

## 陸上競技短距離選手の競技パフォーマンスレベルが 高運動周波数でのカーフレイズにおける 腓腹筋内側頭筋腱複合体の動態に及ぼす影響

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### 【目的】

カーフレイズの運動周波数の増加に伴って起こる腓腹筋内側頭MTUの動態変化が、短距離走パフォーマンスレベルによってどのように異なるのかを比較すること。

### 【方法】

本研究の参加者は男子大学生短距離選手24名であった。参加者は各自のシーズンベスト記録に基づきWorld Athletics scoreにより、参加者のうち上位50%のスコアを持つHigh群と下位50%のスコアを持つLow群に分けられた。参加者は2.67 Hz、3.00 Hz、3.33 Hz、3.67 Hzの4つの運動周波数において片脚立位のカーフレイズを10秒間実施した。その際の腓腹筋内側頭の動態を超音波診断装置によって記録し、筋束及び腱組織の振幅を群間で比較した。また、各試技におけるMTUの正の力学的仕事に占める腓腹筋内側頭の正の力学的仕事の割合を算出し、運動周波数に応じてどのような変化をするか群間で比較した。さらに、各試技の底屈局面と背屈局面における腓腹筋内側頭の筋電図平均値を算出し、その割合が運動周波数に応じてどのような変化をするか群間で比較した。

### 【結果】

腓腹筋内側頭のMTU、筋束、腱組織のいずれもHigh群とLow群に有意な差は認められなかったが、3.00 Hzにおいて筋束の平均短縮速度にパフォーマンスレベル条件間の有意差が認められた。また、MTUに対する筋束の正の力学的仕事の割合は運動周波数及びパフォーマンスレベルによる相違はみられなかった。腓腹筋内側頭の平均筋活動はパフォーマンスレベル条件間で有意な差はなかった。

### 【結論】

高い運動周波数のカーフレイズにおいて、短距離走パフォーマンスの差は、筋腱複合体の各組織における振幅や力学的仕事、平均筋活動ではなく、筋束の収縮様式が変化する周波数の違いとして現れることが明らかとなった。

**Effect of sprint performance level on  
the behavior of the gastrocnemius medialis muscle-tendon unit  
during high-frequency calf-raise exercise**

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[Purpose]

The purpose of this study was to compare how changes in the gastrocnemius medialis muscle-tendon unit behavior differ with increasing calf-raise frequency according to sprint performance level.

[Methods]

Twenty-four male sprinters participated in this study. The participants were divided into two groups based on their best seasonal times using the World Athletics score, with the top 50% assigned to the high-performance group and the bottom 50% assigned to the low-performance group. The participants performed single-leg calf-raise exercises at four frequencies (2.67, 3.00, 3.33, and 3.67 Hz) for 10 s. During each exercise, the behavior of the gastrocnemius medialis was recorded using an ultrasound apparatus. The fascicle and tendinous tissue amplitudes were compared between the high- and low-performance groups. The proportion of positive mechanical work of the fascicle with respect to that of the muscle-tendon unit was calculated for each trial and compared between the performance groups to examine how they responded to changes in movement frequency. Furthermore, the mean value of electromyographic amplitude of the gastrocnemius medialis was calculated during the plantar-flexion and dorsiflexion phases for each cycle, and these values were compared between groups to evaluate frequency-dependent changes.

[Results]

No significant differences were observed in the amplitudes of the muscle-tendon unit, fascicle, or tendinous tissue of the gastrocnemius medialis between the high- and low-performance groups. However, at 3.00 Hz, the mean fascicle shortening velocity differed significantly between the performance-level groups. The proportion of positive mechanical work performed by the fascicle relative to that of the muscle-tendon unit did not differ between movement frequencies or performance levels. Additionally, no significant differences in the electromyographic activity of the gastrocnemius medialis were observed between the performance-level groups across all movement frequencies.

[Conclusion]

During high-frequency calf-raise exercises, differences in sprint performance were not associated with the amplitudes or mechanical work of the muscle-tendon unit and its constituent tissues, or with mean electromyographic activity, but rather with the frequency at which the fascicle contraction mode changed.