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"CHRONIC SPINAL ORD INJURY ON FUNCTIONAL PERFORMANCE"

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Abstract: Traumatic spinal cord injury (SCI) is a life changing neurological condition with substantial socioeconomic implications for patients and their care-givers. Recent advances in medical management of SCI has significantly improved diagnosis, stabilization, survival rate and well-being of SCI patients. However, there has been small progress on treatment options for improving the neurological outcomes of SCI patients. This incremental success mainly reflects the complexity of SCI pathophysiology and the diverse biochemical and physiological changes that occur in the injured spinal cord.

***Index Terms* -** spinal cord injury, secondary injury mechanisms, clinical classifications and demography, animal models, glial and immune response

INTRODUCTION

Spinal cord is the central highway for signals traveling between the brain and the rest of the body. It receives sensory information from the periphery and conveys motor commands to the periphery via the nerves branching from it. A cord injury can disrupt activity and sensation in all tissues below the damage. Hence injury at the neck area can erase control over most of the body.[1] Spinal cord injury is a low- incidence, high cost disability requiring tremendous changes in the individual's life style[2]. There is no more formidable disability in the medical experience than quadriplegia. In the past, both physician and patient have approached this disability with an attitude of hopelessness and futility[3]. Instead of adopting an optimistic outlook and attempting alternative strategies for meeting environmental demands, these patients developed an array of symptoms, which could be described by the general label of helplessness[4]. The patient with cervical lesion has partial strength in his upper extremities[5]. However; individuals at the critical functional levels of C_6 and C_7 quadriplegia are on the borderline of achieving total independence in self-care tasks[6]

Since spinal cord injury is a relatively uncommon event, it has been felt that better treatment can be provided if the care is centralized[7]. Survival rate and quality of life following spinal cord injury have improved continuously and dramatically since World War II. At the present time, most patients with spinal cord injuries become functionally independent due to advances in management[8]. Management of spinal cord injury consists of collaborative work in the field of medical surgical and rehabilitation field. Physical rehabilitation programs include: progressive resisted exercises, mat activities; wheelchair transfer training, ball gymnastics, hydro gymnastics, moist heat, massage, passive and active range of motion exercises, revision of the home environment to facilitate activities of daily living, gait training

and orthotics. Recently, muscle feedback has been incorporated into some rehabilitation programs for the spinal cord injured patients[9]

Biofeedback is a form of behavioral medicine, which assists patients in learning enhanced sensory discrimination to facilitate the acquisition of physiological self-regulated skills to reduce symptoms, identify and avoid aggravating status. Biofeedback has been used in clinical settings for the treatment and rehabilitation of injured workers for more than 30 years. As the technology has advanced, treatment protocols have evolved[10,11,12]

The ultimate goal is returning physiological status to the pre-injury status by the greatest extent possible and transferring skills to the workplace to maximize functional tolerance. Education in conjunction with appropriate feedback facilitates transfer of self-regulation skills to ordinary and novel circumstances. Training includes independent practice by the injured person to strengthen new levels of awareness and self-control[10,11]. EMG feedback is continuous and uninterrupted, thus enabling the patient to ‘internalize’ the meaning of audio or visual signals representing muscle responses. Thus, the clinician may use appropriate feedback equipment to help shape muscle response towards restitution of functional activity

REVIEW OF LITERATURE

This chapter deals with spinal cord injury and its possible causes, pathophysiology, its classification, clinical effects with management and functional recovery and feedback in rehabilitation.

