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## HAMSTRINGS AND QUADRICEPS PRELANDING ELECTROMYOGRAPHY WHEN LANDING FROM DIFFERENT HEIGHTS

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### SUMMARY

ACL injury has been a major concern among athletes, coaches and sports scientists. More than taking the athlete away from training and competition, ACL tear is a risk factor for early-onset of knee osteoarthritis. Here we investigated the prelanding electromyographic activity of the hamstrings and quadriceps muscles in recreational athletes performing jump-landing tasks from different heights.

### INTRODUCTION

Anterior cruciate ligament (ACL) tear is a serious sports injury commonly occurring among athletes involved in sports that include jump-landing tasks. ACL injury is more common among female athletes. One of the theories suggested to explain this sex disparity is that females athletes preferentially activate their quadriceps compared to the hamstrings. The ACL prevents anterior translation of the tibia; thus, who excessive quadriceps forces would increase the strain within the ACL. Recent research has shown that athletes who exhibit greater quadriceps and lower hamstrings electromyographic (EMG) activity in the preparatory phase of athletic activities are more likely to suffer an ACL tear [3]. The aim of this study was to investigate the prelanding electromyography of the hamstrings and quadriceps of recreational athletes performing jump-landing tasks from different heights.

### METHODS

Fifteen male and 15 female recreational athletes consented to participate in the study [age: 28.9(4) vs. 28.4(6) years, height: 182(7) vs. 167(6) cm, body mass: 81(11) vs. 59(6) kg].

EMG measurements were in reference to the right lower extremity. EMG data were collected with the Noraxon Myosystem 1400 (Noraxon USA, Inc., Scottsdale, AZ). The electrodes were disposable, surface, passive electrodes (Blue Sensor, Ambu, Inc., Linthicum, MD). EMG data were filtered through a low pass 2<sup>nd</sup> order Butterworth filter with a 6Hz cut-off frequency. The skin was prepared and the surface electrodes were placed on the vastus lateralis, rectus femoris, biceps femoris and medial hamstrings between the motor point and the distal tendon in order to improve intra and inter-subject comparison reliability consistently with recent guidelines [2]. Two electrodes were placed on each muscle at

a 20 mm distance and parallel to fiber orientation while athletic tape was used to fixate the electrodes and decrease movement artefact [2].

The subjects were allowed two practice jumps from each height (in a randomized order) and then performed three bilateral drop jumps from a 20 and a 40 cm platform. They were instructed to drop directly down off the box and land with both legs on a force plate. Subjects did not receive any instructions on the landing technique to avoid a coaching effect. EMG amplitude was normalized to the maximum linear-enveloped EMG of each muscle [1] and the average of the 100 ms preceding landing (initial contact with the force plate) was calculated.

A 2 x 2 mixed MANOVA was performed to evaluate the effect of height (20 vs. 40cm) and sex on prelanding normalized EMG (NEMG) activity followed by post-hoc univariate ANOVAs and pairwise tests when statistical significance was detected. The  $\alpha$  level was a priori set at 0.05. Knee flexion immediately after (40ms) initial contact was also assessed to insure that any NEMG differences were not due to the knee joint being at different flexion angles between the two heights.

### RESULTS AND DISCUSSION

A main effect for height ( $p < 0.001$ ) but not for sex ( $p = 0.094$ ) or the interaction of height x sex ( $p = 0.216$ ) were found. Post-hoc tests revealed that prelanding NEMG of the rectus and vastus medialis was increased ( $p \leq 0.002$ ) by 19% and 18% respectively but no changes were found for the NEMG of the hamstrings ( $p \geq 0.123$ ). Knee flexion angle at take-off was identical between the two heights ( $33.5^\circ$  vs.  $33.8^\circ$ ).

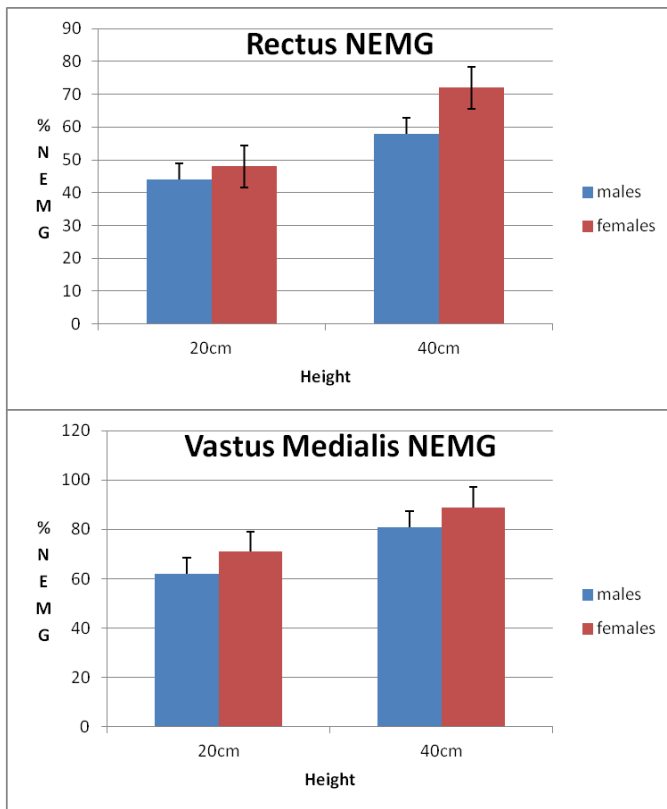


Figure 1. NEMG% of rectus and vastus medialis for different heights and for male and female.

The main finding of this project is that feedforward changes occur in the NEMG activity of the knee muscles when increasing the height of a landing task, however, the same effect was found for both male and female athletes. While the quadriceps preactivates to a greater extent when increasing the height from 20 to 40 cm, the hamstrings do not follow the same pattern. This may create an imbalance in the anterior-posterior shear forces as the quadriceps cause anterior translation that is not counteracted by posterior translation forces of the hamstrings and may have implications for the mechanism of ACL injuries. As ACL injuries frequently occur immediately after landing, muscle preactivation may be more effective in preventing excessive forces within the ACL than muscle recruitment after landing has initiated.

## CONCLUSIONS

This study showed that increasing the height of drop landing tasks is associated with increased NEMG activity of the quadriceps but not the hamstrings in recreational athletes. No differences were found between males and females. By finding these differences in activation of these muscles may be possible to discover if the athletes have risk factors for ACL injury.

## REFERENCES

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