



Title: NORDIC CURL HAMSTRING ACTIVATION INDICATES PRESENCE OF INJURY HISTORY

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Introduction

The Nordic curls (NC) exercise is associated with reducing injury risk linked to the terminal swing phase of sprinting. The eccentric phase of the NC is reported to activate the medial hamstrings (MH) to a greater extent than the lateral hamstrings (LH) (1). However, in footballers with a history of history of hamstring strain injury (HHSI) a shift in relative contribution from the MH to the LH has been observed during other eccentric knee flexor exercises (2). As the presence of HHSI is also seen to acutely alter hamstring activation at increasing amounts of knee excursion (3), questions arise whether a shift towards LH activation may be detectable in previously injured footballers during the NC at knee joint angles approximating to those associated with the terminal swing phase of sprinting (~30°).

Methods

Sixteen elite youth male, outfield footballers were recruited (age, 18.3 ± 1.7 years; stature, 181.8 ± 7.1 cm; mass, 76.6 ± 8.6 kg). Eight players met inclusion criteria (hamstring injury in last year) for a HHSI group and 8 players formed an injury history free (IHF) matched control group. Ethical approval was gained from the institution and subsequent signed informed consent/parental consent was obtained prior to commencement. Following a standardised warm-up, a ground electrode was fixed to the right olecranon and bipolar surface electrodes (DE– 2.3 MA; DelSys Inc., Boston, MA, USA) were placed 10mm apart on the LH and MH of both limbs in accord with SENIAM guidelines. Three, 5 second maximal voluntary isometric contractions (MVIC) were performed 30 seconds apart at 45° of knee flexion and 0° of hip extension. A single axis electrogoniometer (S700; Measureand Inc., Fredericton, NB, Canada) was secured to each participant's right knee, ensuring the device's axis of rotation was positioned over the lateral femoral condyle. Participants then performed 6 NC. Kinematic data was collected synchronously with EMG at two epochs: 90-30° and 30-0° of knee flexion. Raw sEMG and electrogoniometer data were sampled at 1 kHz through a 16 bit, 8-channel telemetry system (Delsys Myomonitor IV, Delsys Inc., Boston, MA, USA). The EMG signal was band-pass

filtered (Butterworth filter, fourth order, zero-lag, cut-off frequencies 450-20 Hz), full wave rectified, followed by the application of a low pass filter (Butterworth filter, fourth order, zero-lag, cut-off frequency 4 Hz). Maximal EMG amplitude was calculating from a mean value around a 300ms epoch centred on the single peak EMG value of the second and third MVIC trial. The aggregated mean of these values was subsequently used to normalise EMG (nEMG) recorded during NC performance. For the NC, a single peak magnitude EMG was identified from each epoch and averaged over repetitions 2 to 5 for analysis. Mean NC EMG amplitudes were divided by mean MVIC values to normalise data. Following processing and normalisation, activation ratios were derived by dividing mean LH nEMG by mean MH nEMG amplitude (LH/MH).

Results

There was a significant relationship between injury history and activation ratios, $F(2, 13) = 5.60, p < .05$, partial $\eta^2 = .76$. Post-hoc analysis showed no significant difference in ratios between groups at 90-30° epoch ($F(1, 14) = .43, p = > .05$, partial $\eta^2 = .03$). However, at the 30-0° epoch, HHSI players displayed significantly higher LH/MH activation ratios than IHF ($F(1, 14) = 11.89, p < .05$, partial $\eta^2 = .46$).

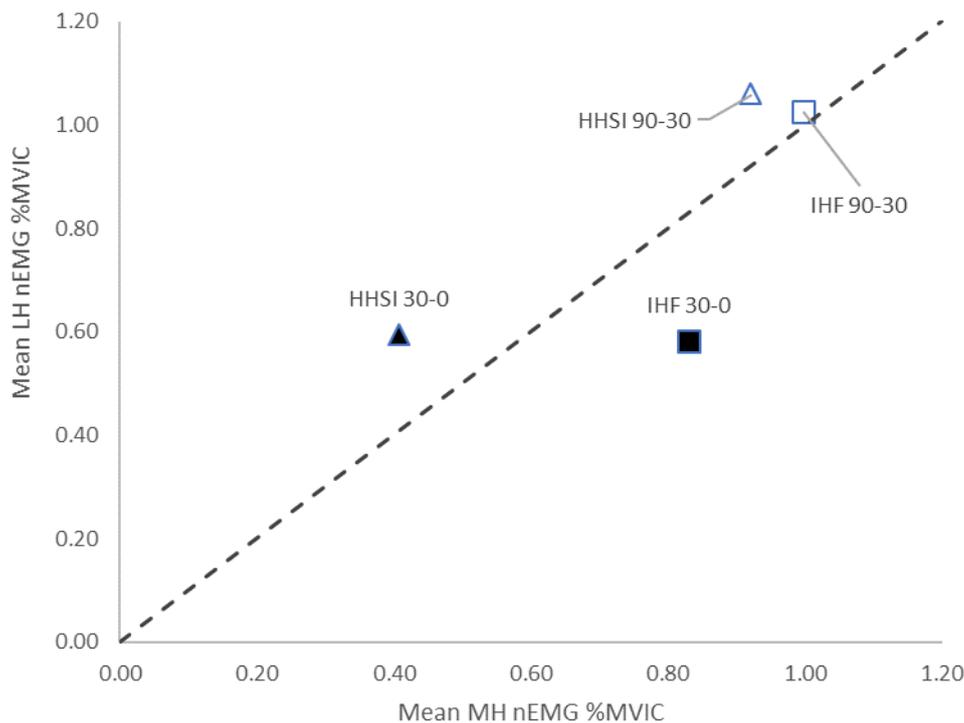


Figure 1. Relative contributions of LH and MH at 90-30° and 30-0° of knee flexion for the HHSI and IHF groups.

Conclusions

The findings suggest HHSI is detectable during the NC when activation ratios are considered. However, these ratios, representing the respective LH and MH activation presented in Figure 1, identify this finding is sensitive to muscle length, only appearing in knee joint angles approximating to those associated to the terminal swing phase of sprinting. While informing on differential qualities of returned to play footballers, the results suggest clinicians should consider that muscle synergies potentially altered in the presence of acute hamstring injury persist beyond the end stage of rehabilitation and that these changes are detectable in risk related muscle lengths.

References

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