The spinal cord is the major conduit through which sensory and motor signals pass between brain and other structures. Injury to the spinal cord results in a disruption of the neural pathways and in a dramatic functional loss.[18] Spinal Cord Injury, which results in damage to the Central Nervous System, is often considered to have a poor prognosis for recovery.[19] Spinal Cord Injury of traumatic origin, may be due to motor vehicle accident, violence, falls, recreational activities. Non-traumatic causes of spinal cord injury involve congenital and developmental anomaly, degenerative Central Nervous System disorders, Genetic and Metabolic causes, Infections, inflammation, degenerative disorders, toxins and tumors.[2,20,21]

Stewart found that maximum movement occurs between 5th and 6th vertebrae. Because of this mechanical phenomenon, this level becomes the logical site of traumatic selection of cervical injuries. It is an unfortunate site because the major nerve roots innervating the triceps muscle are frequently damaged at this level. Since adequacy in crutch walking is dependent on a strong forearm extensor group of muscles (triceps) and other relevant functional activities the significance of trauma at this site is apparent [3]

Pathophysiology

Vascular mechanisms play an important role in primary and secondary injury mechanism that causes damage to the acutely damaged spinal cord. Damage to the spinal cord follows a sequence of events categorized into primary and secondary injury.

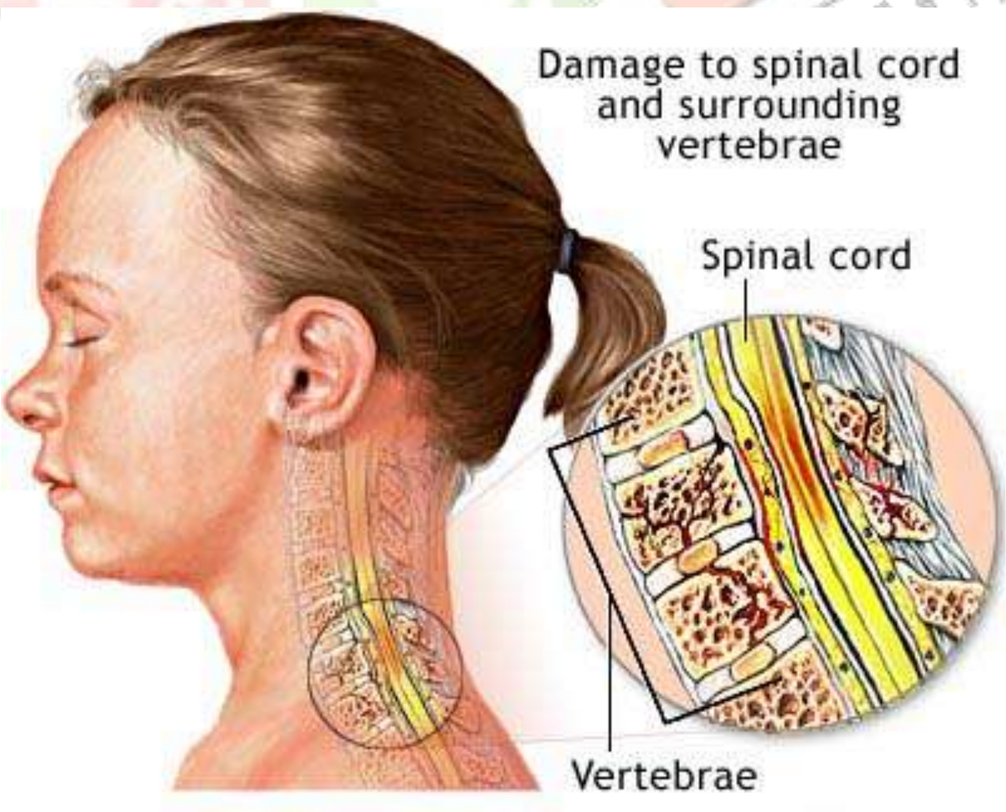


Fig. No. 2.1 Spinal cord injury close view

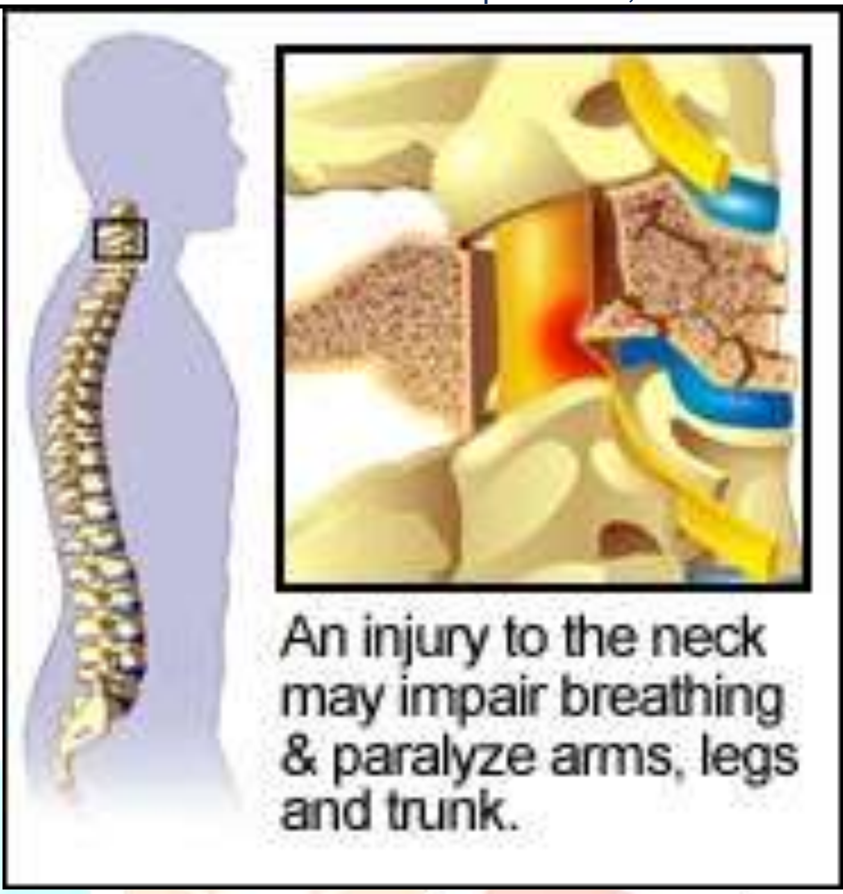


Fig. No. 2.2 Spinal cord injury

METHODOLOGY

This chapter deals with the methods used for this study. These include information on the subjects, instruments used and procedures used in data collection and analysis.

