Original Article

EFFICACY OF ISOKINETIC STRENGTH TRAINING AND BALANCE EXERCISES ON LOWER LIMB MUSCLES IN SUBJECTS WITH STROKE

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ABSTRACT

Background: To evaluate the efficacy of isokinetic strength training and balance exercises on lower limb muscles among the subjects suffering with stroke. **Materials and Methods:** 40 subjects who are suffering from stroke were divided into two groups, Experimental group received Isokinetic strength training and balance exercises (n=20) and Control group received conventional physiotherapy, results were measured with Isokinetic device and Berg balance scale for peak torque of knee extensors on paretic leg and balance respectively. **Results:** obtained results were analyzed with the use of Paired T-test, which has been carried out to observe the treatment impact between the groups before and after the treatment. After a 6 week treatment period, the subjects in the Group I (strength training and balance exercise) compared with the subjects in the Group II (conventional physiotherapy) had shown a statistically significant improvement with the outcome measures at 0.05 level.**Conclusion:** Isokinetic strength training and balance exercise was found much effective in improving strength of quadriceps lower limb and balance in subjects with stroke.

KEY WORDS: Cerebro-Vascular Accident (CVA); Upper motor neuron (UMN); Berg balance scale (BBS); Range of motion (ROM); Center of mass (COM); Base of support (BOS)

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INTRODUCTION

Stroke (cerebro-vascular accident) is rapidly developing deficit to the brain which may be due to disturbance in the blood supply. This can be due to ischemic changes which will be resulting due to the thrombosis, embolism and hemorrhage.

As stroke is a major health problem in every part of the world. It is also considered as the most life threatening neurological condition of elderly and the most common cause of adult disability, Stroke is a major cause of disability: 25% of stroke survivors live with minor disability, 40% with moderate to severe disability and 10% require long-term care (Heart & Stroke 2003)[1,2].

Men have a higher incidence of stroke than women. After Coronary heart disease (CHD) and cancer, stroke is the 3rd most common cause of death worldwide.

In the early 1980s the prevalence rates of stroke was around 500-700 / 100,000 in western countries and 900 / 100,000 in Asia. According to world health organization the incidence of stroke was 130/100,00 in 2009.

A large number of survivors of stroke present with various disabilities, including impairment of sensory, motor, mental, perceptual and language functions. The motor deficits are characterized by paralysis (hemiplegia) or weakness (hemiparesis) on one side of the body opposite to the site of the lesion [3].

As stroke leads to weakness and impaired balance which is due to reduced activity of lower limb muscles. The weakened muscles are exposed to different activities and functions after stroke which causes type II fibers atrophy and predominance of type I are seen in paretic limb. The strength deficit in paretic side of body is by reduction in muscle fiber number and increase fatigability and decreased motor unit recruitment and its altered recruitment. Stroke subjects likely develop lower oxidative capacity along with impaired blood flow. Due to altered muscle fiber composition and impaired neural drive the rate of torque development is more deteriorated in paretic muscles [2,5]. Stroke patients frequently develop balance impairments with increased risk of fall, the main components which interpret balance is interaction of many physiological systems[6,9]. These are the Biomechanical constraints, cognitive processing, Perception of Verticality, Movement strategies, Sensory integration and Sensory modalities.

MATERIAL AND METHODS

Subjects were collected from the department of physiotherapy, Sri Venkateswara Institute of Medical Sciences (SVIMS) Tirupati. The study sample of 40 subjects between 30-50 years. Prospective randomized experimental control study. Inclusion criteria 30-50 years, both male and female, both right and left hemiplegics, first time onset of stroke and Subjects with Modified Ashworth scale of 1+, 2.

Exclusion criteria for the study were subjects with hemianopsia, Contractures in lower limb, Any cognitive or sensory deficits are stroke patients, Other neurological and musculoskeletal conditions, People with cardiovascular diseases, Recurrent stroke, Participants who cannot comprehend and obey verbal commands.

