Deep tendon reflex of biceps brachii is an important physical sign in neurological examination. A brisk tap with a reflex hammer on the biceps brachii tendon elicits a reflexive contraction of the biceps brachii, because quick stretch activates neural connections between muscles spindles (i.e. type la sensory fibers) and alpha motor neurons to the same muscles (Dick 2003). Reflexes are usually graded at the bedside, in a semi-quantitative manner, by visual inspection of the muscle contraction. The response levels of deep tendon reflexes are graded by “0” to “4+”. In a normal subject, when muscle is tapped briskly the muscle immediately contracts (scored “2+”) while in subjects with neurological conditions the reflexive contraction may be altered. Hyporeflexia or areflexia (scored “1+” or “0”) indicates a lesion of the peripheral nerve or spinal nerve root. Hyperreflexia or clonus (scored “3+” or “4+”) indicate upper motor neuron lesion (Walker 1980). The aim of the study was to characterize the deep tendon reflex of biceps brachii using high-density surface EMG.

### Materials and Methods

13 healthy volunteers (7 males, 6 females, age 36±8) were enrolled in the study. The force of the hammer as well as the time of impact was estimated using the signals of a linear uniaxial accelerometer embedded in the hammer. Surface EMG signals were detected in monopolar configuration using a 16x8 adhesive array of electrodes (OT-Bioelettronica). The instant of contact between the hammer and the tendon were identified from the acceleration signal using a simple threshold technique. The EMG signals evoked by the tendon reflex were aligned, with the acceleration signal as trigger. EMG parameters of interest were: muscle fiber conduction velocity (CV) (Farina and Merletti 2003), reflex latency between the hammer hit and the sEMG signal onset (Sharma et al. 2007), width of the evoked action potential, and the peak-to-peak amplitude of the potential. The protocol was divided in two parts: constant tapping (100 taps divided in two groups of 50) and increasing amplitude tapping (3 series of 10 taps with increasing strength. The EMG parameters and impulse amplitude were computed as a percentage with respect to the mean values computed during constant tapping in order to compare different subjects.

### Results

The mean and standard deviations of the extracted parameters were: Pk: 41.2±40.3 µV; CV: 3.73±0.44 m/s; Latency: 25.6±2.2 ms; Width 13.2±2.6 ms during the constant tapping. A positive correlation was observed between impulse of hammer tap and the peak amplitude of the EMG response. In addition a positive correlation was observed between latency and impulse with 100% variations of tap impulses corresponding to 5% change in latency. The impulse amplitude was computed as the integral of acceleration in time multiplied by the mass of the hammer (100g).

During the increasing amplitude tapping, no statistical correlation was observed between conduction velocity of motor fibers and impulse amplitude.

### Conclusions

Deep tendon reflex was characterized with a novel technique including electrophysiological variables acquired using high-density surface EMG. The impulse of the hammer tap seems to have little influence on the EMG response suggesting that the technique is reliable.

### References


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