Sample

Sample of convenience was taken.

Participants included 30 [thirty] male and female spinal cord injury persons who were being treated in Indian Spinal Injuries Center, New Delhi. They were selected after meeting the following criteria and were randomly assigned to one of the two groups- Group I=Experimental group [15 subjects] and

Group II=Control group [15 subjects]

Inclusion criteria

Following subjects were included in the study [28]-

1. Patients with stable incomplete myelopathic lesion, as determined by clinical examination with ASIA scale.
2. Patients at least 1 year post injury
3. Neurological level C_6 and above
4. Triceps muscle strength grade 2 as measured by MRC
5. Vision and hearing intact
6. Patients who are able to follow commands.

Exclusion criteria

Following patients were excluded from the study –

1. Spinal shock
2. Patients with peripheral nervous system injury of upper extremity.
3. Upper extremity fracture.
4. Upper limb amputation
5. Upper limb spasticity more than grade 1 as determined by Modified Ashworth Scale
6. Contracture or deformity of upper limb
7. Pressure sore
8. Heterotopic ossification
10. Autonomic dysreflexia
11. Altered sensorium

Design

It was an experimental design.

Variables

EMG amplitude

Quadriplegic Index of Function scores

Spinal Cord Independence Measure scores

Instrumentation

Equipment used was Myomed 932, which is a complete unit for EMG biofeedback, pressure feedback and electrotherapy and electro diagnosis.

Myomed 932, analysis and provide feedback of EMG signal. It consists of 2 independent channels EMG feedback unit. It measures EMG ranging from 4 to

Figure 3.1 Myomed 932

Figure 3.2 Electrodes

10,000 microvolt.

