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Research Article

ANALYZING LOWER LIMB REFLEX AND TONAL RECOVERY AFTER APPLICATION OF TOE SPREADER IN ACUTE STROKE HEMIPLEGIC SUBJECTS

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Abstract

Stroke is the major disease that leads to an increase in the number of people with motor or sensory impairment and loss of function on one side of the body (hemiplegia). Many devices used to inhibit excess the tonic toe flexion like orthosis, toe spreader in chronic stroke patients. The main purpose of the present study is to investigate the effect of toe spreader to facilitate normal tonal recovery and reflex in acute stroke subjects. Twenty stroke subjects were randomly assigned into two groups i.e. group A (toe spreader group) and group B (conventional therapy group). After taking the informed consent, pretest score of tone and reflex were recorded. Group A received passive range of motion exercises repeated 10 times at each joint of affected lower limb with toe-spreader for five days. Group B received passive range of motion exercises for five days. Post test scores of tone and reflex were recorded on the six day after treatment. Experimental group showed more significant normal tonal recovery as compared to control group. There were no significant changes in reflexes in both groups. Toe spreader group showed more significant improvement in normal tonal recovery as compared to control group. Significantly prevent extensor synergy in lower limb in experimental group i.e. Group A.

Keywords: Stroke, toe-spreader, tone, passive movement, reflex.

INTRODUCTION

Major risk factors in stroke for men are hypertension, clinical evidence of cardiac disease, transient ischemic attack, diabetes mellitus, elevated blood cholesterol and lipids, cigarette smoking, excessive alcohol intake, physical inactivity, and obesity[1]. Patient diagnosed with stroke often present with a one side muscle weakness combination of decreased postural control, muscle spasticity, poor voluntary control and body mal-aligment[2]. About half of all stroke survivors have a significant persisting neurological impairment and disability (Tennant *et al*., 1997). Initially flaccidity is present immediately after stroke and is due primarily to the effects of cerebral shock. It is generally short-lived, lasting a few days, or weeks[3]. A variety of therapeutic approaches are used in treatment of patients with stroke such as propriceptive neuromuscular facilitation, brainstorm etc.[4] One of the neurophysiological approach to improve the functional recovery in the patients is Bobath. K. Bobath and B. Bobath developed treatment designed to increase normal movement patterns in hemiplegia[5,6]. The treatment in the acute case makes subsequent restoration of function of affected limbs during the residual stage. According to them, quicker and better results could be obtained if, during the early stage while the patient is still in hospital, the emphasis in treatment is planned. The goal of their treatment was to retrain normal movement responses on the patient's hemiplegic side because we cannot superimpose normal on abnormal patterns. After cerebrovascular accident, most patients the flaccidity that follows the acute episode is sooner or later replaced by spasticity[7]. It is during the early spastic period that the hemiplegic limb synergies make their appearance, either as reflex responses or as voluntary movement or both. Extensor synergy dominates in lower extremity[8]. As a result of a cerebrovascular accident, the tonic toe flexion reflex has been seen. It is hollowing out of the sole and exaggerated curvature of the foot due to toe flexion and adduction with foot inversion. It prevents normal plantar surface contact with the ground and weight transfer from lateral border of the foot. Many devices used to inhibit excess the tonic toe flexion like orthosis, toe spreader in chronic stroke patients[9]. It decreases tonic toe flexion which is useful treatment option for improving gait. The toe spreader is a device used to inhibit excess the tonic toe flexion. Abduction of the toes by the toe spreader, appears to inhibit toe clawing and extensor spasticity of the foot, and often inhibits extensor spasticity of the entire lower extremity in patients with hemiplegia[10]. As toe-spreader has proved to be highly successful and highly clinically effective in improving standing and gait in chronic hemiplegic subjects. Since this has not yet been used in acute stage therefore as using bobath approach, the treatment in the acute stage for subsequent restoration of function of affected limbs during the late stage, the toe-spreader is use in acute stroke subjects as early rehabilitation result in the avoidance of increase abnormal tone in lower limb as well as to see the reflex changes.

Methodology

A total of 20 subjects examined, included for physical therapy after stroke with age range 50 to 70 under the guidelines of informed consent. The 20 subjects were randomized into one of two groups: the experimental group (Group A) and the control group (Group B). The intervention conducted in neurology ward in HIHT University-India for 1 Year. Subjects selection criteria were diagnosis of stroke, both male and female, stroke subjects between 5 to14 days, lower limb voluntary control less than or equal to 2, tone in affected lower limb according to modified ash worth scale "0",reflex grade less than 2. Exclusion criteria: history of previous stroke, uncooperative subjects**,** amputation below knee joint, edema in lower limb.

