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Using surface electrodes for the evaluation of the rectus femoris, vastus medialis and vastus lateralis muscles in children with cerebral palsy

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Abstract

The purpose of this study was to determine if surface electrodes are adequate in the determination of the activity patterns of the rectus femoris, vastus medialis and vastus lateralis in children with cerebral palsy (CP). Ninety patients with a diagnosis of CP underwent electromyography (EMG) testing. Surface electrodes were placed on the rectus femoris (RF), hamstrings, vastus medialis (VM) and vastus lateralis (VL). Muscle isolation tests revealed no cross-talk of the RF muscle on the vastii electrodes in any subject indicating surface EMG is sufficient for testing RF, VM and VL function in children. Muscle activation patterns during gait showed that the RF and not the VM or VL was active in mid-swing in the majority of cases.

Keywords: Electromyography; Quadriceps; Gait; Cerebral palsy; Cross-talk

1. Introduction

Dynamic electromyography (EMG), a component of computerized gait analysis, provides a measure of muscle activity of the lower extremity during gait. In the majority of laboratories using EMG for treatment decisions in children, activation patterns are recorded primarily with surface electrodes [10]. The use of intramuscular or fine wire electrodes is generally limited to the testing of deep muscles, such as the posterior tibialis, and small surface muscles such as the peroneals. Debate continues as to whether surface electrodes are adequate in the determination of activity in surface muscles, especially in small children [11–13]. That is, it is unclear in many circumstances whether surface electrodes record activity from the muscle of interest as well as activity from adjacent and deeper muscles (referred to as cross-talk). As a result, fine wire electrodes are used for the determination of activity in relatively large surface muscles such as the rectus femoris (RF) in many clinical settings.

There are many negative aspects to using fine wire electrodes for the determination of muscle activity. Fine wire electrodes take longer to apply than surface electrodes, are invasive and can cause pain, cramping and an increase in tone in persons with spasticity. The variability of the signal associated with the fine wire electrode is also greater than that of the surface electrode [11]. As a result, it would be best to limit their use to those situations when surface electrodes are not an option.

The major reason for using fine wire EMG on surface muscles is the possibility of cross-talk from adjacent muscles confounding the signal of interest. It has been shown that several factors contribute to the presence of cross-talk including the cross-sectional area of the muscle of interest and relative proximity of adjacent and deep muscles and the interelectrode distance (distance between electrodes in an electrode pair) [3,14]. Fuglevand et al. reported that minimizing the interelectrode distance reduces cross-talk primarily from adjacent muscles and that the surface EMG signal is dominated by activity from motor units that are within 10–12 mm from the recording electrode regardless of electrode size.

Therefore, the primary purpose of this study was to

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