

Reliability of Identifying EMG Onset of Complex Human Movement Electromyography Signals

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Electromyography (EMG) is a popular method for measuring muscle activity in human movement with magnitude and timing two commonly reported variables. While different algorithms to determine EMG onset exist, the gold standard of comparison remains visual observation. This process, however, is subjective and is complicated by the complexity of the underlying neuromuscular signal and noise from the electrode-skin interface, electronics, and electromagnetic interference. To obtain valid measures of EMG onset and to ascertain the validity of different algorithms for determining EMG onset, it is important to establish the reliability of visual observation for determining EMG onset. **PURPOSE:** To determine the agreement between and within raters for EMG onset visual analysis. **METHODS:** Muscle activity on 10 healthy active subjects was collected from the gastrocnemius, biceps femoris, and vastus lateralis using surface electrodes placed over the muscle bellies following skin preparation with sandpaper and alcohol. Subjects completed 4 minutes of exercise on a treadmill, cycle ergometer and stair climber at a low to moderate intensity. EMG were collected with a wireless EMG system (4000 Hz) for 5 to 6 complete movement cycles (6 to 10 seconds depending on cadence) at time points 1:30 and 3:30. The raw EMG data were visually analyzed with custom software. Three researchers manually identified muscle onsets twice for the 180 EMG trials (3 muscles, 3 exercise modes, 10 subjects, 2 time points) with the trials presented in random order. To determine rater agreement, intraclass correlation coefficients (ICC) were calculated for the number of muscle onsets identified per trial. **RESULTS:** Within-rater $ICC_{(2,1)} = 0.85$ and between-rater $ICC_{(2,1)} = 0.89$. However, there were only 132 instances, out of 180, where two researchers agreed with both themselves and another researcher (i.e. two different researchers selected the same number of onsets twice). **CONCLUSION:** Despite moderate to high intraclass correlation coefficients, caution should be taken when determining EMG onset using visual observation since less than 75% of trials had consensus agreement between and within raters.