Neuromuscular characteristics of previously injured and non-injured biceps femoris in competitive athletes: research proposal

Eszter Pocsai[1], Martino Franchi[2], Alberto Botter[3], Taian M. Vieira[3], Annamária Péter[1], András Hegyi[1]
[1]Department of Kinesiology, Hungarian University of Sports Science, Budapest, Hungary
[2]Department of Biomedical Sciences, University of Padova, Padova, Italy
[3]Laboratory for Engineering of the Neuromuscular System (LISiN), Department of Electronics and Telecommunications, Politecnico di Torino, Turin, Italy
Email: pocsai.eszter@tf.hu

Summary

Strain injuries are frequently observed in the biceps femoris long head (BFlh), particularly in sprint based athletic activities.[1] Most studies focus only on the mechanical aspects of injury mechanisms, yet injury rates keep increasing. The neuromuscular aspects of hamstring injuries (HSI) are unclear, especially at the level of motor units (MUs). This ongoing study aims to compare the MU characteristics of recently injured and non-injured BFlh in high-level athletes.

Introduction

Forty (injured = 20 ; non-injured = 20) high-level sprint and jump track and field athletes, aged 18-35 (female and male) will be recruited. Inclusion/exclusion criteria for the non-injured group: healthy, injury free at the time of testing, already considered fully recovered and returned to sport recent (<12 months). Participants in the healthy group must have no prior history of hamstring injuries and no hamstring-related complaints.

The objective of this study is to investigate the MU characteristics of the BFlh based on high-density surface electromyography (HD-sEMG) signal decomposition in recently injured track and field athletes in comparison to healthy, non-injured athletes during submaximal contractions and an isometric fatigue protocol on a dynamometer to find a correlation between the assessed neuromuscular characteristics of the BFlh and the history of HSI. The study also seeks to determine whether muscle length has an effect on MU characteristics, providing further insight into the neuromuscular mechanisms underlying HSI.

Methods

Meacs HDsEMG system (ReC Laboratories, Torino, Italy) will be used to record BFlh MU activity. Three EMG grids with a total of 96 EMG channels will be applied over the target muscle, covering most of the skin surface of the BFlh and 24 additional channels on the adjacent muscles (semitendinosus, semimembranosus) to minimize crosstalk.

Two-dimensional resting ultrasound scans will also be performed on BFlh and ST, SM in order to assess information on muscle architecture. Measurements will begin with a standardized warm-up, followed by maximal voluntary isometric knee flexion contractions (MVC) in a prone position on an isokinetic dynamometer at short and long BFlh lengths (short: hip = 0°, knee = 40°; long: hip = 40°, knee = 20°). Submaximal isometric contractions at 20% and 60% of MVC will then be performed at the same muscle lengths with visual force-time feedback. The protocol ends with an isometric fatigue protocol, where participants are requested to maintain 60% of MVC at long muscle length until exhaustion.

The recorded HDsEMG signals will be decomposed to the level of the identified motor units, using DEMUSE software, followed by the analysis of the variables of interest.

Expected results

We expect that the previously injured group will exhibit lower BFlh MU discharge rates and greater coefficient of variation (CoV) for interspike interval (ISI) compared to the healthy group. Additionally, we expect that different muscle lengths will influence MU characteristics, including recruitment threshold discharge rate, and spatial activation patterns. Furthermore, we anticipate that isometric fatigue will induce neuromuscular changes and that individuals with a history of HIS may exhibit altered neural drive responses compared to the healthy controls.

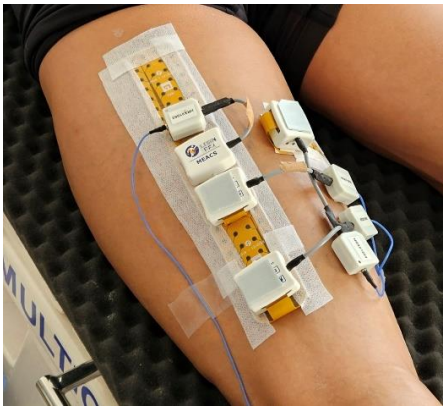

Figure 1: Meacs HDsEMG system applied over BFlh, ST and SM

Conclusions

The findings of this study will reveal whether there is a link between the neuromuscular properties of the biceps femoris long head muscle and a history of hamstring injuries. This will serve as a foundation for subsequent longitudinal follow-up studies and interventions and may facilitate a deeper comprehension of the underlying mechanisms of hamstring injuries, may serve as a screening tool, and may contribute to a reduction in injury rates in the long term.

References

[1] Maniar et al, BJSM, 2023