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COMPARATIVE BIOMECHANICAL ANALYSIS OF HURDLE TECHNIQUES ON 110m AND 400m IN ELITE ATHLETES

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INTRODUCTION

In athletics, the events with hurdles are a combination of cyclical running and the technical clearance of movements, however one of the most important elements in the determination of the final athletic result [1]. The events that involve the hurdles are inserted in the Events of Sprint Group, being considered as High Sprint Hurdles, the events of 100m for the women and 110m for the men, and low hurdles, being established as speed endurance, the events of 400m are for men and women [2]. In that events, the loss of horizontal velocity should be a minimum is possible, but some factors are limiting for that occur, as the deficiency of flexibility, low power level, physical contact with the hurdle, as large swings of center of mass (CM), in intervals between the hurdles, in transposition over or in landing after hurdle. Therefore, the placement appropriate of these last two points is ideal condition for a quick and short flight.

In studies considered model in the trial of biomechanical measure in hurdles events [3], valuing specific movement at event of 110m, the authors measure the ankle articulation angle in hurdle approach (take off) in two different situations: (Previous Support Phase, and Subsequent Support Phase, moment where it takes to higher of the CM), in not being took into account the intermediary moment between these two stages (Balance Phase). Knowing that it exists specific differences between specialists in the events of 110m and 400m hurdles, the focus of our work was established the ankle and knee articulation angles on the support leg and hip articulation angle of the lead leg, in this phase (balance) where it takes the most depression of CM [4]. Therefore, the study aimed to analysis biomechanics technical differences in athletes sprinters specialists in hurdles events of 110m and 400m during the balance phase. Was valued the angles at the moment from hurdle approach to the Take Off at the sagittal plan of the ankle and knee articulations angles of the leg support, the hip articulation angle in the lead leg, and the Ground Reaction Force (GRF) at the moment from the hurdle approach (take off), and at the landing moment after the hurdle.

METHODS

The sample consisted by one hurdler athlete specialist in 110m race, and one hurdler athlete specialist in 400m hurdles. The Athletes are the national Junior finalists championships (under 20 years), and are among the top tree in their categories.

For this study, the athletes submitted if the execution of technical gesture of transposition on the official Nordic hurdle, with height in a smaller setting customarily used in competitions, 9 cm below the official for the 110m and 7 cm below for the 400m, carrying 10 transpositions each of the athletes evaluated, being 5 transpositions watching propulsion time to hurdle approach, and 5 transpositions watching the landing after the hurdle.

Initially the volunteers participated in a process of adaptation with movements over the hurdles in a different location to your usual, and thus becoming familiar with the size of the laboratory. For each trial the following parameters were analyzed, vertical impulse, vertical peak force and ankle and knee of the supporting leg angles and hip angle to lead leg in the sagittal plane at the time of the hurdle approach. This time was determined as the moment when the CM is aligned with support. To acquire these data were used two force platforms AMTI BP600900-2000 (AMTI, Watertown, USA) connected to amplifiers AMTI MINIAMP MSA-six, and seven cameras VICON MX3 +, (VICON, Oxford, USA) connected to the module VICON MX Ultranet HD who also performed the synchronization with data from force platforms via analog connection with the amps.

The data was filtered in Matlab 2009b (Mathworks, Natick, USA) with a filter-type fourth-order Butterworth with a cutoff frequency of 8 Hz for data and kinematics of 90Hz to ground reaction force. The parameter settings were also calculated using specific software routines.

Table 1: Comparison of kinematic variables analyzed and obtained in both athletes;

Parameters	110Hurdles (Average-SD)	400Hurdles (Average-SD)
GRF -Take Off (N.s)	144.11 - 4.70	143.09 - 3.79
GRF - Landing (N.s)	78.68 - 15.33	82.52 - 18.05
Ankle Angle	84.7 - 3.9	93.2 - 3.9
Knee Angle	32.6 - 5.0	39.0 - 9.2
Hip Angle	60.7 - 5.1	6.8 - 2.9

RESULTS AND DISCUSSION

We present in Table 1 parameters that were analyzed in this study, with respect to quantification overload measured by GRF that could detect no significant difference between the subjects analyzed at the time of approach, but still found that the athlete specialist 400m hurdles incurred in a greater application of force in the landing moment.

In the same table, when we find the joint angles in both athletes we can observe that, to ankle though was no significant difference, the 110m hurdler showed a lower value for this topic, but in knee angle in both subjects, we can observe a relative difference between them, and there was also a greater flexion athlete in the 400m, and the hip angle leg in the attack on the two subjects observed a greater angle at 110m athlete, being that confirming the findings in [2]; when the hurdlers of 110m athletes because of their greater skill and technical clearance promote a faster lead leg, and consequently lower angular levels in ankle joint on the support leg in the approach. The evaluation criterion for a efficient technique hurdle is to use the shortest possible time between approach and landing [5]; this moment is defined as air phase and is the moment of greatest propensity to significant loss of speed, the landing phase is one of the most important moments performed on the hurdle technical, when it is the athlete employs a large power level, which provides an improvement competitive final result [6,7]. Studies occurred in Sports Australian Institute of Biomechanics Department, using force platform in 100m hurdles athletes showed that, the braking phase occurred in the approach before the hurdle and landing after the hurdle does not incur a significant loss of speed, provided that the athlete use a clearance technique. Studies also showed that in 400m hurdles events, the athlete normally have a significant loss of speed, because of the low clearance technical and also of the instability occurred in a long space that the athlete run between one and another hurdle (35 meters, 14-15 steps), thereby generating a greater hurdle proximity on the approach moment [2], however, a greater contact time on the approach moment, as the landing moment, thereby generating a increase application of force

in those two moments, and causing also a increase in the ankle angle of the take off [3,8];

CONCLUSIONS

In our study we found that when analyzing the forces exerted on the platform at the time of approach (take off) in both athletes did not detect significant differences for GFR, but we detected that the specialist in the 400m had greater application of force in the landing, however we can see yet that analyze balance phase in the approach moment was extremely important, once we found a lower ankle joint angle of 110m specialist, and greater knee flexion at 400m athlete. In the evaluation of hip angle of lead leg there is a greater angle at 110m athlete. We believe that both the measurement of GRF as for reviews angular to support phase may suffer some changes when evaluated in real competitive situation, since we observed that the movement of the technician specialist athlete in 400m hurdles is poorer according its lower technical skill in motion.

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