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Effectiveness of Otago Exercise Versus Task Oriented Progressive Resistance Strength Training on Balance and Functional Performance in Stroke Patients

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ABSTRACT

BACKGROUND:
Stroke is one of the main causes of adult disability worldwide and global health problem. Due to ongoing neurological sequelae post stroke patients have a two-fold higher risk of falling than other people with same age or gender. Around 85% of these patients have residual symptoms of paralysis post stroke, which predisposes them for fall. Balance disorders reduces the independence and level of participation in community. As the stroke patients balance is impaired and can lead to complications such as fall, knowing the questions related to balance and gait will be important in order for these two physical capabilities to be better understood in hemiparetic patients. Promising interventions that could be beneficial to improve the aspects of gait include fitness training, high intensity therapy and repetitive task training.

AIM: The aim of this study is to compare the effectiveness of Otago exercise versus Task oriented progressive resistance strength training on balance and functional performance in stroke patients.

METHOD: 30 hemiplegic stroke patients able to ambulate independently will be taken for the study. The subjects were divided in two groups. Pre-test assessment (Berg balance scale, timed up and go test) will be taken. Group A will be given Task oriented progressive resistance strength training with Conventional Physiotherapy and Group b will be given Otago exercise program fifty minutes each session three times per week for 4 weeks. Then post-test assessment (Berg balance scale, timed up and go test) will be taken.

RESULT: Statistical analysis was done within group using paired t test, which showed significant improvement post exercise protocol in both the groups with p value 0.001. Statistical analysis done between the group using unpaired t test, which showed significant improvement in Group B compared to Group A, with the effect size for group A is 4.89 for BBS and 3.24 for TUG and the effect size for group B is 7.47 for BBS and 4.69 for TUG. Which shows Group B is better than Group A.

CONCLUSION: Otago exercise and Task oriented progressive resistance strength training were significant in terms of clinical outcome and both shows equal p- value of 0.001. the effect size of group B for BBS and TUG is more as compared to group A BBS and TUG, which shows group B is more effective.

Keywords: Stroke, Otago exercise program, Task oriented progressive resistance strength training, balance, functional performance, BBS, TUG.

INTRODUCTION

Stroke is a clinical syndrome marked by the sudden onset of localized neurological indications that persist longer than 24 hours or result in death, and is thought to be caused by a vascular problem. This definition includes stroke both due to infarction and due to haemorrhage.[1] Stroke is the second or third most common cause of death, one of the main causes of adult disability worldwide and global health problem.[2] It can be caused by a number of different pathologies which all result in a usually sudden-onset focal cerebral damage.[1] The majority of strokes are caused by intracerebral bleeding, with a small percentage caused by subarachnoid haemorrhage. The remaining 80% are due to ischemic stroke which itself has a number of different subtypes, including large artery disease, cardio embolism, and small vessel disease.[1]

Stroke patients have a two-fold higher risk of falling than other people with same age or gender. In particular 30% to 50% of elderly those over 65 years old experience falls every year.[3] Loss of independent community ambulation is one of the most disabling consequences of stroke.[4]In a recent meta-analysis, women with stroke had 30% lower odds of receiving tissue plasminogen activator than did men, and some studies have reported greater in-hospital delays in women with stroke.[5] More than 85% of these patients experience hemiplegia immediately after stroke. Hemiplegia is divided in two types: Congenital and Acquired. Congenital hemiplegia happens before, during or soon after the birth (up to two years of age approximately), and those that occur later in life as a result of injury or illness, in which case it is called as Acquired hemiplegia.[3]

Most risk factor includes: -Age - Age is the strongest risk factor for both cerebral infarction and primary intracerebral haemorrhage. For example, the risk of stroke is more by 25 times in people aged 75–84 years then the risk in people aged 45–54. Gender - Male gender is a risk factor for stroke, however because of their longer life expectancy and the relevance of age as a risk factor, more men die from stroke than women. Blood pressure - Increasing blood

