順天堂大学大学院スポーツ健康科学研究科 和文抄録
2025年度修士論文

衝撃緩衝材の相違が連続跳躍運動時の筋腱動態と鉛直スティフネスに与える影響―床材およびシューズの影響―

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【目的】
本研究では、ホッピング運動における床材およびシューズの素材条件の相違が、筋腱複合体の動態および鉛直スティフネスに与える影響を解明する。

【方法】
本学に所属する男子大学生7名を対象とし、3種類の床材、2種類のシューズ、2種類の動作テンポ（90・180 BPM）の計12条件で10回連続ホッピングを行った。地面反力、身体重心変位、関節角度、筋活動(腓腹筋内側頭:MG、腓腹筋外側頭:LG、ヒラメ筋:SOL、前脛骨筋:TA)、超音波画像を取得した。算出項目はVertical Stiffness、筋腱複合体変化量（ΔMTU）、直列弾性要素長変化量（ΔSEC）、接地中平均筋活動、プレアクティベーションとした。

【結果】
床材条件では、時空間変数、Vertical Stiffness、筋活動、筋腱動態のいずれにも有意差は認められなかった。シューズ条件では、ΔMTU・ΔSEC に有意差はみられなかったが、腓腹筋内側頭および外側頭の接地中筋活動は薄底シューズで高値を示した。動作テンポ条件では、Vertical Stiffnessは180 BPMで高値を示し、LG・MG・SOL の接地中筋活動は90 BPMで高値を示した。SOL のプレアクティベーションは180 BPMで高値を示し、ΔMTUおよびΔSECは90 BPMで高値を示した。

【結論】
ホッピング動作における変化は，素材特性による筋腱複合体の動態の差として現れるのではなく，主に筋活動パターンおよび動作テンポに応じた調整としていることが示された。

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

Effects of differences in shock-absorbing materials on muscle–tendon dynamics and vertical stiffness during repetitive hopping: influence of surface and shoes

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[Purpose]
This study aims to elucidate the effects of differences in flooring and shoe materials on muscle–tendon unit (MTU) dynamics and vertical stiffness during continuous hopping.

[Methods]
Seven male graduate students performed 10 consecutive hops under 12 conditions, comprising three flooring materials (Nomat, Connectmat, and Taraflex), two shoe types (thin-soled and thick-soled), and two movement tempos (90 and 180 BPM). The fourth to eighth hops were selected for analysis. The ground reaction force, center-of-mass displacement, joint kinematics, and muscle activity of the plantar flexor muscles, as well as ultrasound images of the medial gastrocnemius, were recorded. The outcome variables included jump height, ground contact time, vertical stiffness, changes in MTU length (ΔMTU), changes in the series elastic component length (ΔSEC), mean muscle activity during ground contact, and pre-activation. Statistical analyses were conducted using the Friedman test for the flooring conditions and the Wilcoxon signed-rank test for the shoe and tempo conditions, with the significance level set at 5%

[Results]
No significant differences were observed among the flooring conditions for spatiotemporal variables, vertical stiffness, muscle activity, and MTU dynamics. Between the shoe conditions, ΔMTU and ΔSEC did not differ significantly; however, the muscle activity of the medial and lateral gastrocnemius muscles during ground contact was higher in the thin-soled shoe condition. Regarding the tempo conditions, ground contact time and jump height were lower at 180 BPM, whereas vertical stiffness was higher. The contact-phase activities of the medial gastrocnemius, lateral gastrocnemius, and soleus were greater at 90 BPM, whereas soleus pre-activation was higher at 180 BPM. Both ΔMTU and ΔSEC were significantly greater at 90 BPM.

[Conclusion]
Differences in flooring and shoe materials exerted limited effects on vertical stiffness and MTU length changes, whereas shoe type affected gastrocnemius muscle activity during ground contact. By contrast, movement tempo significantly affected the spatiotemporal parameters, muscle activity, and MTU dynamics during continuous hopping.