Simple random sampling, the subjects were selected by lottery method. Study was conducted by using the Isokinetic analyzer #850-0001, Stationary bicycle, Wobble board, Football. All subjects who were selected on the basis of inclusion criteria were divided into two groups: Group I, Group II with 20 subjects in each group. All subjects who were selected underwent strength assessment through the ISOKINETIC ANALYSER for knee extensor peak torque which is measured by N-m[2]. Each subject performed a practice trail consisting of three sub maximal knee extension and flexion at 30°/s, 60°/s and 90°/s angular velocity before recording the data. All subjects who were selected underwent balance assessment through the berg balance scale.

PROTOCOL FOR GROUP I: The subjects in Group I was trained with quadriceps and hamstring muscles stretches for 65sec each, continued for 6 repetition of affected leg. This is followed with warm up on a stationary bicycle for 10-minutes. Then the subjects were trained for strength of quadriceps on ISOKINETIC DEVICE for 6 to 8 repetitions are performed. After strengthening exercises subjects were trained for static and dynamic balance exercises. The static balance exercises are as follows:

STATIC BALANCE EXERCIESE: These are performed to improve control in sitting and standing positions. Subjects follows sequence to develop sitting or standing control (patient can skip any step in which they have good control)

SITTING: Sitting with 2 hands support, sitting with 1 hand support, sitting unsupported, Change the sitting surface from hard to soft.

STANDING: Standing in parallel bar with 2 hands support followed with 1 hand support, standing unsupported, changing the base of support wider to narrow base of support, tandem standing one foot in front of another foot, standing on one leg and followed with dynamic balance exercises as below.

DYNAMIC BALANCE EXERCISE: After achieving unsupported sitting, patient is asked to look up and down; from side to side this activates the vestibular system, reaching activities on same -

side and then contralateral side both in sitting and standing, sitting to standing with both hands support followed by one hand and then without support, stepping forward and backward is trained first in parallel bar with one or two hands then without parallel bar, standing to supine on mat and then moving back to standing, balance on wobble board and weight shifting in forward and side to side direction, kicking ball activities, walking through obstacles, walking with various speeds from slow to fast , walking on different surfaces from hard to soft.

PROTOCOL FOR GROUP II: The subjects in group II was treated with conventional physiotherapy which is as follows: Active exercises for muscles of hip, knee, ankle, pelvic bridging, modified pelvic bridging, stretches to hamstring, quadriceps, plantar flexors, strengthening exercises for lower limb muscles by 1 kg cuff and manual resistance. Mat activities in prone lying by prone on elbows, prone on hands , quadruped position , kneeling , half kneeling, kneel walking, standing with double limb support ,standing with single limb support, manual perturbations when subject stands with wider base of support and then training with narrow base of support.

OUT COME MEASURES: Pre values and post values are taken from the patients before and after 6 weeks of training session through Isokinetic analyzer and berg balance scale.

RESULTS

Statistical analysis was done using the statistical soft ware “spss 16.0 version”.

After a 6 week treatment period, the subjects in group I (isokinetic strengthening and balance exercises) and Group II (Conventional physiotherapy) had shown improvement with the outcome measures; but on comparing group I with group II, group II had shown a statistically significant improvement at 0.05 level with the outcome measures i.e.; isokinetic peak torque at 30Ú/s shows(p=0.018), 60Ú/s shows (p=0.031), 90Ú/s shows (p=0.015) and berg balance scale and its score shows (p=0.004).

TABLE - I: Analysis of Group – I (control group) Paired t-test has been used.

Parameter	N	MEAN	SD	t-value	Df	p-value
30°PRE	20	53.38	19.1	6.099	19	0.001*
30°POST	20	60.41	20.16			
60°PRE	20	46.66	18.27	6.081	19	0.001*
60°POST	20	52.64	17.41			
90°PRE	20	40.23	17.09	2.315	19	0.03*
90°POST	20	43.16	16.8			
BBS PRE	20	39.75	8.23	8.133	19	0.001*
BBS POST	20	44	7.32			

* indicates significant at 5% level

TABLE - II: Analysis of Group – II (experimental group) Paired t-test has been used.

