

## ANTAGONIST MUSCLE ACTIVITY DURING MAXIMAL ISOMETRIC KNEE STRENGTH TESTING

Williams G.N.<sup>a,b</sup>, Krishnan C.<sup>a</sup>

<sup>a</sup> Physical Therapy & Rehabilitation Science, University of Iowa, Iowa City, USA

<sup>b</sup> University of Iowa Sports Medicine Center, University of Iowa, Iowa City, USA

**KEY WORDS:** strength, antagonist, EMG, knee

**INTRODUCTION:** Atrophy and weakness are common after anterior cruciate ligament injury and in people with knee osteoarthritis (Lewek *et al.*, 2004; Williams *et al.*, 2005). Strength testing is an important part of managing people with knee conditions such as these, as the strength is often used as a criteria for surgical timing, rehabilitation progression, and return to sport. Antagonist activity may lead to measurement errors in strength testing, which adversely impact clinical decision-making. The purpose of this study was to assess the magnitude and variability (by side and across sessions) of antagonist muscle activity during maximal voluntary isometric knee strength testing in males and females.

**METHODS:** Thirty active young people (15 males, 15 females) of similar age and activity-level underwent maximal voluntary isometric strength testing of the knee extensors and flexors at two sessions that took place approximately 1 week apart. Electromyograms from the quadriceps and hamstrings muscles and peak torque data were recorded continuously during strength testing. The magnitude of antagonist muscle activity, peak torque, and the variability in these parameters between sides and across test sessions were analyzed.

**RESULTS:** Noteworthy activity was observed in each muscle during maximal testing of the antagonist muscle group (mean EMG values presented in percent maximum values recorded when the muscles were agonists: vastus lateralis 8.8%, rectus femoris 9.9%, vastus medialis 13.6%, medial hamstrings 8.5%, and lateral hamstrings 15.4%). Significant differences in the magnitude of antagonist muscle activity ( $P<.001$ ) and peak torque ( $P<.001$ ) were observed between sides (side with higher values contrasted with side with lower values). Females displayed significantly higher vastus medialis activity ( $P=.001$ ) than males when this muscle was an antagonist; all other muscles had similar activity profiles by sex. There was no significant difference in peak torque or the magnitude of antagonist activity observed across sessions.

**DISCUSSION AND CONCLUSIONS:** Significant antagonist muscle activity is present during maximal isometric knee strength testing in active young people. This antagonist muscle activity may lead to strength testing measurement errors that can adversely impact clinical decision-making and therefore should be considered when setting criteria for functional progression and return-to-sport. The variability in antagonist muscle activity and peak torque between limbs suggests that a simple correction for this antagonist muscle activity is not possible and that the contralateral limb provides a questionable comparison for knee strength.

### REFERENCES:

- Lewek, M. D., Rudolph, K. S., and Snyder-Mackler, L. (2004). Quadriceps femoris muscle weakness and activation failure in patients with symptomatic knee osteoarthritis. *J Orthop Res*, **22**, 110-115.
- Williams, G. N., Buchanan, T. S., Barrance, P. J., Axe, M. J., and Snyder-Mackler, L. (2005). Quadriceps weakness, atrophy, and activation failure in predicted noncopers after anterior cruciate ligament injury. *Am J Sports Med*, **33**, 402-407.