pressure is a major risk factor for stroke and is strongly and independently associated with both ischemic and haemorrhagic strokes. Smoking - Cigarette smoking people are more prone to develop the risk of stroke. Carbon monoxide and nicotine enter the bloodstream when you inhale cigarette smoke. Nicotine makes the heart beat quicker and increase blood pressure, while carbon monoxide reduces the amount of oxygen content in blood giving rise to stroke. Diabetes mellitus– Diabetes is also a risk factor of stroke. It is said to be a risk factor for both carotid atherosclerosis as well as large vessel disease. Body mass index and physical exercises–Increase in body mass index is a risk factor for stroke although it is partly because of its association with other risk factors such as hypertension and diabetes. Other risk factors for stroke include migraine, especially migraine with aura, and the oral contraceptive pill (especially oestrogen-containing versions). Hormone replacement therapy appears to increase the risk of stroke, particularly soon after its initiation.[1]

Clinical features of stroke divided according to arterial territory a) Anterior circulation – carotid territory symptoms are Amaurosis fugax/retinal infarction (ophthalmic artery), Hemiparesis, Hemisensory loss, Hemianopia (optic tract and radiation), Dysphasia (expressive and/or receptive) if dominant hemisphere, Sensory inattention, Visual inattention, Neglect. b) Posterior circulation – vertebro-basilar territory symptoms are Ataxia – cerebellum and brainstem cerebellar connections, Cranial nerve nuclei involvement, Diplopia and extraocular eye movement disorders, Facial sensory loss, Facial palsy – lower motor neuron (affects upper and lower face), Dysphagia, Vertigo, Hearing disturbance, Vomiting, Dysarthria, Hemiparesis (descending corticospinal tract) – can be bilateral weakness, Hemisensory loss (ascending sensory tracts) – can be bilateral sensory loss, Hemianopia – occipital lobe involvement, Cortical blindness – basilar artery occlusion, causing ischemia in both occipital cortices.[1]

Balance disorders in patients with stroke cause restrictions in daily living activities, which in turn reduces their independence and their level of participation in community.[6]

Since most patients with stroke will survive the initial illness, the greatest health effect is usually caused by long term consequences for patients and their families. Over the next two decades, the prevalence of stroke-related burden is predicted to rise. Promising interventions that could be beneficial to improve the aspects of gait include fitness training, high intensity therapy and repetitive task training.[7]

Acute reperfusion therapy is founded on the idea that the degree and duration of

ischemia determine whether a given area of ischemic brain tissue becomes irreversibly damaged (i.e., infarcted). The only treatment for acute ischemic stroke currently approved by the US Food and Drug Administration is the administration of alteplase (IV-tPA) within 3 hours of symptom onset (FDA).[8] Large cerebral infarction has a high case fatality. The result of this syndrome remains bad despite the administration of standard medical treatments such as hyperventilation, mannitol, diuretics, corticosteroids, and barbiturates. Decompressive surgery to relieve intracranial pressure is performed in some cases, although evidence of any clinical benefits has not been available until recently.[9]

Physiotherapy is established component of stroke rehabilitation but uncertainties remain about the most appropriate intensity of therapy input.[10]Physiotherapy in the rehabilitation of stroke patients is represented by various approaches, e.g. Proprioceptive Neuromuscular Facilitation, Brunnstrøm, Bobath and the Motor Relearning Programme.[11]The Bobath concept represents a theoretical framework in a reflex-hierarchical theory, while Motor Relearning Programme is based in system theory, and is basically task oriented.[11]

When walking, stroke patients typically demonstrate impaired balance and compensatory movements in various portions of their bodies, have difficulty performing activities of daily living, and may sustain injuries from falls. Various interventions, such as virtual reality, robotics and mental practice with motor imagery, have been studied to improve the gait ability of stroke patients.[12]

The Otago exercise program (OEP) was developed at Otago Medical School. OEP is an evidence-based fall prevention program developed and designed for the performance in home by Physical Therapist.[3] The Otago Exercise Program (OEP) is one of the most recent home-based exercise training programs. The OEP was first introduced in New Zealand.[13] OEP is composed of three domains, namely muscle strengthening, balance training and walking.[3]

The measures used to avoid falls in the elderly are called Otago exercises. OEP is a muscle strengthening and balance retraining program.[3] The Otago exercise program (OEP) is one of the most recent home-base exercise training programs.[13]