Procedure

The subjects were screened based on the selection criteria and divided equally in two groups. Consent was taken and the purpose, procedure of the study has been explained to the caretakers. Group A (n = 10) which underwent toe-spreader (experimental group) and Group B (n = 10) which underwent conventional physiotherapy intervention (Stretching and AT Exercises). Pre-test score of tone and reflexes was measured by Modified Ashworth Scale, knee hammer respectively. Intervention was administered continuously 5 days for 1 week. Subjects in both groups were treated one session each day for a one week. Next on 6 day post test score, for above outcome measures were taken. At the end comparison between the two groups was calculated.

Experimental group (Group A)

In this group 10 subjects underwent 2 interventions, which consisted of passive movements and the toe spreader.

Therapist Position

The therapist positioned herself in a stride standing position towards the affected side of subjects.

Patient position

Subjects were in the supine position.

Intervention

After positioning, subjects were received passive range of motion exercises for the affected lower limb. Each joint movement i.e. hip, knee and ankle was repeated 10 times during intervention. After passive range of motion, toe spreader will be placed between the toes of the subjects for 5 days. It will be re arranged daily at the time passive movements given to the subjects. To assess the effect of intervention, the post score of tone and reflex was taken.

Control group (Group B)

Therapist Position

The therapist positioned herself in a stride standing position towards the affected side of subjects.

Patient position

Subjects were in the supine position.

Intervention

After positioning, subjects were received passive range of motion exercises for the affected lower limb. Each joint movement i.e. hip, knee and ankle was repeated 10 times during intervention.

Data Analysis

Statistics were performed by t- test within the group and between the groups. A significant level of $P > 0.05$ was set for data analysis.

RESULT

Table 1: Comparison of Tone changes in lower ext. between Group-A and Group-B in 7 day of Training

Knee Flexor Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	1.2 + 0.6325	7.779	< 0.0001[s]
Post, Group B	0.1 + 0.3162		
Knee Extensor Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	0.1 + 0.3162	4.071	0.0007[s]
Post, Group B	1 + 0.6236		
Ankle Dorsiflex Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	0.95 + 0.599	2.01	0.003
Post, Group B	0.11 + 0.21		
Ankle Plantarflex Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	0.2 + 0.6325	3.019	0.0077[s]
Post, Group B	1.1 + 0.6992		
Ankle Inversion Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	0.01 + 0.12	1.012	0.001[s]
Post, Group B	0.1 + 0.3162		
Ankle Eversion Tone	**Mean + SD**	**t- value**	**P-value**
Post, Group A	0.3 + 0.4830	1.14	0.001[s]
Post, Group B	0.1 + 0.111		

Inter group analysis for reflexes in between group A and group B shows not significance differences. Thus an overall analysis of various scores showed that experimental group (group A) prevents increase in anti-gravity muscles tone in lower limb but no significant changes in reflexes in both group.

DISCUSSION

This study employed a experimental design to facilitate normal tonal recovery of lower limb with toe-spreader intervention in acute stroke hemiplegic patients. The influences of the etiology and lesion site were not analyzed because of the small number of subjects

The toe-spreader used in this study was designed to evaluate the effectiveness of toe –spreader in accelerating normal tonal recovery and to establish evidence based clinical

significance of toe-spreader in facilitate normal tonal recovery in acute stroke hemiplegic patients. The intervention involves the use of toe-spreader with conventional therapy. The effect of the intervention on reflex and tone at knee and ankle joint were evaluated using reflex grading, modified ash worth scale respectively. Result of the present study supported our hypothesis and hence toe-spreader intervention was found to be effective technique in field of rehabilitation. The result of the present study indicate that the outcomes measure i.e. tone represents normal motor recovery of the lower limb in hemiplegic stroke patients improved significantly by toe-spreader intervention in the acute phase.[11] A normal tonal recovery implies that the extensor synergy develop in lower limb after stroke can be prevent by using toe-spreader. Although reflex changes in both group are not significant. Use of the toe- spreader did not significantly affect reflex. The possible explanation for improvement in tone in group A (experimental group) can be due to inhibition of toe plantar flexion and abduction of toes by toe spreader. Such results are thought to the shunting rule of Magnus (1924, 1926). He stated that at any moment, the central nervous system mirrors the state of elongation and contraction of the musculature. It means that the state of muscles, therefore, determine the distribution of excitory and inhibitory processes within the central nervous system and subsequent outflow of excitation and inhibition to the periphery.[12.13] It is the body musculature which controls the opening and closing of synaptic connections within central nervous system and determines the subsequent outflow[14,15]. Sherrington found that the same stimulus applied within the same receptive field of a particular reflex could produce directly opposite results. For instance, pinching of toe of extended leg produced a total flexion movement of leg with flexion and abduction[16,17]. Pamela, Linda Rogers and Richard *et al* have suggested that toe-spreader inhibit extensor spasticity of entire lower extremity in patients with hemiplegia[18,19].

