A MYOELECTRIC COMPARISON OF TREADMILL AND ICE SKATING

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Due to technical and logistic difficulties in conducting skating research on the ice rink surface, the skating treadmill is an excellent resource from a diagnostic and industrial perspective. However; the potential benefits of the skating treadmill hinge on the similarity of treadmill and ice skating parameters. The purpose of this study was to compare the two myoelectric profiles with regards to both temporal and amplitude measures. The findings show that despite intratester, and intersubject variability and differences in stride rate and velocity, the respective myoelectric profiles of the quadriceps and lower leg show strong similarities further indicating a specificity of conditions and gross motor function between conditions.

KEYWORDS: training specificity, skating treadmill, EMG, ice hockey.

INTRODUCTION: The purpose of the skating treadmill (Frappier Acceleration, Fargo, ND, USA) is to provide a platform for training that permits a variety of training intensities while replicating forward skating motion. In addition, the skating treadmill presents certain advantages to diagnostic and industrial research by circumventing problems traditionally associated with ice hockey skating (i.e. large volume, low temperature, high velocities.) The mechanics of the skating treadmill are similar to that of a conventional running treadmill. A belt is driven at designated velocities by two rotating drums. The treadmill belt is tiled by polyethylene panels allowing for a skating surface area of 1.8 m x 1.8 m. A silicon lubricant is sprayed evenly onto the surface to further decrease the friction and skate blades penetrate the polyethylene surface. The question of how well the skating treadmill replicates the skating motion was first addressed by Hinrich (1994). Using EMG, Hinrich found no statistically significant differences between the two conditions with the exception of the duration of muscle activity of Adductor Longus. Although a large number of muscles were reported and respective stride rates were matched a criticism is that the analysis of the myoelectric signal was strictly temporal. Muscles were reported as being "on" or "off" based on a previously determined baseline threshold value. This paper presents the myoelectric profiles collected on ice and on treadmill in two different studies. Despite data collection being performed by different experimenters (Goudreault et al. 2002 & Dewan et al. 2004) with different subjects, at different velocities, stride duration, and stride rates myoelectric profiles show striking similarities.

METHODS: A total of 7 and 5 subjects participated in the respective studies. All of the subjects were varsity hockey players from McGill University. Subjects performing treadmill skating were sufficiently accustomed to the apparatus; in both studies subjects skated while carrying a hockey stick. Bipolar surface electrodes were placed on the Vastus Medialis (VM), Medial Gastrocnemius (GM), Tibialis Anterior (TA), and Peroneus Longus (PL). Electrode site locations on the right leg were prepared by removing local hair, abrading the skin with abrasive scrub pads, then cleaning the area with rubbing alcohol. One-inch disc (2.5 cm) shaped disposable bipolar differential electrodes (Meditrace Inc., conductive adhesive electrodes) were used. The EMG and goniometer signals were measured using the Multi Signal System ME3000P8 muscle tester unit (Mega Electronics, Finland). Data were sampled at 1000Hz.

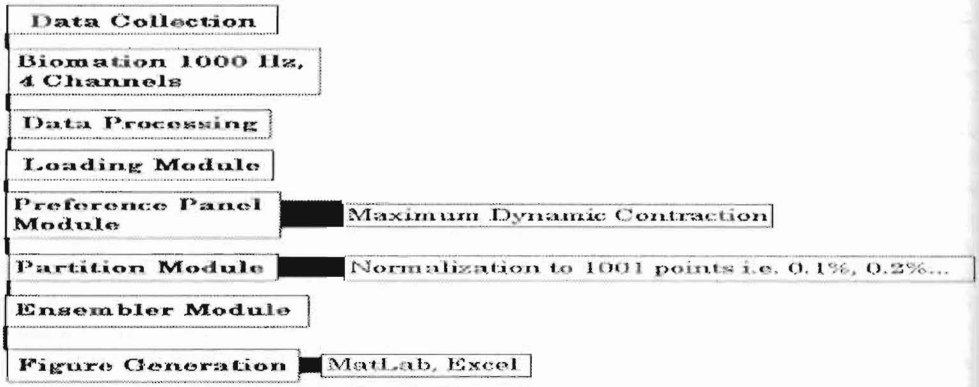

Figure 1: A flow chart of the data collection and data processing steps performed by Goudreault (2002) and Dewan (2004).