Parameter	N	MEAN	SD	t-value	Df	p-value
30°PRE	20	50.15	19.58	11.742	19	0.00*
30°POST	20	76.68	21.43			
60°PRE	20	43.45	18.18	10.419	19	0.00*
60°POST	20	65.78	19.52			
90°PRE	20	38.4	18.99	7.635	19	0.00*
90°POST	20	57.61	19.18			
BBS PRE	20	39.55	4.817	15.427	19	0.00*
BBS POST	20	49.8	4.36			

* indicates significant at 5% level

TABLE-III: Comparison between experimental group and control group was done by Unpaired t-test has been used.

Parameter	N	MEAN	SD	t-value	Df	p-value
GROUP I 30°POST	20	60.41	20.16	-2.47	38	0.018*
GROUP II 30°POST	20	76.68	21.43			
GROUP I 60°POST	20	52.64	17.4	-2.24	38	0.031*
GROUP II 60°POST	20	65.78	19.52			
GROUP I 90°POST	20	43.16	16.8	-2.53	38	0.015*
GROUP II 90°POST	20	57.61	19.18			
GROUP I BBS POST	20	44	7.327	-3.04	38	0.004*
GROUP II BBS POST	20	49.8	4.36			

* indicates significant at 5% level

DISCUSSION

The aim of the study was to evaluate the effectiveness of isokinetic strength training and balance exercises on strength of lower limb muscles and balance in subjects with stroke.

The results of the present study revealed significant differences exist between the two groups that received the isokinetic strength training along with balance exercises and conventional physiotherapy. Hence, the alternate hypothesis stating that there is significant improvement with isokinetic strength training along with balance in subjects with stroke can be accepted and the null hypothesis can be rejected.

Subjects who received isokinetic strength training along with balance exercises and conventional physiotherapy showed improvement in peak torque in 30°/s, 60°/s, 90°/s angular velocity and berg balance scale – score. But comparing experimental group with conventional group, isokinetic strength training and balance exercises (experimental group) seems beneficial results.

Muscle weakness in quadriceps on the paretic side is well known phenomenon [11] and this weakness develops in first week following stroke [10] Previous studies have shown an overall loss of the muscle mass, type II fiber atrophy and predominance of type I fibers in paretic muscles after stroke [12] Bourbonnais and vanden Noven (1989) and Newham and Hsiao (2001) showed the stroke patients have disturbed central activation, which would lead to an impairment of the ability to maximally drive their muscles and most probably also to altered coordination of muscles involved.

Thus there is clear evidence that change in muscle fiber composition, characterized by selective type II fiber atrophy and predominance of (slow twitch oxidative) type I fibers, has been shown in paretic muscles. Some strategies could be considered 'perturbations' which causes behavior to move out of stable pattern into a period of instability and then into a new pattern [13].

The natural study on the patients did provide a proven insight into distinction of which mode of treatment between both the groups was better and found strength training and balance exercises are proved in improving strength of lower limb and balance.

The positive results from table II might have occurred because of the underlying physiology behind the improvement in both motor unit recruitment and firing and motor learning frequency and by rotation in sitting.

However there was a significance result in the table III with strengthening and balance exercises, when t-test performed to find out the efficacy of strengthening and balance exercises over conventional physiotherapy in improving strength of lower limb and balance.

This study also showed that Conventional physiotherapy was effective in improving strength and balance in table I, but the strengthening and balance exercises group was proved much better than conventional physiotherapy group. This study shows a considerable improvement in strength of lower limb and balance in subjects with stroke.

In this way, the result of present study indicates strength training and balance exercise were proved to be effective intervention than conventional physiotherapy on strength of lower limb and balance in subjects with stroke ,through physiological and as well as statistical measures.

CONCLUSION

This study had shown that in hemipelgia, the Group-I given with Isokinetic strength training for knee extensors and balance exercises was better than Group-II with conventional physiotherapy over the 6-week treatment.

Group-I showed considerable improvement in outcome measures i.e.; Isokinetic Peak Torque of knee extensors of paretic leg and balance through Berg Balance Scale. This study was done on knee extensors of lower limb on paretic side with balance exercises and found that there was increase in strength and improvement in balance.

FURTHER RECOMMENDATIONS

i)Studies may further be conducted on other muscles also.

ii)Follow up is necessary for the recurrence rate of strength decline after 6 weeks.

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