Abstract

Study of EMG patterns and muscle strength in asymptomatic volunteers during isokinetic flexion-extension movement of the trunk

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Introduction: The objective of our study was to assess concentric muscle strength during flexion and extension of the trunk using an isokinetic device combined with analysis of back and pelvic muscle activities.

Methods: Forty-one healthy volunteers, 21 females and 20 males (age: 25 ± 2 years; weight: 79 ± 8 kg; 178 ± 6 cm) participated in the study. They had no history of back or hip injuries. All subjects were familiar with concentric isokinetic back movements. Before the evaluation, the subject achieved a 10-minute bicycle warm-up and four pretest contractions. The assessment session consisted of 3 and 5 maximal concentric contractions during trunk flexion-extension at 30°/sec and 120°/sec, respectively. All tests were accomplished using an isokinetic dynamometer (CYBEX NORM). All electrical activities of paraspinal (PS) and gluteus maximus (GM) muscles were recorded from surface electrodes (Ø = 9 mm) bilaterally using a standard surface EMG procedure. Electrodes were positioned over the PS muscles at L5-S1 spinal levels and over the GM at the sacrospinous ligament level. EMG data and torque were sampled at 1000 Hz and recorded using Noraxon Myosystem Software. All EMG signals were rectified and smoothed (RMS 50). All data were collected every 5 degrees from 0 degree to maximal range.

Statistical analysis: Control of distribution and homogeneity of variances was conducted using Kolmogorov-Smirnoff and Levene tests. Influence of gender, velocity, movement and motion range on outcome measurements was analyzed using multivariate analysis of variance (ANOVA).

Results: For each velocity males achieved significantly larger extension or flexion torque than females ($p < 0.001$). At each angle of movement, significant interaction of independent variables on torque values was found at the lower velocity in both groups ($p = 9 \times 10^{-6}$ for females and $p = 0.02$ for males). Concerning muscle activity, no difference was found between right and left nor between males and females ($p > 0.05$). In general, total ROM and velocity significantly influenced agonist EMG activity ($p < 0.00001$). Analysis of peak torque and peak EMGs demonstrated that maximal torque did not correspond to maximal muscle activity for either PS or GM. A significant linear correlation was obtained between EMG curves of PS and GM ($r > 0.89$). During extension EMG recruitment patterns showed that PS and GM displayed peak activity for around 15° of trunk flexion while peak torque occurred around 35° and 65° for 45° and 75° ROM, respectively, at the lower speed. This observation was similar for males and females. Figure 1 illustrates torque intensity and EMG activities during flexion and extension over a 45° range of motion at 30°/s.
for the female population. Moreover, during flexion permanent antagonist activity of PS and GM was observed at both speeds. Larger antagonist activity occurred at the end of flexion around 40° and 70°. On the other hand, at the higher speed, PS and GM displayed early activity around 30° and 55° for the small and large ROM tests respectively.

Conclusions: The results of this investigation demonstrated significant influence of gender, velocity, total amplitude and position of the trunk on torque and EMG activity. During flexion all investigated muscles displayed antagonist activity that increased at the end of the movement. Early antagonist activity was observed when subjects performed fast movement (120°/s). However, these findings have to be related to our methodology [1–3].

Finally, similar patterns of recruitment were observed in each group.

References