IMMEDIATE EFFECT OF TRANSCUTANEOUS ELECTRICAL NERVE STIMULATION VERSUS CRYOTHERAPY ON CALF MUSCLE SPASTICITY IN CEREBRAL PALSY PATIENTS – AN ELECTROPHYSIOLOGICAL COMPARATIVE STUDY

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ABSTRACT

Background: The disorder of reflex and motor function in Cerebral Palsy (CP) patients causes negative impact on the performance of movement patterns and affects the functional activities.

Aim: Electrophysiological comparison of the effect of Transcutaneous Electrical Nerve Stimulation (TENS) and Cryotherapy on Calf muscle spasticity in CP patients.

Study design – Comparative Experimental Study

Method: The study included 20 CP patients aged 5-18 years with Calf muscles spasticity. Subjects were randomly divided into two groups: TENS Group and Cryotherapy Group. Motor Nerve Conduction (MNC) Studies and H–Reflex for Tibial Nerve were assessed and then each group received two different therapies, following which again the electrophysiological tests were done.

Results: After the use of the TENS, a reduction in the HM Ratio ($p<0.0001$) and increase in H-Reflex latency ($p=0.0003$) was observed. However, after the use of Cryotherapy, an increase of the HM Ratio ($p<0.0001$) was observed, which was accompanied by an increase in the H-Reflex Latency ($p=0.0002$).

Conclusion: The findings of the study suggested that TENS would lead to immediate reduction of spasticity, whereas Cryotherapy would lead to immediate increase of spasticity of Calf muscle in CP patients.

KEYWORDS: Spastic Diplegic Cerebral Palsy; TENS; Cryotherapy; H- Reflex; Modified Ashworth Scale (M.A.S.)

INTRODUCTION

Spasticity is a major challenge to the rehabilitation team. Spasticity can prevent or hamper function, cause pain, disturb sleep, cause unnecessary complications and present major difficulties for care workers[1]. Spasticity has been narrowly defined as a motor disorder characterized by velocity dependent increase in tonic stretch reflexes (muscle tone) with exaggerated tendon jerks[1]. The extent and type of spasticity can fluctuate widely according to position, fatigue, stress and drugs. One limb may have one pattern of spasticity whilst another may have a different pattern[1].

Spasticity in children with brain injury, cerebral palsy or spinal cord injury is very common but often difficult to treat[2]. Cerebral palsy is the most common cause of physical disability affecting children in developed countries, it is the term used for a group of nonprogressive disorders of movement and posture caused by abnormal development of, or damage to, motor control centers of the brain. Prevalence of CP at school age is 2 per 1000 live births in industrialized nations[3].

Cerebral palsy (CP) results mainly from damage to the developing brain before, during, or after birth. It causes various clinical features including developmental delay, motor dysfunctions, proprioception disturbance, postural impairment, seizures, speech disorders, hearing impairment, visual problem and mental retardation[2].

CP has been classified into various types. However, the most common type of CP is Spastic Diplegia. The term "Diplegia" is used to describe CP which affects the lower extremities primarily, with relatively normal upper extremity function[4]. The main physical problem of Diplegic CP is spastic gait. It is characterized by flexion, adduction and internal rotation at the hips, flexion at the knees, valgus at the hindfoot with tight Achilles tendon and supination with abduction at the forefoot[2]. Spasticity is assessed clinically by MAS or Tardieu scale as well as Electrophysiologically by H-Reflex (HM Ratio)[5].

There are numerous ways to treat spasticity. These include stretching, strengthening, orthotics, casting, therapeutic electrical stimulation, nerve or muscle blocks, medications, tendon lengthening and other orthopedic procedures, and dorsal rhizotomy. The goal of these treatments is to increase range of motion of a joint and decrease spasticity. This may help to increase functional mobility[2].

Spasticity in calf muscles has been managed pharmacologically and surgically to improve standing & gait, surprisingly, non-pharmacological management of spasticity calf muscles has not been documented thoroughly.