STATISTICAL ANALYSIS

This chapter deals with the procedures in the data analysis of the obtained data.

Performance of characteristics for each group including EMG amplitude, Quadriplegic Index of Function scores and Spinal Cord Independence Measure scores were analyzed using't' tests through SPSS software. Paired't' test was used for analysis within the group and student's't' test was used for inter group analysis. A significant value p ≤ 0.05 was fixed.

RESULTS

This chapter deals with the results of the data analysis of the EMG amplitude and functional scores readings.30 subjects participated in the study and were divided into two groups- experimental group and control group.

Pre and post intervention comparison of results:-

<u>EMG Amplitude</u>

A paired't' test was used to compare the performance within the groups.

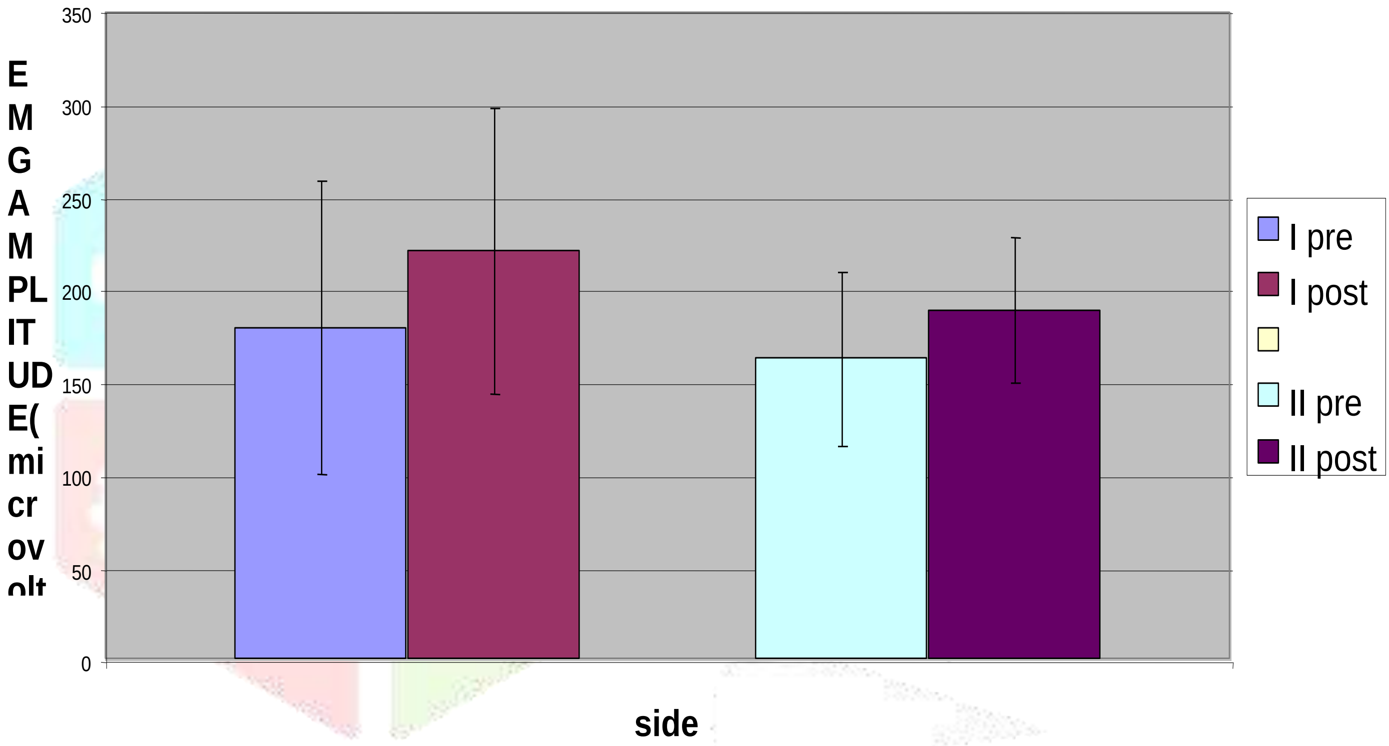
Pre EMG scores of left upper extremity of experimental group [Mean ±standard deviation=193.2±79.063] compared with post EMG scores of left upper extremity [Mean ±standard deviation = 231.8±77.422] Indicates highly significant changes for left side after EMG biofeedback treatment

