

Musculotendinous adaptations induced by training and competitions in high and low performance triathletes

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ABSTRACT

The study investigated musculotendinous adaptations in high- and low-performance triathletes compared to a control group, using ultrasound to analyze the calcaneal tendon and triceps sural muscles. Only the pennation angle of the medial gastrocnemius muscle showed statistically significant differences between the groups ($p = 0.002$), with higher values in the control group compared to the triathletes. The angle of pennation directly influences the capacity to generate muscle strength and endurance, and stands out for the greater cross-sectional area in efficiently packed muscle fibers. This study suggests that these adaptations may influence performance and predisposition to injury in triathletes.

Keywords: Triathlon, Calcaneal tendon, Triceps sural, Ultrasound.

INTRODUCTION

Triathlon grows globally, but it brings with it an increase in injuries, especially in running, such as calcaneal tendinopathy. Studies on muscle architecture and tendinopathy in triathletes are limited, but essential to understand adaptations and injury prevention. Ultrasonography is crucial, offering quality, portability, and real-time data. The aim of the present study is to identify musculotendinous adaptations in the calcaneus tendon and triceps suralis of high- and low-performance triathletes, compared to a control group.

MATERIALS AND METHODS

Cross-sectional study approved by the Research Ethics Committee of the Faculty of Ceilândia (CAEE - 70162723.0.0000.8093). The sample consisted of 32 participants, 21 male triathletes (11 high-performance and 10 low-performance), and 11 physically active individuals who formed the control

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group. The thickness, pennation angle, and fascicular length of the soleus, medial gastrocnemius, and lateral gastrocnemius muscles, tendon length, and cross-sectional area of the Achillaeus tendon were evaluated with the aid of a portable ultrasound. SPSS version 26.0 was used in the analyses. A significance level of $p < 0.05$ was adopted.

FINDINGS

Statistically significant differences were found only for the pennation angle of the medial gastrocnemius muscle ($p = 0.002$). It was observed that the participants in the control group had higher values when compared to the triathletes of high ($p=0.002$) and low performance ($p=0.011$).

The angle of pennation directly influences muscle strength and endurance in runners. Larger pennation angles increase the force generation capacity due to the larger cross-sectional area provided by the efficient packing of muscle fibers. On the other hand, smaller angles favor muscular endurance, as they are associated with longer fibers, reducing fatigue in prolonged activities.

FINAL CONSIDERATIONS

It is concluded that high and low performance triathletes have lower values of the pennation angle of the medial gastrocnemius muscle. The findings suggest that the pennation angle of the medial gastrocnemius may play an important role in determining athletic performance and specific muscle adaptations to triathlon training. However, further research is needed to confirm and better understand these associations and their impacts on sports performance and injury prevention in triathletes.