DIFFERENCES IN THE FREQUENCY OF MYOELECTRIC ACTIVATION OF LOWER LIMBS BETWEEN SINGLE AND DOUBLE LEG LANDINGS IN MALES

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INTRODUCTION: The frequency of myoelectric activation seems to be related to the recruitment of different motor units (Wakeling, 2009). Fast muscle fibers are responsible to the production of higher forces related to the slow fibers (Wakeling, 2009). Therefore, the pattern of activation of some muscles could be associated to the risk of injuries (Bealieau et al., 2008). However, it is not well described whether the muscular activation, in the time-frequency domain, used by males in tasks with different mechanical stresses would truly be related to the strategies of protection of the ACL. The aim of this research was to compare the instantaneous median frequency (IMF) of the EMG signal of lower limbs muscles between different landing tasks in males.

METHODS: Fifteen male athletes (13±1 yr, range 11-14 yr) performed double leg vertical jumps, landing on one leg (SL) or both legs (DL). The project was approved by the Institutional Ethics Committee and all parents signed an informed consent. Before the positioning of the electrodes, the skin was shaved and cleaned with alcohol. The myoelectric signals of rectus femoris (RF), biceps femoris (BF) and hip adductors (HA) were captured (BIOPAC Systems Inc., California) and resolved into their myoelectric intensities in time–frequency space using Choi-Williams transformation technique (Choi, Williams, 1989) (MatLab, Version 7.04, The Mathworks, Inc). The positioning of the electrodes was done according to Cram et al. (1998). EMG signal was filtered with a 4^{th} order Butterworth filter. IMF values were obtained at every 20ms in the window between 100ms before ground contact and 100ms after ground contact, totalizing 10 IMF values. These values were compared between the landings tasks within each phase using Wilcoxon Ranked Test and compared among each phase within each of the landing tasks using Friedman test, with post hoc Dunn's test. Significance level was set at $p<0.05$.

RESULTS: IMF values of RF showed no significant differences when comparing SL and DL within each phase ($p>0.05$). However, when compared within each of the landing tasks RF demonstrated some decrease on IMF values of SL between 40ms and 60ms after ground contact ($p=0.0032$). During the landing phase IMF values of BF tended to be higher in the SL than DL, with statistical significance differences for the 20ms and 40ms interval before ground contact ($p=0.0256$) and 40ms and 60ms after ground contact ($p=0.0181$). Higher IMF values for HA were found during the 40ms to 80ms interval before ground contact compared to 40ms to 80ms after ground contact ($p=0.0011$) for the SL. No statistical differences ($p>0.05$) were observed for DL (Figure 1).

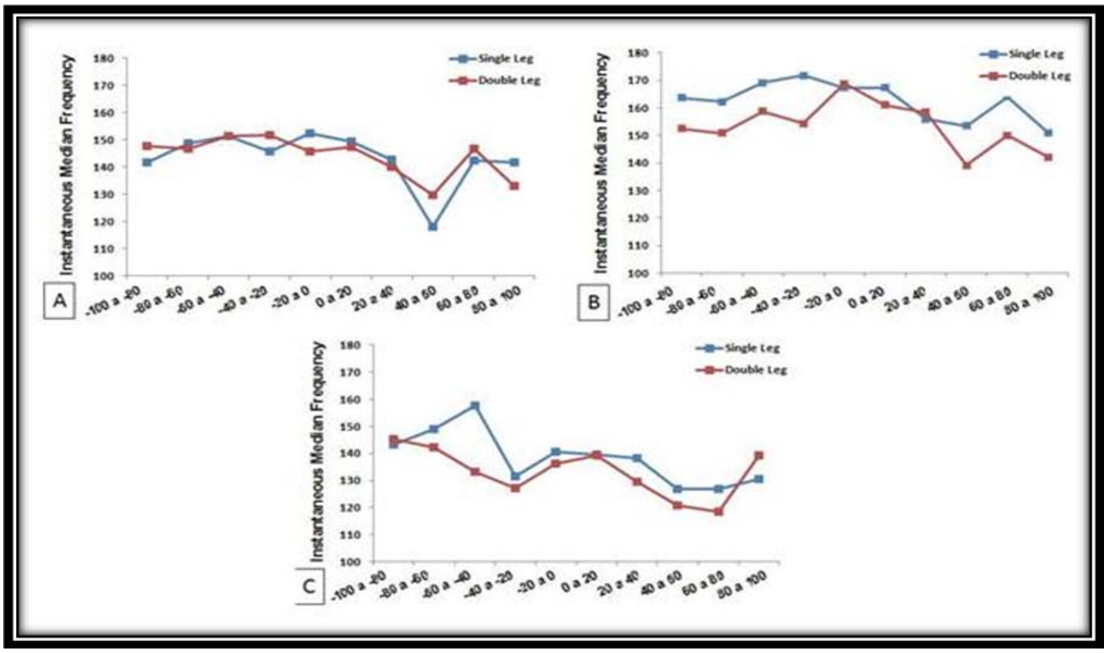

Figure 1. Instantaneous Median Frequency (IMF) values of each of the muscles during the two landing tasks. A: Rectus Femoris; B: Biceps Femoris; C: Hip Adductors.

DISCUSSION: The results suggest a pattern of motor recruitment compatible with strategies to prevent ACL injuries. According to Demorat et al. (2004) RF seems to increase ACL load by increasing anterior tibial shear forces, while BF seems to decrease it. Our results demonstrated that in the SL, RF decreased IMF values and BF increased in the 40ms and 60ms interval, when is believed that ACL injuries occur (Krosshaug et al., 2007). This muscular synergism may increase knee dynamic stability, decreasing ACL tension (Demorat et al., 2004). With the exception of RF, the IMF values for DL tended to be constant, but lower than for SL. The results of HA have demonstrated the strong relation of hip muscles to increase core stability, allowing the activation of distal muscles with safety (Zazulak et al., 2007).

CONCLUSION: The results of this study may provide new insights into the strategies of ACL injury prevention used by male athletes regarding the safety muscular recruitment observed during these both landing tasks.

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