Pre EMG scores of right upper extremity of experimental group [Mean ±standard deviation= 180± 46.833] compared with post EMG scores of right upper extremity [Mean± standard deviation=177.26±39.246] Indicates highly significant changes for right upper extremity after EMG biofeedback.

Pre EMG scores of left extremity of control group [Mean± standard deviation=151.2±42.87] compared with post EMG scores of left upper extremity [Mean± standard deviation= 177.26± 43.47] Indicates highly significant changes for left upper extremity after conventional treatment.

Pre EMG scores of right upper extremity of control group [Mean± standard deviation=163.2±34.329] compared with post EMG scores of right upper extremity [Mean± standard deviation=189.33±33.014] Indicates highly significant changes for right upper extremity after conventional treatment.

Figure 5.1 EMG - Comparison of EMG amplitude changes in each arm experimental group



I pre – Pre intervention EMG amplitude of left arm in experimental group

I post- Post intervention EMG amplitude of left arm in experimental group

II pre – Pre intervention EMG amplitude of right arm in experimental group

II post- Post intervention EMG amplitude of right arm in experimental group

Quadriplegic Index of Function scores

A paired't' test was used to compare the performance within the group.

Pre QIF scores of experimental group [Mean± standard deviation= 10.46±1.598] compared with post QIF scores of experimental group [Mean± standard deviation=11.26±1.534] Indicates highly significant changes in experimental group after EMG biofeedback.

Pre QIF scores of control group [Mean ±standard deviation=9.86± 0.990] compared with post QIF scores of control group [Mean± standard deviation= 10.13±1.125] Indicates significant changes in control group after EMG biofeedback.

Spinal Cord Independence Measure Scores

A paired‘t’ test was used to compare the performance within the group.

Pre SCIM scores of experimental group [Mean ±standard deviation= 19.93±2.18] compared with post SCIM scores of experimental group[Mean ± standard deviation=21.06± 2.251] Indicates significant changes in experimental group after EMG biofeedback

Pre SCIM scores of control group [Mean± standard deviation=19.8± 2.077] compared with post SCIM scores of control group [Mean ±standard deviation= 20.06±2.282] Indicates significant changes in control group after EMG treatment.

Comparison of results in between two groups

EMG Amplitude

A student’s‘t’ test was used.

Pre EMG scores of left side of experimental group [mean ±standard deviation==193.2±79.063] compared with pre EMG scores of left side of control group [Mean± standard deviation =151.2±42.871] Indicates non-significant difference in EMG scores of left side between experimental and control group before treatment.

Post EMG scores of left side of experimental group [Mean ±standard deviation =231.8±77.422] compared with post EMG scores of left side of control group [Mean ±standard deviation=177.2±43.473] Indicates significant difference in EMG scores of left side between experimental and control group after treatment.

Difference of EMG scores of left side of experimental group [Mean ±standard deviation =38.6±10.901] compared with difference of EMG scores of left side of control group [Mean ±standard deviation=26.06±7.950] Indicates highly significant difference in EMG scores of left side between experimental and control group.

Pre EMG scores of right side of experimental group [Mean ±standard deviation =180±46.833] compared with pre EMG scores of right side of control group [Mean ±standard deviation=163.2±34.329] Indicates non-significant difference in EMG scores of right side between experimental and control group before treatment.

Post EMG scores of right side of experimental group [Mean ±standard deviation=221.26±39.246] compared with post EMG scores of right side of control group [Mean ±standard deviation=189.33±33.014] Indicates significant difference in EMG scores of right side between experimental and control group after treatment.

