

Evaluation of hurdle crossing with the non-dominant leg for those with no experience of the 400m hurdles

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Summary

This study focused on beginners and analyzed the trail leg of hurdle jumping for the dominant and non-dominant legs. We compared the timing and abduction angle of hip joint movement at two hurdle heights (low and medium). The results showed that the maximum hip abduction angle of the non-dominant leg was smaller than that of the dominant leg only when the hurdles were medium height. We suggest that focusing on hip abduction and body rotation of the back leg when the hurdles are medium height may help beginners learn to jump with their non-dominant leg.

Introduction

In the 400m hurdles, excellent hurdle jumping technique is essential to maintaining speed and minimizing deceleration. A technique unique to this event is taking off with the non-dominant foot.

Few studies have analyzed this running style, most of which have been conducted on top athletes [1]. The importance of this running style has been demonstrated to the best of our knowledge, but no studies have investigated general problems among beginners. In this study, we analyzed the running phase of both legs in novice hurdle running, clarified the movement pattern concerning the “whip motion” reported by Fujii[2], and proposed a method for learning the running phase of the non-dominant leg.

Methods

This study followed the Helsinki Declaration and was approved by the Niigata University Research Ethics Committee (2023-0234). The subjects were 21 male students with no 400m hurdle experience. The dominant foot was defined as the first trail leg used without instruction, determined during warm-up. Hurdle heights were 0.762 m (Low) and 0.914 m (Middle). Using eight optical motion capture systems, 3D position data from 40 reflective markers were analyzed to calculate the timing of hip joint movement and maximum external rotation of the trailing leg.

Results and Discussion

The Wilcoxon signed-rank test was used for comparisons, with Bonferroni correction for multiple tests. No significant differences were found in the timing of hip joint angles contributing to the whiplash action in either condition.

In the middle condition, the maximum external rotation angle of the non-dominant leg was significantly smaller than that of the dominant leg (Figure 1, Table 1). This may be because beginners attempted to jump higher vertically to avoid contact

with the hurdle, relying on sagittal plane movement rather than lowering their center of gravity due to fear of using an unfamiliar leg.

There was no significant difference between the dominant and non-dominant legs when jumping over the hurdle in low conditions (Figure 1, Table 1). Since the body's center of gravity is higher than the hurdle, clearing it without leg abduction is possible. For example, the hurdle in women's 100 m hurdles is lower than the body's center of gravity, so it need not be opened directly next to the takeoff leg [3]. We inferred that the need for abduction decreased, reducing the difference in the low condition.

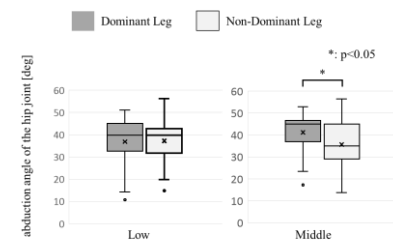


Figure 1: Maximum abduction angle of the two conditions.

Table 1: Average \pm standard deviation and P-value of the maximum abduction angle under the two conditions

Trail leg	dominant	non-dominant	dominant	non-dominant
Avg. \pm SD [deg]	36.83 \pm 11.21	37.25 \pm 10.31	41.20 \pm 9.04	35.67 \pm 11.42
p Value	0.759		0.026*	

Conclusions

Beginners commonly showed a smaller maximum hip abduction angle in the non-dominant leg during the Middle condition than in the dominant leg. Focusing on non-dominant leg abduction at this height may be effective. Future work should evaluate other body parts and conduct kinetic analyses.

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References

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