Task oriented strength training performed at a high intensity may enhance walking competency in people with stroke. Many randomized control trial studies, found circuit training to be effective in improving walking ability and postural control with standing, in patients after chronic stroke.[2]

Progressive resistance strength training refers to progressive increase in resistance to a muscle as training induces greater

ability to produce and sustain force. This programme was designed to strengthen the muscles of the lower extremities while performing the functional activities. Previous studies illustrated the beneficial transfer effects of task-oriented strength training in disabled older adults and traumatic brain-injured patients.[14] The key elements of progressive resistance strength training are to provide sufficient resistance, to progressively increase the amount of resistance as strength increases and to continue the training program for sufficient duration (a minimum of four weeks) for benefits to accrue.[14]Progressive resistance strength training has been used successfully to restore function in older adult with chronic disease and frailty.[14] The purpose of the study was to There is loss of balance after stroke thereby decreasing the ability to perform ADL, so using Task oriented progressive resistance strength training to find out the effectiveness of balance and functional performance in Stroke patients. There is increased risk of fall because of loss of balance in stroke patients, so using Otago exercise program to evaluate the effect of balance in Stroke patients. There is scarcity of study done to compare Otago and Task oriented strength training in stroke patients. So, need to conduct the study is to find out effectiveness of Otago exercise versus Task oriented progressive resistance strength training on balance and functional performance in stroke patients.

The aim of the study was to compare the effectiveness of Otago exercise versus Task oriented progressive resistance strength training on balance and functional performance in stroke patients.

The objective of the study was to evaluate the effectiveness of Otago exercise and Task oriented progressive resistance strength training to improve balance using Berg balance scale (BBS) in stroke patients. The second objective of the study is to evaluate the effectiveness of Otago exercise and Task oriented progressive resistance strength training to improve functional performance using time up and go test (TUG) in stroke patients.

MATERIALS & METHODS

MATERIALS:

1. Different height Chairs
2. Different size blocks
3. Stopwatch

METHODOLOGY:

- Type of study - Comparative study
- Study design - Randomized clinical trial
- Study duration - 6 months
- Type of sampling - Randomized sampling
- Sample size –30 (15 in each group)
- Study setting –Tertiary Care Hospital, Miraj

PROCEDURE

- Ethical clearance was obtained from Institutional Ethical Committee. Participants were screened based on the inclusion and exclusion criteria. Both males and females of age group between 45 to 75 years old were included in the study. Informed consent was obtained from the participants and procedure was explained to them in their vernacular language. Subjects were randomly divided in two groups. Group A was given Task oriented progressive resistance strength training with Conventional Physiotherapy for 50 mins 3 times per week for 4 weeks. Group B was given Otago Exercise for 50 mins times per week for 4 weeks.

TASK ORIENTED PROGRESSIVE RESISTANCE STRENGTH TRAINING INTERVENTION

- Progressive resistance strength training Program was designed as circuit class, with

  subjects completing practice at a series of work station.
- The work stations were designed to strengthen the muscle in bilateral lower limb.
- The 6 work stations incorporated in circuit were:
- Standing and reaching in different directions for object located beyond the arm's length, Sit to stand from various chair heights to strengthen the lower limb extensor muscles, Stepping forward and backward on to blocks of various heights, Stepping sideways on to blocks of various heights, Forward step upon to blocks of various heights, Heel raise and lower while maintaining in standing posture to strengthen plantar flexor muscles.
- Each works station was 5 mins in duration for each exercise class. Progressions included increasing the number of repetitions completed within 5 mins at workstation and increasing complexity of exercises, such as distance reached in standing, reducing the height of chair during sit to stand and height of blocks.
- Conventional Physiotherapy given were active assisted range of motion exercises for upper and lower extremity, functional mobility exercises and balance training.

Fig no.1. Sit to stand from various chair height.

Fig no.2. Stepping forward and backward on blocks of various height.

Fig no.3. Conventional Physiotherapy- Active range of motion of hip

OTAGO EXERCISE PROGRAM (OEP)

- Muscle strengthening, balance training, and walking are the three

domains of the Otago exercise programme.