Difference of EMG scores of right side of experimental group [Mean ±standard deviation =41.26±24.309] compared with difference of EMG scores of right side of control group [Mean ±standard deviation=26.13±4.941] Indicates highly significant difference in EMG scores of right side between experimental and control group.

Mean EMG scores of experimental group [Mean standard± deviation=39.93 ±15.269] compared with mean EMG scores of control group [Mean± standard deviation=26.1±5.465] Indicates highly significant difference in mean EMG scores between experimental and control group after treatment

Quadriplegic Independence of Function

Pre QIF scores of experimental group [Mean± standard deviation=1O.46± 1.598] compared with pre QIF scores of control group [Mean ±standard deviation= 9.86±0.990] Indicates non-significant difference in QIF scores between experimental and control group before treatment.

Post QIF scores of experimental group [Mean ±standard deviation= 11.26±1.534] compared with post QIF scores of control group [Mean ±standard deviation=10.13±1.125] Indicates significant difference in QIF scores between experimental and control group after treatment.

Difference of QIF scores of experimental group [Mean= 0.8±standard deviation = 0.676] compared with difference of QIF scores of control group [Mean= 0.2 ±standard deviation= 0.458] Indicates highly significant difference in QIF scores between experimental and control group after treatment.

Spinal Cord Independence Measure

Pre SCIM scores of experimental group [Mean ±standard deviation= 19.93±2.187] compared with pre SCIM scores of control group [Mean ±standard deviation=19.8±2.077] Indicates non-significant difference in SCIM scores between experimental and control group before treatment.

Post SCIM scores of experimental group [Mean ±standard deviation=21.06 ±2.251] compared with post SCIM scores of control group [Mean ±standard deviation= 20.06±2.282] Indicates non-significant difference in SCIM scores between experimental and control group after treatment.

Difference of SCIM scores of experimental group [Mean ±standard deviation =1.13±1.506] compared with difference of SCIM scores of control group [Mean± standard deviation=0.26±0.458] Indicates significant difference in difference of SCIM scores between experimental and control group after treatment.

DISCUSSION

This chapter deals with discussion of the findings of this study with critical analysis and co-relates with previous studies and for future improvements and studies possible in this field.

The study resulted in the following main findings-Both EMG biofeedback and physical therapy resulted in highly significant increments in the EMG activity. Application of EMG biofeedback in addition to physical therapy led to significant improvement in functional scores.

Both feedback and physical therapy was shown to produce highly significant increments in the electromyographic activity. However, the mean difference for experimental group was higher than the control group. The results of this study is similar to the results of previous studies[19,45,51,66]. EMG activity, reflecting motor unit recruitment in the target muscle was significantly greater with EMG feedback as compared with contractions attempted by the other patients under the same conditions without EMG biofeedback. Increased EMG activity was attributable to the specific effects of the biofeedback display. The data indicate that biofeedback can significantly increase voluntary EMG responses from specific muscles below the level of injury in long term spinal cord injury. Because the study population included only long term injured persons, improvement were probably not related to spontaneous recovery [45].

Possible neuronal mechanisms that can be suggested for increased surface EMG generated in the muscles through the use of biofeedback are-Increased firing rates in the population of motor units that were activated before biofeedback. Increased number of motor units recruited to fire. Increased synchronization of motor unit firing so that less cancellation occurs in the surface EMG. An improved safety factors in neuromuscular transmission so that muscle fibers continued to fire for longer periods of time or at higher rates of activation. Sprouting of motor nerve terminals to innervate additional muscle fibers .

SUMMARY AND CONCLUSION

Although both the groups showed significant improvement, but there was more improvement in the experimental group as compared to the control group. Application of EMG biofeedback in the experimental group led to the significant improvement in the functional scores of the patient. Thus, it can be concluded that EMG biofeedback can be used as an adjunct to physical therapy in functional performance in spinal cord injured patients.

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