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Amongst non-pharmacological are TENS and Cryotherapy[6]. Results on the action of TENS and Cryotherapy in the treatment of spasticity are conflicting, and studies on their short-term effects are scarce, hence this study was planned.

AIMS & OBJECTIVES

- To study the electrophysiological effect of TENS on Calf muscle spasticity in CP patients.
- To study the electrophysiological effect of CRYOTHERAPY on Calf muscle spasticity in CP patients.
- To study the electrophysiologic comparison of the TENS and CRYOTHERAPY on Calf muscle spasticity in CP patients.

Experimental Hypothesis- Use of TENS and cryothreapy would have a statistically significant effect on Calf muscle spasticity in Spastic Diplegic CP Patients.

Null Hypothesis - Use of TENS and cryothreapy would not have a statistically significant effect on Calf muscle spasticity in Spastic Diplegic CP Patients.

METHODS AND MATERIALS

Study Population: Spastic Diplegic CP
Age: 5 – 18 years
Sample Size: 20 patients, GROUP A – 10, GROUP B – 10
Study Setting: Shri K. K. Sheth Physiotherapy Center
Sampling Method: Convenient Sampling
Study Design: Comparative Experiment Study.

INCLUSION CRITERIA

- Spastic Diplegic CP with Calf spasticity (M.A.S.: Grade 1 - 3)
- Age Group: 5-18 years
- Both Genders
- Willingness to participate in the study

EXCLUSION CRITERIA

- Ongoing Complains of seizures
- Mentally Retarded
- Surgical treatment at Calf Muscle
- Allergy to Icing
- Unco-operative Patients

MATERIALS

EMG-NCV INSTRUMENT (RMS EP MK-II, Version 1.1), Spirit, Cotton, Surface Electrodes, Electrode Gel, Micropore, TENS Machine, Ice Packs, Straps, Pillow, Towel, Treatment Table.

FIGURE 1: MATERIALS USED

FIGURE 2: ELECTROPHYSIOLOGICAL ANALYSIS

METHODOLOGY

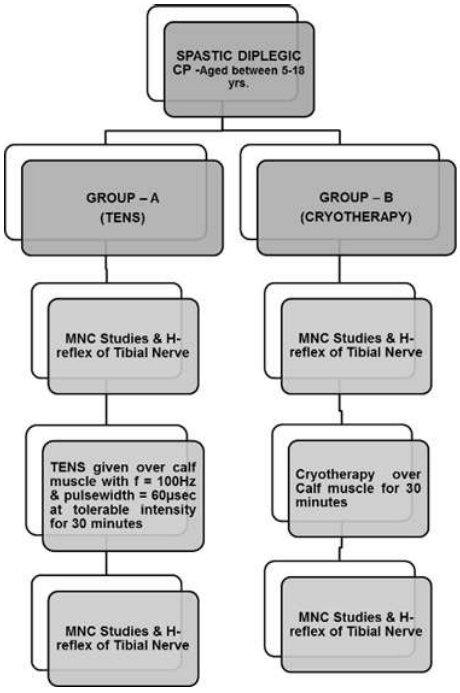


FIGURE 3: ELECTRODE PLACEMENT

OUTCOME MEASURES

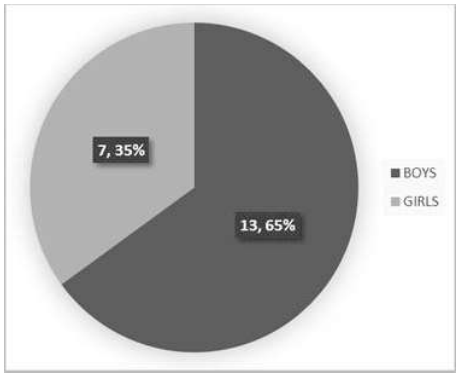
Electrophysiological Analysis – Tibial Nerve MNC Studies & H- Reflex (HM Ratio and H – Latency)

