Electromyography responses of pediatric and adult volunteers in low speed frontal impacts

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ABSTRACT

No data exists on the electromyography (EMG) responses in children exposed to dynamic impacts. The objective of the current study was to measure the EMG responses of the neck, torso and lower extremity in children and adults during a low speed frontal impact. Low speed volunteer testing were performed on pediatric (n=10, ages 9-14 years) and adult (n=10, ages 18-30 years) male subjects. EMG signals were collected from the cervical paraspinous, upper trapezius, sternocleidomastoid, lumbar and rector femoris muscles with surface electrodes and processed using a bandpass (20 Hz-500 Hz) finite impulse response filter, utilizing a Kaiser windowing method to eliminate noise from the signal. Post filtering, a root-meansquared method was applied and each muscle signal was normalized by the subject's maximum voluntary isometric contraction (MVIC) for the respective muscle. The timing and magnitude of the EMG responses were then compared across age. Parameters of interest include EMG onset (5% value of the normalized peak RMS value), normalized peak EMG (the highest magnitude between event onset and maximum head rotation), latency (time difference between event onset and EMG onset), and reflex response time (time difference between EMG onset and time at maximum head rotation). Comparison of these parameters across ages revealed no significant differences. The cervical paraspinous muscles have the earliest onset (0.108- 0.178 seconds). The normalized peak values indicate that the neck muscles (cervical paraspinous, upper trapezius, and sternocleidomastoid) have the largest magnitudes (0-80x MVIC) while the rector femoris muscles have the least (0-40x MVIC). For all of the muscle groups, the time at peak EMG is between 0.15-0.35 seconds. Additionally, across trials within each subject, there appears to be no evident trend suggesting no habituation. These data could be used to model active musculature in computational models used in impact biomechanics studies.