The purpose of the study was to characterize the EMG activity of the elbow flexor muscles measured at different depths in selected muscles and to quantify changes in muscle architecture during a sustained submaximal contraction. Eleven subjects performed a fatiguing contraction with the elbow flexors at 20% of the maximal voluntary contraction force. EMG activity was recorded in the deep and superficial biceps brachii, brachialis, and brachioradialis muscles using intramuscular and surface electrodes. A B-mode ultrasound with a 7.5-MHz linear-array probe was positioned on the skin to determine the depth of the intramuscular electrodes and the thickness of long head of biceps brachii, brachioradialis, and brachialis muscles before and after the sustained contraction. Furthermore, the pennation angle of the brachialis muscle was measured. The time to failure was 8.2 ± 6.2 min. The average EMG amplitude of superficial and deep biceps brachii, brachialis, and brachioradialis increased progressively during the contraction (P < 0.009). The rates of increase in the surface EMG of the long and short head of biceps brachii and brachioradialis were greater (P < 0.02) than that for the intramuscular recordings measured at different depths. The rates of increase in the average amplitude of the surface EMG were similar for brachioradialis and the two heads of biceps brachii (P = 0.8). The rates of increase in the brachialis muscle EMG measured at two different depths did not differ (P = 0.39). The increase in the amplitude of the deep intramuscular brachioradialis EMG was associated with the increase in the thickness of the muscle (22.6 ± 4.6 to 25.2 ± 3.4 mm; P = 0.004). There was no change in thickness of the long head of biceps brachii. The thickness of the brachialis muscle increased from 27.7 ± 5.4 mm before to 30.6 ± 3.5 mm after the contraction (P < 0.05) and the pennation angle increased from 11.2 ± 3.4 to 16.6 ± 4.6 degrees (P = 0.002). Changes in brachialis thickness were associated with changes in pennation angle (P = 0.007, r = 0.75), but neither architectural change was associated with the increase of the brachialis EMG. These findings demonstrate that the architecture of brachialis and brachioradialis, but not biceps brachii, were altered after the fatiguing contraction. The greater rates of increase in the amplitude of the surface EMG indicate that the recording conditions changed during the contraction, such as due to changes in muscle architecture and the summation of the motor unit potentials. The similar increase in surface EMG amplitude for brachioradialis and biceps brachii but the absence of a change in thickness for biceps brachii suggests that the recording conditions changed differently for these two muscles. The results caution against generalizing about motor unit activity from surface EMG recordings made during fatiguing contractions.

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