RESULTS & DISCUSSION: The myoelectric profiles of the respective studies are shown in the figures 2 to 5 below.

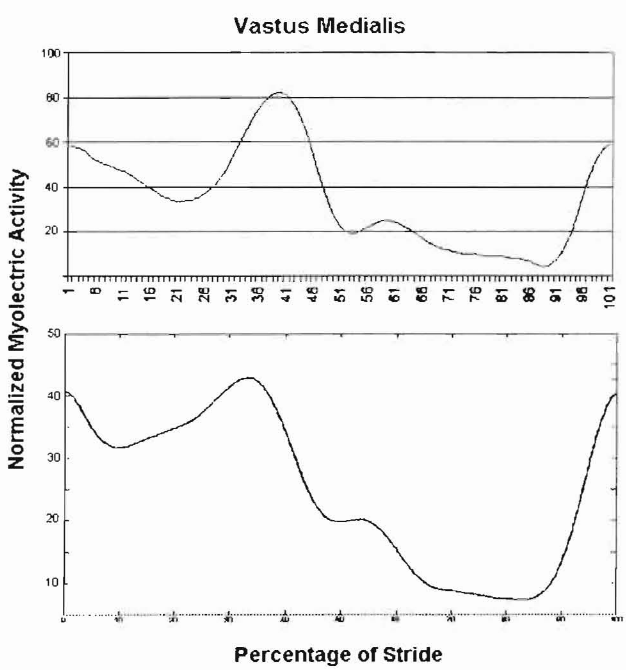

Figure 2. Shows the muscle activation of the VM on a skating treadmill (above) and on ice (below). Mean myoelectric profiles on treadmill have been adjusted to account for different stride parsing criteria. The shaded region identifies the termination of the foot contact phase.

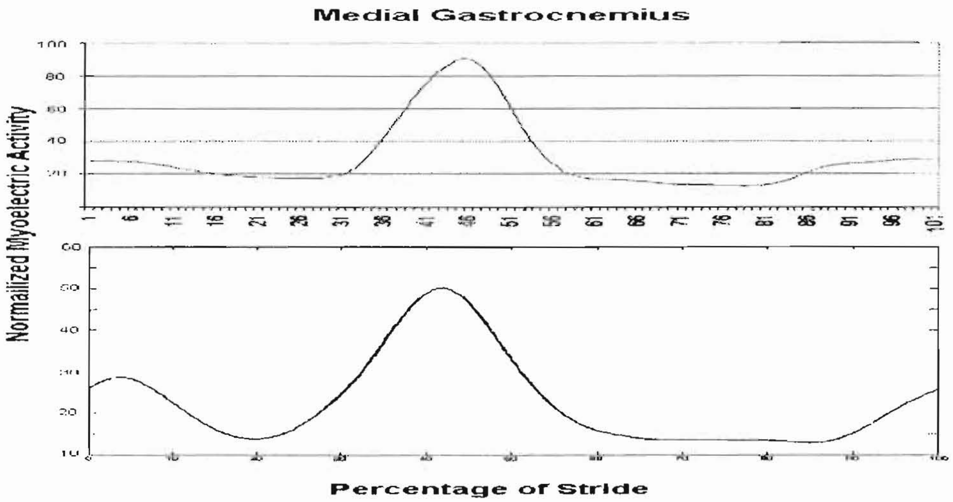

Figure 3: Shows the muscle activation of the MG on a skating treadmill (above) and on ice (below). Mean myoelectric profiles on treadmill have been adjusted to account for different stride parsing criteria. The shaded region identifies the termination of the foot contact phase.

