the goal of simulate the velocity variations, as like the distances covered by the athletes in these velocities during the basketball match [3]. The volunteers were oriented to perform the following sequence of actions: run at 15km/h (medium run) for 20s; rebound vertical jump; 20s pause; run at 11km/h (slow run) for 10s; run at 19km/h (fast run) for 10s; 20s pause; walk at 3,6km/h (walk) for 10s; slow run for 10s; rebound vertical jump; and 20s pause [3].

During the vertical jumps the ground reaction force (GRF) was collected with a force plate (AMTI®, Watertown, USA), operating at 2000 Hz. The jump consisted in a simulation of the rebound, in which the volunteers started on a orthostatic position, with arms along the body, followed by a counter movement and maximum extension of the hip, knees and ankles, with the purpose to touch both hands in a basketball ball suspended at 95% of the maximum range reached by the athlete in a previous test.

The ANOVA *Two-Way* test for repeated measures 2x4 [conditions (Braced and Unbraced) x periods (P1, P2, P3 and P4)] was used to compare the vertical and medium-lateral components of the GRF, between the conditions Braced and Unbraced and between the four periods (P1, P2, P3 and P4) of the test protocol ($p \leq 0,05$).

RESULTS E DISCUSSION

It was observed significant effect to the period and condition on the medium-lateral GRF. However, for the vertical GRF was found effect for the period only ($P < 0,05$) (Table 1).

The use of braces promoted attenuation of the GRF medium-lateral peaks about 12,8%-21,1% and 8,6%-19,8%% to the takeoff and landing phases of the jump, respectively. The attenuation of the medium-lateral peaks of the GRF with the use of braces could be related with the range of motion restrictions on the frontal plane, which confirms its effect in increase the stability and maintenance of the neutral position of the ankle during the ground contact in the landing [2,4]. However, during the takeoff, a lower mobility of inversion and eversion could indicate a lower risk of sprains during this phase of the jump [5].

Additionally, was verified the increase of the medium-lateral and vertical GRF, during both takeoff and landing phases along the test protocol, being more pronounced on the P4 when compared with P1. Therefore, it is verified that the braces presents the higher contribution percentage on the attenuation of the medium-lateral GRF on the fourth period (21,1% to $Fx_{\_MED\_D}$, 19,8% to $Fx_{\_MED\_A}$, 19,9% to $Fx_{\_LAT\_D}$ and 11,4% to $Fx_{\_LAT\_A}$, Table 1) which demonstrates that the its use was more efficient when the locomotor system most needed. The increase of the vertical and medium-lateral components during the takeoff could indicate the effect of the fatigue inherent to the test protocol, and to compensate this mechanism a higher muscle activity could have promoted a higher effort on the ground, as well as the maintenance of the jump height along the test. On the other hand, the increase of the medium-lateral and vertical components during the landing could indicates an increase of the ankle sprain risk and increase of the impact forces, respectively [5,6].

These results suggests that, with the elapse of the basketball match the locomotor system suffers crescent increase of the external loads associated with a muscular fatigue mechanism and the frequency of the athletes exposures to jumps, the training practices and match, could explain the stress injuries which are characteristics of the modality [6,7].

CONCLUSION

The use of braces promotes attenuation of the medium-lateral GRF during the three final periods of the exercise protocol which simulated the basketball match intensity in relation to the unbraced condition, specially on the fourth period. Thus, considering that the medium-lateral GRF is the main responsible by the ankle inversion and eversion movements, we could deduce that the use of the lace-up braces guarantees higher stability in these directions, constituting an important tool to the prevention of ankle sprains in basketball. We could also conclude that the fatigue inherent to the test protocol induced an increase of the vertical and medium-lateral components of the GRF when compared the periods, mostly on the fourth period. It suggests the increase of the overload to the musculoskeletal structures and the increase of the injury risk on the lower limbs, mainly on the final basketball match period.

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Table 1: Mean values (± SD) for the vertical and medial-lateral ground reaction force, normalized by body weight, during the periods of the test protocol.

	UNBRACED				BRACED			
	P1	P2	P3	P4	P1	P2	P3	P4
$H_{\_Jump}$ (m)	0,46 (0,08)	0,46 (0,08)	0,46 (0,08)	0,46 (0,08)	0,46 (0,08)	0,45 (0,08)	0,46 (0,08)	0,46 (0,08)
$Fz_{\_MAX\_D}$	1,95 (0,27)	2,00 (0,25)	2,02 (0,24)[a]	2,08 (0,27)[ab]	1,96 (0,25)	2,02 (0,29)	2,02 (0,27)	2,10 (0,29)[ac]
$Fz_{\_MAX\_A}$	2,68 (0,62)	2,71 (0,61)[a]	2,74 (0,60)[ab]	2,77 (0,60)[abc]	2,70 (0,60)	2,73 (0,60)	2,76 (0,60)[ab]	2,86 (0,65)
$Fx_{\_MED\_D}$	0,031 (0,008)	0,035 (0,009)[ad]	0,039 (0,009)[abd]	0,041 (0,008)[abd]	0,028 (0,007)	0,030 (0,008)	0,032 (0,009)[a]	0,034 (0,007)[ab]
$Fx_{\_MED\_A}$	0,143 (0,061)	0,157 (0,073)[da]	0,169 (0,076)[abd]	0,184 (0,083)[abcd]	0,131 (0,055)	0,139 (0,060)[a]	0,147 (0,061)[ab]	0,153 (0,067)[abc]
$Fx_{\_LAT\_D}$	-0,045 (0,008)	-0,050 (0,007)[da]	-0,054 (0,008)[abd]	-0,060 (0,010)[abcd]	-0,043 (0,007)	-0,044 (0,007)	-0,046 (0,005)[ab]	-0,050 (0,007)[abc]
$Fx_{\_LAT\_A}$	-0,161 (0,039)[d]	-0,173 (0,046)[da]	-0,181 (0,045)[abd]	-0,191 (0,049)[abcd]	-0,148 (0,032)	-0,159 (0,037)[a]	-0,166 (0,043)[ab]	-0,172 (0,049)[abc]

Maximum Vertical Force at takeoff ($Fz_{\_MAX\_D}$) and landing ($Fz_{\_MAX\_A}$); Maximum Medial Force at takeoff ($Fx_{\_MED\_D}$) and landing ($Fx_{\_MED\_A}$); Maximum Lateral Force at takeoff ($Fx_{\_LAT\_D}$) and landing ($Fx_{\_LAT\_D}$); Jump Height ($H_{\_Jump}$).;(Periods 1, 2, 3 and 4 (P1, P2, P3 and P4, respectively). [a] $P < 0.05$ when compared to P1; [b] $P < 0.05$ when compared to P2; [c] $P < 0.05$ when compared to P3; [d] $P < 0.05$ when compared to Braced condition.