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Relationship between body centre of gravity velocity and lower limb joint angles in lunge movement of fencing athletes

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INTRODUCTION:
The lunge in fencing is the most fundamental attack movement. Although previous studies investigated the relationship between lower limb joint (hip, knee, and ankle joints) angles and sword velocity during lunging [1], knowledge of body (centre of gravity) velocity, which determines lunge movement quality, is lacking. Therefore, this study aimed to clarify the relationship between the body centre of gravity (peak velocity) and lower limb joint angles in the lunge movement of fencing athletes.
METHODS:
Fourteen right-handed male university student fencing athletes (mean competition history, 9.7±3.1 years) were included. Lunge distance was defined as the horizontal distance from the rear leg toe to the target during the engirdle, with the length set at 1.5× the height of each subject [2]. The subjects performed three lunge trials towards the target, and the trial with the highest peak body centre of gravity velocity was considered representative. A three-dimensional motion analysis system (Miqus M3) was used for the data collection. Eight high-resolution cameras were used to capture images. Three-dimensional coordinate values were measured by the analysis software, and the centre of body gravity and the centres of the hip, knee, and ankle joints were calculated based on the three-dimensional coordinates. The start of the lunge movement was defined as the toe-off of the front leg, after which the front leg swung forward in coordination with the rear leg, and heel contact with the front leg was defined as the end of the movement [3]. To determine the lower limb joint angles influencing the peak lunge velocity, multiple regression analysis was performed with the peak velocity of body centre of gravity in the lunge as the dependent variable and the lower limb joint angles (peak flexion angle, peak extension angle, and total joint range of motion) as predictor variables.
RESULTS:
The peak velocity of the body's centre of gravity in the lunge was 1.88±0.16 m/s. Multiple regression analysis showed that the rear hip total range of motion (β=0.592) was significantly related to the peak velocity of body centre of gravity, with a coefficient of determination adj. R^2=0.297.
CONCLUSION:
The results of this study were similar to those of a previous study [1]; however, the knee joint findings differed. One possible reason for this is that the target distance in the present study was shorter than those in previous studies. The findings suggest that, when the target distance is longer, the knee joint is involved in addition to the hip joint; thus, the joint angle during lunge movement may be significantly influenced by both distance and velocity.

References
[1] Bottoms et al., Acta Bioeng Biomech, 15: 109–113, 2013
[2] Williams et al., Percept Mot Skills, 91: 131–142, 2000
[3] Guan et al., Eur J Sport Sci, 18: 201–208, 2018

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