KNEE GAIT KINEMATIC RESPONSES TO VIBRATION OF THE HAMSTRING TENDONS: AN EXPLORATORY STUDY OF PERSONS WITH ANTERIOR CRUCIATE LIGAMENT INJURY

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INTRODUCTION
Anterior cruciate ligament (ACL) injuries are common and involve changes in knee gait kinematics of the affected limb. Greater flexion and increased internal tibial rotation have been demonstrated [1] and could persist due to the proprioceptive deficit. Increased internal tibial rotation is associated with knee osteoarthritis initiation in this population. This underlines the importance of increasing knowledge on modalities to correct this abnormal rotation. Science shows that vibration applied to a tendon is accompanied by an illusion of stretching and contraction of the vibrated muscle (Tonic Vibration Reflex or TVR) or of its antagonist (Antagonist Vibration Response or AVR) [2]. This response can affect segment kinematics during gait [3].

METHODS
Two groups six healthy subjects and 7 individuals with complete ACL tear (> 50%) for over three months (1 man, 6 women) participated in this exploratory study. Position and orientation coordinates of the femoral and tibial segments were recorded using a Fastrak electromagnetic motion capture system (Polhemus, Vermont, USA) and a KneeKG captor attachment system (Emovi, Montreal, Canada) while participants walked at a comfortable speed on a treadmill. To locate the knee joint center and identify the axes, a validated calibration protocol was conducted. From these data, internal/external rotation angles were calculated during complete gait cycles and used as reference. Two walking tests were then carried out while a low amplitude (0.5-1 mm) vibration of 80Hz was applied to the tendons: 1) the medial hamstring and 2) the lateral hamstring. The angle at initial foot contact and the maximum internal rotation angle during terminal stance were extracted over 15 gait cycles for each participant to compare the effect of vibration for both conditions (medial and lateral tendon) with the reference values. Given the exploratory nature of the study and sample size, a descriptive analysis was performed. To determine the nature of the response elicited (TVR or AVR) under each vibration condition on knee rotation, the difference between the parameter of interest and the reference values had to be greater than the device’s error measurement in the transverse plane (2.3°).

RESULTS
The results demonstrated a trend in AVR for healthy participants (Figure 1), especially for the vibration applied to the medial hamstring. Five of the 6 healthy participants showed a decrease in internal knee rotation for at least one parameter. An AVR also seemed to be observed with lateral vibration, though less frequently (3 of 6 healthy participants) and only at initial contact of the foot. Among the ACL participants (Figure 2), medial tendon vibration seemed to have no effect. We noted that lateral tendon vibration also tended to produce AVR by increasing internal rotation for at least one parameter in 3 of 7 ACL participants.

DISCUSSION AND CONCLUSION
The results suggested that the AVR was elicited in healthy individuals. It was therefore hypothesized that vibration of the medial hamstring may correct internal rotation in patients with an ACL injury. However, vibration does not seem to elicit AVR in these individuals. The lack of reaction of the injured knees during medial vibration could be explained by the fact that vibration acts on proprioception, which might be altered following ACL injury.

REFERENCES