Impact of previous hamstring injury on lower-limb kinematics during sprint acceleration in rugby players

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Summary

Hamstring strain injuries are prevalent in rugby and have a high recurrence rate. This study compared lower-limb kinematics in previously injured and healthy rugby players during sprint acceleration using a markerless motion capture system. A previous hamstring injury significantly reduced knee flexion range of motion ($p < 0.01$).

Introduction

Hamstring strain injuries account for 15% of injuries in professional rugby players and have a high recurrence rate [1,2]. This type of injury occurs mainly during high-speed movements (e.g. sprinting) and in almost half of cases during an acceleration phase [3].

The aim of this study is to analyze and compare lower-limb kinematics and muscle activations patterns of a subject with a history of hamstring injuries to a healthy player, during sprint acceleration in sub-elite rugby players, close to ecological conditions. The hypothesis is that a previous hamstring injury alters the kinematics of the lower limbs during sprinting.

Methods

A markerless system with 12 video cameras (Qualisys Miqus, 180 Hz) and Theia3D software (Theia Markerless Inc., Kingston, 2024.1.19) was used.

Two male players at the academy of a professional rugby club were included in this study. The mean age, height, and weight (± standard deviation) of the volunteers were 18 years old, 183,7 (± 0,7) cm and 94,5 (± 2,1) kg. The player with the previously injured had two hamstring strain injuries at the same leg at 11 and 20 months prior to the test.

After a warm-up of 15 minutes including (cycloergometer, athletic drills and two sprints at 60% of the maximal speed), the subject were asked to performed 5 sprints at maximum speed with 10 m run-up and 10 m acquisition (still in an acceleration phase) and 3 min recovery between each sprint. The acquisitions were conducted on a synthetic pitch similar to the one used for training and matches, with full training outfits to be as representative as possible of the real conditions of when the injury usually occurs.

Kinematic data were divided into running cycles. Horizontal velocities in the ground plane were averaged over each cycle to ensure that subjects were always in an acceleration phase. Kinematics data were compared with non-parametric Wilcoxon test.

Results and Discussion

In the recently injured player, a significant reduction in knee flexion/extension range of motion (ROM) is observed between the previously injured leg and the uninjured leg ($p < 0.01$). The maximum flexion is also significantly decreased ($p < 0.01$). In the player without prior injury, the maximum and minimum flexion values do not differ significantly between the two legs. However, the knee flexion ROM is significantly altered between the two legs ($p < 0.05$) (Figure 1). No significant difference were observed for the hip flexion angles.

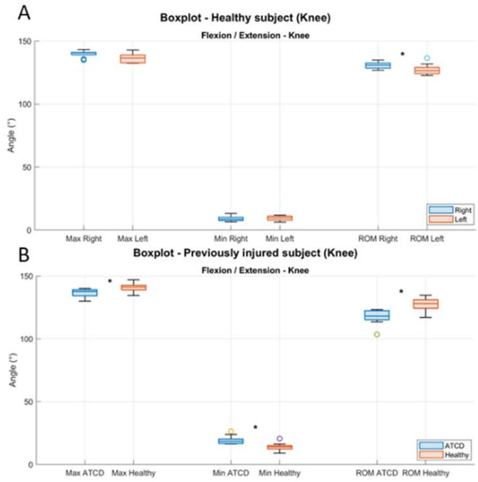

Figure 1: Boxplot of the maximal, minimal and range of motion of the flexion angle (*: significant difference) A: healthy subject ; B : previously injured player.

The differences observed for the healthy subject are of the order of magnitude of the precision corridors of Theia3D compared with a marker-based system, while those for the subject with a history are greater [4].

Conclusions

The initial results indicate trends regarding the impact of a previous hamstring strain injury on knee kinematics in rugby players. Further investigation is needed to determine whether these findings hold on a larger population and whether EMG sensor data can reveal differences in activation patterns between previously injured and uninjured legs. These modifications could help explain the high risk of reinjury if they are detectable.

References

[1] Brooks JHM et al. (2006). *Am J Sports Med*, **34(8):**1297-1306.
[2] Kenneally-Dabrowski, C. et al. (2019) *Phys. Ther. Sport*; **38**: 192-198
[3] Kerin F. et al. (2022) *BJSM,* **56(11):** 608-615.
[4] Kanko R. et al. (2021) *J. Biomech.,* **127**.