順天堂大学大学院スポーツ健康科学研究科 和文抄録
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3000m障害競走におけるクリアランス技術の特徴

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【目的】
通常障害における足かけのキネマティクス的特徴を記述するとともに、競技力に関連する技術的要因を明らかにする。

【方法】
対象者は、トップアスリートを含む3000m障害競走に出場したことのある男子競技者7名とした。練習の一環で実施された1000m障害競走のクリアランスおよびその前後を側方からビデオカメラで撮影し、動作分析ソフトによって23点の身体分析点、通常障害への足部の接地点、通常障害の座標を取得した。座標データから、身体重心の各区間での水平速度および鉛直速度と足かけ前後における水平速度の変化量、踏切・着地時の通常障害からの距離、踏切・着地時の角度、クリアランス高、足かけ時の下腿角度および通常障害への接地点－身体重心の水平距離を算出した。これらの変数とシーズンベスト、足かけ時の下腿角度と水平速度の変化量、足かけ時の下腿角度と接地点－身体重心の水平距離について相関分析を行った。なお、有意水準は5%未満とした。

【結果】
シーズンベストは、踏切区間の鉛直速度($r = -0.76, p < 0.05$)、着地区間の水平速度($r = -0.77, p < 0.05$)、水平速度の変化量($r = -0.82, p < 0.05$)、クリアランス高($r = -0.83, p < 0.05$)、着地距離($r = -0.91, p < 0.01$)との間に有意な負の相関関係がみられたが、その他の変数にはみられなかった。また、足かけ時の下腿角度と水平速度の変化量($\rho = -0.82, p < 0.05$)、足かけ時の下腿角度と接地点－身体重心の水平距離($\rho = -0.86, p < 0.05$)に有意な負の相関関係が認められた。

【結論】
競技力の高い選手は踏切区間の鉛直速度や着地区間の水平速度、クリアランス高、着地距離が大きかった。さらに、足かけ前後の水平速度の変化量は小さく、このような選手は足かけ時の下腿が前傾していた。

Juntendo University, Graduate School of Health and Sports Science 英文抄録（Abstract）
2025 Master's Thesis

Characteristics of Hurdling Technique in the 3000m Steeplechase

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[Purpose]
This study aimed to identify technical factors related to athletic performance during foot contact hurdling of a 3000m steeplechase.

[Methods]
The study included 7 males who were 3000m steeplechasers including 1 top-level athlete. During a regular training session, the motions involved in hurdle clearance and the phases immediately before and after clearance in a 1000m steeplechase training were recorded from the side using a video camera.
Coordinates of 23 body landmarks were extracted using motion analysis software. The velocity of the center of mass (COM) and changes in each phase were calculated using these coordinates. The following distances were calculated: distance from takeoff to the hurdle, distance from the hurdle to landing, height and length of hurdle clearance, angle between the resultant velocity vector at takeoff and landing on the horizontal plane, angle of the lower leg at foot contact with the hurdle, and horizontal distance between foot contact point and the COM.
Pearson's product–moment correlation coefficients were used to examine associations between season-best time and the kinematic variables, whereas Spearman's rank correlation coefficients were used for analyses of the non-normally distributed variables for lower leg angle. Statistical significance was set at $p < 0.05$.

[Results]
Season-best time showed significant negative correlations with vertical velocity in the takeoff phase ($r = -0.76$, $p < 0.05$), horizontal velocity in the landing phase ($r = -0.77$, $p < 0.05$), changes in horizontal velocity before and after foot contact with the hurdle ($r = -0.82$, $p < 0.05$), clearance height ($r = -0.83$, $p < 0.05$), and landing distance ($r = -0.91$, $p < 0.01$).
In addition, significant negative correlations were found between the lower leg angle at foot contact and changes in horizontal velocity before and after foot contact ($\rho = -0.82$, $p < 0.05$), and the lower leg angle at foot contact and the horizontal distance between the foot contact point and body COM ($\rho = -0.86$, $p < 0.05$).

[Conclusion]
Athletes with higher competitive performance demonstrated greater vertical velocity during takeoff, greater horizontal velocity during landing, higher clearance height, and longer landing distance during hurdle clearance with foot contact. Furthermore, smaller reductions in the horizontal velocity before and after foot contact were associated with a forward-inclined lower leg orientation at hurdle contact. These findings suggested that lower leg orientation plays an important role in minimizing deceleration and maintaining horizontal velocity in the 3000m steeplechase.