

The Role of Heel Pain in Achilles Tendon Structure and Calf Strength During Adolescent Development

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Summary

Adolescents heel pain is a prevalent injury that impairs physical function during crucial years of development. Yet, the mechanism of injury is unknown. Findings from this study indicate that while heel pain relates to greater Achilles tendon size during adolescent growth and worse calf muscle endurance, isometric calf strength gains do not differ from healthy adolescents.

Introduction

Adolescent heel pain is a debilitating injury that can reduce quality of life and impede the development of a physically active lifestyle into adulthood [1]. Physically active adolescents may be susceptible to developing heel pain and suffering Achilles tendon injury due to an overdevelopment of calf strength that may alter Achilles tendon structure and reduce calf muscle-tendon unit function. However, no study has investigated adaptations to Achilles tendon structure and calf strength during adolescent growth. The purpose of this study was to identify Achilles tendon structure and calf strength alterations during 4 months of growth in adolescents with and without heel pain.

Methods

Thirty physically active adolescents (12 F, 10-17 years, 22 healthy, 8 with clinically confirmed heel pain) were included in this longitudinal study. To assess structure, Achilles tendon cross-sectional area (CSA) and thickness were measured using validated B-mode ultrasound protocol [2]. To assess calf strength, peak isometric plantarflexor torque was measured at 0° plantarflexion on a HUMAC Norm isokinetic dynamometer (CSMi, Stoughton, MA) and normalized (Nm/kg/m) from the maximum of five 5-sec trials. Additionally, total work (bodyweight in Newtons x heel displacement) was measured from a single-leg heel-rise endurance test [3]. Linear Mixed Models were used to evaluate Achilles tendon structure and calf muscle strength measures in the involved limb (most symptomatic by self-report) between groups (healthy, heel pain) over time (baseline, 2-month, 4-month). Alpha was set at 0.05.

Results and Discussion

Change in Achilles tendon structure during adolescent growth was significantly affected by heel pain symptoms (Figure 1). Adolescents with heel pain had thicker tendons than healthy adolescents at baseline and 4 months (+0.10cm, $p<0.04$). Additionally, adolescents with heel pain increased tendon

thickness from 2 months to 4 months (+0.05cm, $p=0.010$) and baseline to 4 months (+0.03cm, $p=0.010$), with no significant change over time in healthy adolescents. Adolescents with heel pain also had larger tendon CSAs compared to healthy adolescents regardless of timepoint (+0.10cm², $p=0.022$). Calf strength changes during adolescent growth were not affected by heel pain symptoms (Figure 1). Adolescents with heel pain performed less heel-rise work than healthy adolescents regardless of timepoint (-363.95J, $p=0.014$) and all adolescents increased peak plantarflexor torque over 4 months regardless of group (+0.14BW, $p=0.007$). Thus, an overdevelopment of calf strength does not coincide with alterations to Achilles tendon structure in adolescents with heel pain. In adolescents with heel pain, increased tendon size may compensate for calf muscles that fatigue quicker during demanding tasks (i.e., a heel-rise endurance test).

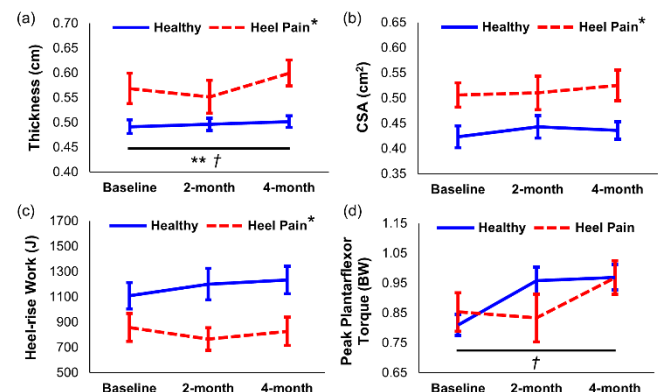


Figure 1: Achilles tendon structure (a-b) and calf strength (c-d) for each group over time. **significant interaction ($p<0.05$), *significant group effect ($p<0.05$), †significant time effect ($p<0.05$).

Conclusions

Adolescents with heel pain had greater Achilles tendon size and worse calf muscle endurance, with no difference in isometric calf strength compared to their healthy peers. Future longitudinal research with a larger sample size is warranted to explore calf muscle and tendon structure-function relationships in adolescents with heel pain.

References

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