STATISTICAL ANALYSIS

The entire data obtained from the pre and post assessment of H-Reflex within the group was analyzed using paired t- test and calculated using Graphpad Version 3.10

RESULTS

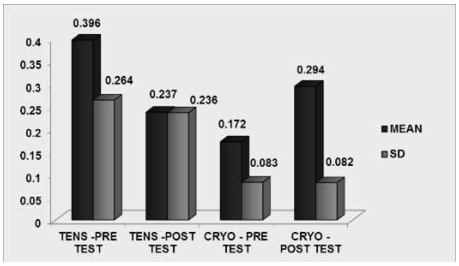
GENDER DISTRIBUTION



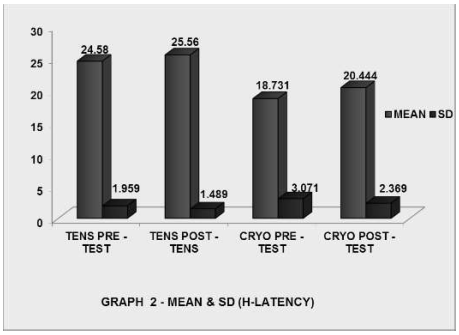
GRAPH 1: GENDER DISTRIBUTION

RESULTS OF STATISTICAL ANALYSIS

- Obtained value for HM ratio of TENS group from two-tailed t test, were p value < 0.0001, considered extremely significant with t = 5.314
- Obtained value for HM ratio of Cryotherapy group from two-tailed t test, were p value < 0.0001, considered extremely significant with t = 7.369
- Obtained value for H-Latency of TENS group from two-tailed t test, were p value was 0.0003, considered extremely significant with t = 4.642
- Obtained value for H-Latency of cryotherapy group from two-tailed t test, were p value was 0.0002, considered extremely significant with t = 5.014



Graph 2: Mean & SD (HM Ratio)



Graph 3: Mean & SD (H LATENCY)

Thus all the data obtained were highly significant at 95% confidence interval.

DISCUSSION

The study results suggests that after the use of the TENS, a reduction in the HM Ratio ($p<0.0001$) and increase in H-Reflex latency ($p=0.0003$) was observed. However, after the use of Cryotherapy, an increase of the HM Ratio ($p<0.0001$) was observed, which was accompanied by an increase in the H-Reflex Latency ($p=0.0002$).

The decreased HM Ratio following TENS application suggests that this treatment led to a reduction in the motor neuron excitability. Martin et al suggested that activating large diameter afferent nerve fibers through TENS may modulate interneuron activities in several spinal segments, which then activate inhibition mechanisms of the presynaptic nerve[6]. An alternative hypothesis is that somatosensory stimulation through TENS due to continuous activation of peripheral nerve fibers causes insensitivity to prolonged central excitation accompanied by lower corticomotor neuron excitability.

An increase in HM Ratio and H- latency was observed following application of cryotherapy suggesting that there was increase in

motor neuron excitability. Similar results were found by Dewhurst et al., suggesting that the mechanism responsible for increasing H-reflex during local cooling might be explained by greater synchronism of prolonged depolarization in afferent fibers[6]. It has been suggested that a change in temperature alters the opening and closing duration of sodium channels along the axon. Thus, cooling reduces depolarization velocity, allowing more sodium to enter the cell, increases latency, amplitude and action potential duration[7].

CONCLUSION

TENS would lead to Immediate Reduction of Spasticity, whereas CRYOTHERAPY would lead to immediate Increase of Spasticity of Calf Muscle in CP Patients.

FURTHER RECOMMENDATIONS

In the light of limitations in the present study, future study can be done using a larger and more homogeneous sample, as well as investigation of long term effect of TENS and CRYOTHERAPY on Spasticity.

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