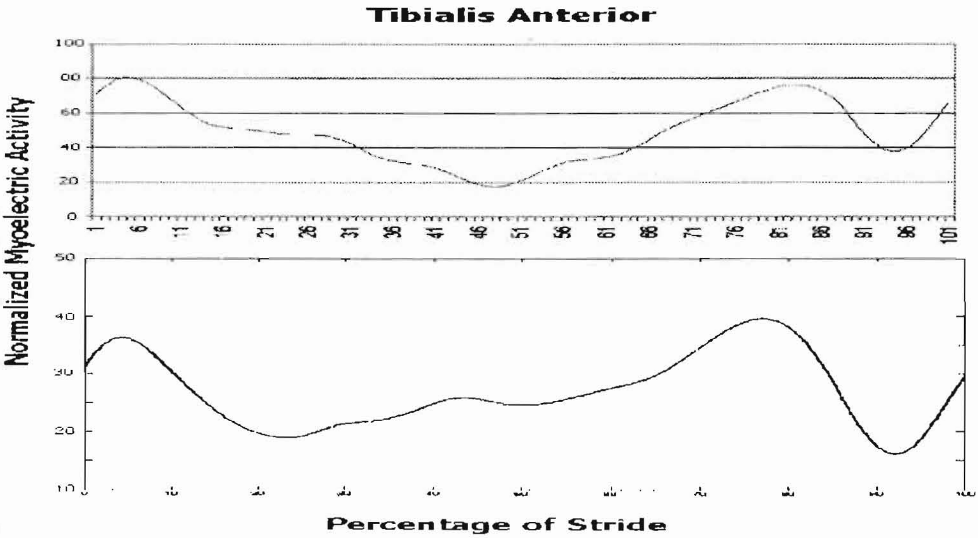

Figure 4: Shows the muscle activation of the TA on a skating treadmill (above) and on ice (below). Mean myoelectric profiles on treadmill have been adjusted to account for different stride parsing criteria. The shaded region identifies the termination of the foot contact phase.

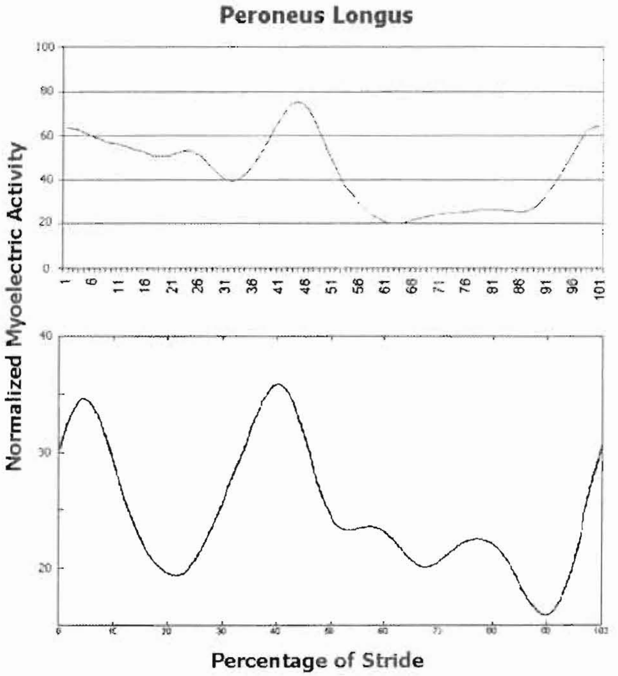

Figure 5: Shows the muscle activation of the PL on a skating treadmill (above) and on ice (below). Mean myoelectric profiles on treadmill have been adjusted to account for different stride parsing criteria. The shaded region identifies the termination of the foot contact phase.

Despite different criteria identifying foot strike, the experimental EMG results in this study are show strong congruence with the results of Goudreault (2002) for each of the four muscles. Notable differences did exist between the magnitudes of the normalized values however. The amplitudes reported by Dewan (2004) were substantially lower than in Goudreault for each muscle throughout the entire skating stride; this is thought to be due to the application different normalization coefficients based on differing maximum dynamic contraction criteria. The occurrence of increased myoelectric magnitudes seen during acceleration strides compared to constant velocity probably accounts for these differences (ensembled acceleration to constant velocity peak myoelectric magnitude ratios are 1.3:1 help to confirm this). One noticeable difference in EMG profiles between studies is that there is no initial peak, or a much less substantial one, in myoelectric activity in the GM and the PL at touch down. The congruence between the myoelectric profiles findings in the two conditions indicates that on ice skating and on treadmill skating are quite similar. This finding isn't surprising due to the visually observable similarities in skating kinematics and assumed gross motor function.

CONCLUSION: Given the advantages inherent in the use of the skating treadmill (i.e. reducing the required volume for calibration and the increase in measurement resolution, and temperature control that allows a comfortable enough environment for the use of skin based markers, and eliminates electronics concerns) the results show promise to professionals concerned about the specificity and applicability of treadmill skating on skating technique analysis, and athlete rehabilitation and as a tool in the testing protocols for skate design modifications. Further investigation with the purpose of determining the specificity of treadmill to ice skating will likely suggest a high degree of specificity.

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