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ELETROMYOGRAPHIC ACTIVITY OF SELECTED SHOULDER MUSCLES DURING GLENOHUMERAL INTERNAL ROTATION ISOKINETIC CONTRACTION.

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INTRODUCTION

To obtain sufficient data, a number of studies have performed electromyography (EMG) to analyze the function of shoulder muscles. However, previous studies are unclear as to internal rotator and external rotator muscles activity during eccentric and concentric maximal internal rotation isokinetic contraction with low and high speeds. These information would be useful for understanding muscles shoulder stability and would be also useful to exercise prescription for overhead athletes and for patients with shoulder pathology. We hypothesized that external rotator muscles would be active during both concentric and eccentric isokinetic internal rotation action in order to help in glenohumeral joint stability.

The objective of this study was to investigate the EMG activity of infraspinatus (IF), pectoralis major (PE), teres minor (TM), and deltoid medium (DE) muscles during concentric and eccentric internal rotation shoulder action.

METHODS

Thirty-one uninjured female handball players performed isokinetic maximal concentric and eccentric internal shoulder rotation test at angular velocities of 60^{0}/s and 240^{0}/s. Test position was seated with shoulder abducted at 90^{0}. The EMG signals were demeaned, filtered (low pass Butterworth filter, 4^{th} order, 200 Hz) and full wave rectified. A 3D accelerometer was attached to the arm of the isokinetic machine and was used to synchronize the EMG signals to movement of the isokinetic machine. Both signals were sampled at 2 kHz. The acceleration peak during the internal rotation was used as a reference to calculate three time windows: before the peak, from 0.3s before the up to 0.1s before the peak, around the peak, from 0.1s before the peak up to 0.1s after the peak, and after the peak, from 0.1s after the peak up to 0.3s after the peak. For those windows, it was calculated the root mean square (RMS) as a variability parameter of the EMG, the integral of the EMG as an intensity parameter of the EMG and the median frequency of the power spectrum of the EMG. Those parameters were calculated for four muscles IF, PE, TM and DE.

RESULTS AND DISCUSSION

The standard deviation of the EMG was affected by the movement velocity ($F(1.3174)=99$ $p<0.0001$), phase ($F(2.3174)=4.1$ $p=0.01$) and muscle ($F(3.9522)=520.5$ $p<0.0001$) and not affected by the muscle action ($F(1.3174)=1.9$ $p=0.16$). The highest standard deviation was observed during the fast velocity, before and during the peak acceleration, and for PE muscle ($p<0.001$). The lowest standard deviation was observed for the DE and IF muscles ($p<0.001$).

The median frequency of the EMG was affected by the muscle action ($F(1.3174)=9.5$ $p=0.002$), phase ($F(2.3174)=17.3$ $p<0.0001$) and muscle ($F(3.9522)=41.2$ $p<0.0001$) and not affected by the movement velocity ($F(1.3174)=2.5$ $p=0.10$). The lowest median frequency was observed during the peak acceleration, for the DE and TM muscles ($p<0.001$).

The RMS of the EMG was affected by the muscle action ($F(1.3174)=4.9$ $p=0.02$), movement velocity ($F(1.3174)=136$ $p<0.0001$), phase ($F(2.3174)=3.0$ $p=0.04$) and muscle ($F(3.9522)=703$ $p<0.0001$). The highest RMS was observed during the maximal task, fast velocity, before the peak acceleration, and for PE muscle ($p<0.001$). The lowest RMS was observed for the DE and IF muscles ($p<0.001$), during and after the peak acceleration ($p<0.001$).

The iEMG of the EMG was affected by the muscle action ($F(1.3174)=4.7$ $p=0.02$), movement velocity ($F(1.3174)=194$ $p<0.0001$), phase ($F(2.3174)=313$ $p<0.0001$) and muscle ($F(3.9522)=972$ $p<0.0001$). The highest iEMG was observed during the maximal task, fast velocity, during the peak acceleration, and for PE muscle ($p<0.001$). The lowest iEMG was observed for the DE and IF muscles ($p<0.001$), and before and after the peak acceleration ($p<0.001$).

The highest variability of the muscle activation was observed during the fast velocity, before and during the peak acceleration, and for PE muscle. The lowest variability of muscle activation was observed for the DE and IF muscles.

The highest intensity of the muscle activation was observed during fast velocity, before the peak acceleration, and for PE muscle. IF, TM, and DE were activated during concentric and eccentric muscular internal rotation action, and their highest intensity were before peak acceleration. The lowest

RMS was observed for the DE and IF muscles, and after the peak acceleration.

CONCLUSIONS

We can conclude that external rotators agonist muscles, such as infraspinatus and teres minor, were activated during internal rotation action, probably acting in glenohumeral joint stabilization. Another significant difference is that pectoralis major EMG intensity was higher before and in the peak of acceleration and infraspinatus and teres minor was higher before peak of acceleration. The last interesting finding is that infraspinatus and deltoid muscles presented the lowest RMS.

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