Figure 1: Toe spreader

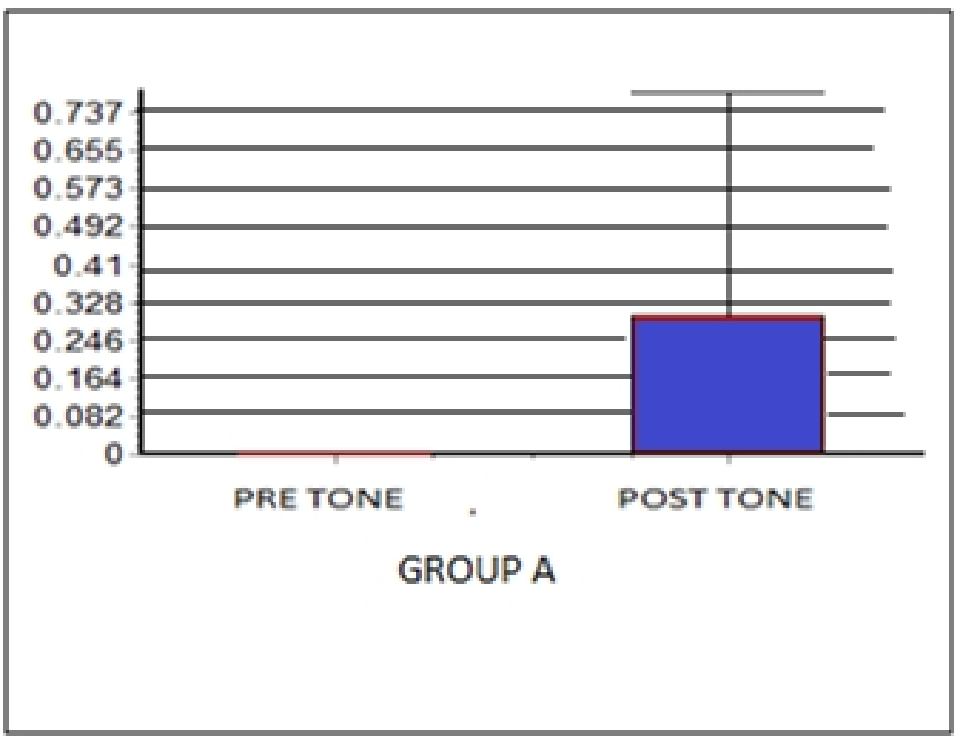
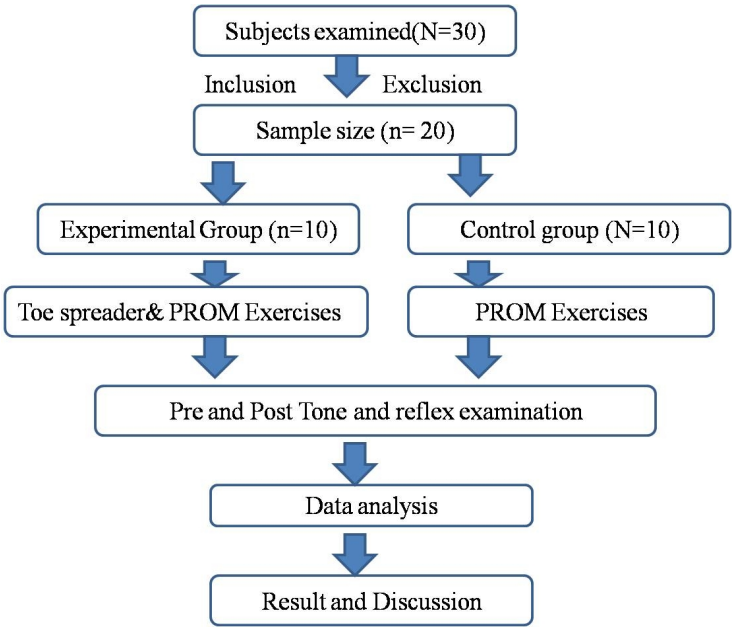


Figure 2: Pre and post test comparison values for subjects in Group A A (Ankle Eversion)



PROCEDURE FLOW CHART

CONCLUSION

Toe spreader group showed more significant improvement in normal tonal recovery as compared to control group. Significantly prevent increase in extensor muscles tone on affected lower limb experimental group i.e Group A.

Clinical Implications

Stroke is a major cause of disability, with up to two- thirds of stroke survivors experiencing impaired function in the paretic leg. There are many different therapeutic approaches for treating abnormal movement pattern but not much of importance was given to facilitate normal tonal recovery after stroke. Therefore present study incorporates bobath approach which prevents abnormal increase in tone and facilitation of normal tonal recovery. Hence toe –spreader technique with conventional therapy should be widely accepted and introduced in stroke patients to facilitate normal tonal recovery.

Limitations of the Study

The study was done on a small sample size. Treatment session was of short duration i.e. 1 week due to inability of subjects to stay in hospital for desired duration. Data for gender, post stroke duration and territory involved was not analyzed. Therefore the influence of these factors on reflex and tone was not recorded.

Future Research

The Duration of treatment session and sample size can be increased. The same study can be done for upper extremity. Effect of toe- spreader on different types of stroke can also be studied and compared.

Conflict of Interest- No conflict of interest is reported among the authors regarding the research.

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