



Electromyographic analysis from patterns of activity in gastrocnemius muscle of hemiparetic patients at ages before and after 7 years old

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Introduction

- In 1925 Charles Sherrington introduced the term motor unit to designate the basic unit of motor function – a motor neuron and the group of muscle fibers it innervates.
- In 1929 Edgar Adrian and Deltev Bronk introduced electromyography, a technique for recording the action potentials from single motor unit in human muscles.



- Electromyography (EMG) is a technique concerned with the development, recording and analysis of myoelectric signals.
- Myoelectric signals are formed by physiological variations in the state of muscle fiber membranes.



- Dynamic electromyography (EMG) is the only means of defining the timing and relative intensity of specific muscle action.



- Surface electromyography (EMG) can be recorded from the lower limb musculature during walking activity.
- These signals represent the excitation level of the muscles.



- The mature pattern of muscle recruitment and EMG activation during gait is achieved by an age of six to eight years in normally developing children.



- The ON–OFF pattern of EMG timing for the leg muscles were well established prior to the age of seven.



Differences between mature and immature gait are characterized by:

- 1) Greater co-contraction during stance phase in an immature gait pattern compared to improved reciprocal activation in fully developed gait patterns.
- 2) Improved integration of descending and stretch-reflex activities in mature gait patterns.



- These mature patterns are typically established before age seven with trends toward increased monosynaptic inhibition and polysynaptic development.



- Cerebral palsy (CP) describes a group of disorders of the development of movement and posture, causing activity limitation, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain.
- The motor disorders of cerebral palsy are often accompanied by disturbances of sensation, cognition, communication, perception, and/or behaviour, and/or by a seizure disorder.



- CP is the most common cause of childhood disability in Western societies.
- The incidence is 2-2.5/1000 live births.
- Some affected children do not survive and the prevalence varies between 1-5/1000 children in different countries.



- Spasticity has been characterized by muscle hypertonia, hyperactive deep-tendon reflex, clonus, and velocity-dependent resistance to passive stretch.



Prior electromyographic studies among spastic patients demonstrated:

- Significant delays in initiation and termination of muscle contraction
- Gaps in electromyographic interference patterns
- Abnormal co-contraction of agonist and antagonist muscles
- Abnormal coactivation of synergistic muscles.



- During normal muscle activation, one or more motor units may be activated by different degrees of voluntary effort.
- Individual anterior horn cells fire at faster rates as the effort increases the input to the anterior horn cell pool in the ventral horn of the spinal cord.



- Concurrent with this, more motor units are activated. Activation of additional motor units, called recruitment.



- sEMG activity during walking can range between +/- 5000 microvolts (athletes) and typically the frequency contents ranges between 20 y 150 Hz.



Hypothesis

- Which is the frequency of gastrocnemius activity between immature and mature gait pattern in hemiparetic patients?



Objective

- Determine the frequency of firing gastrocnemius muscle between immature and mature gait pattern



- Determine the frequency of firing gastrocnemius muscle in hemiparetic patients at different ages



Method

- Patients from the CRIT Estado de México with hemiparetic cerebral palsy between 2 and 18 years old.
- Patients with walking or ambulation skill with devices.
- Healthy population



- Electromyographic activity is recorded via conductive solid-gel electrocardiogram neonatal/pediatric disposable Ag-AgCl transcutaneous recording electrodes placed over the motor point of the gastrocnemius medialis.



- The electromyographic signal will be measured between the time of onset of the stance phase through the heel strike and the termination of the swing phase with the beginning of the next heel strike.



- The onset of electromyographic activity was defined visually on the basis of the earliest rise in electromyographic activity beyond the steady state (more than 3 to 5 microvolts).



- Patients within surgery o botulinum toxin in triceps surae at least 6 month before study



- The electromyographic data will be transformed by the Fast Fourier Transform, to obtain the frequency.



Results

- Study has included 13 patients with diagnosis of hemiparetic cerebral palsy with ages between 2 and 15 years old.
- All patients have three trails at least with barefoot walking.



- We hope the tool to measured the muscle activity in gastrocnemius



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