- OEP starts with head movement, neck movement, back extension, trunk movement and ankle movement. The muscle strengthening exercises includes front knee strengthening exercise, back knee strengthening exercise, side hip strengthening exercise, calf raises, toe raises. Balance training includes knee bend, backward walking, walk and turn around, sideways walk, heel toe stand, heel toe walk, one leg stand, heel walk, toe walk, heel toe walking backwards, sit to stand and stair walk.
- This program is done for 50 mins, 3 times / week for 4 weeks.

Fig no.4. Back extension

Fig no.5. Ankle movements

Fig no.6. Front knee strengthening exercise

Fig no.7. Walking and turning round

Statistical Analysis: Statistical analysis will be done using paired and unpaired t test.

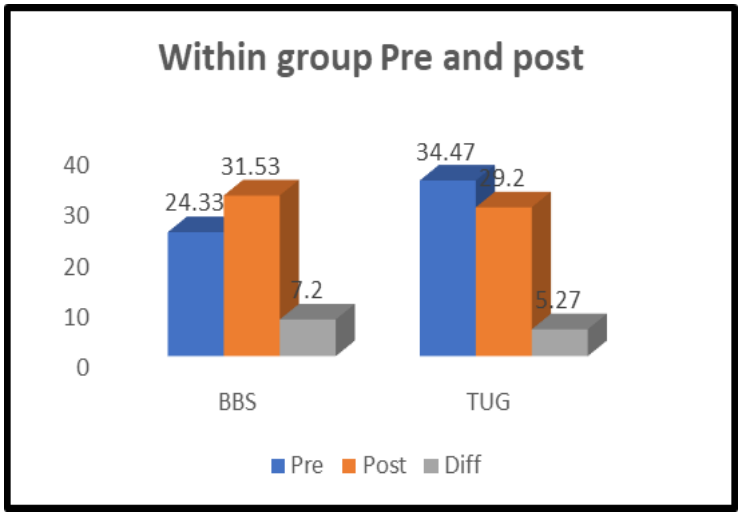
Paired t test is used to check pre and post data of one group. Unpaired t test is used to check data within different groups.

RESULT

Data analysis was performed using statistical package for the social sciences (SPSS) software. Group A and Group B data was analyzed using paired and unpaired t test.

Variable	Pre		Post		Diff		Effect size	t– value	p – value
	Mean	SD	Mean	SD	Mean	SD			
BBS	24.33	7.02	31.53	6.61	7.20	1.47	4.89	18.924	0.001*
TUG	34.47	11.19	29.20	10.77	5.27	1.62	3.24	12.558	0.001*

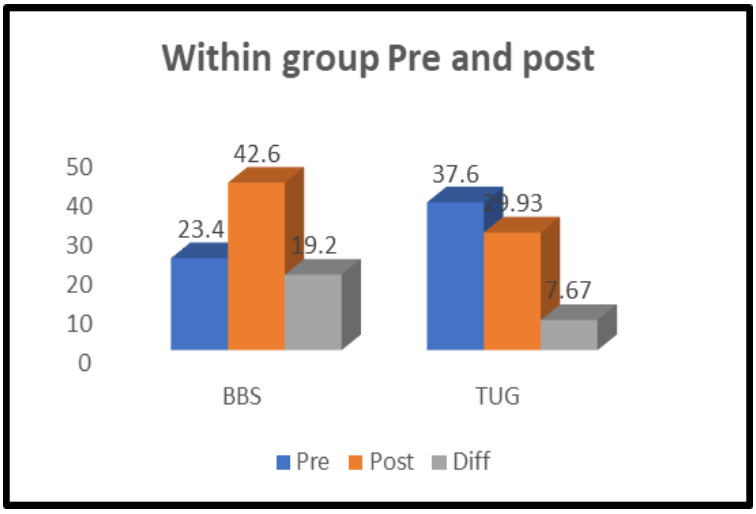
Table no 1: shows the pre and post mean, standard deviation, difference, t-value, p-value of berg balance scale and time up and go test in group A



Graph no 1: shows the pre and post mean and difference of berg balance scale and time up and go test in group A

Variable	Pre		Post		Diff		Effect size	t– value	p – value
	Mean	SD	Mean	SD	Mean	SD			
BBS	23.40	4.82	42.60	6.38	19.20	2.57	7.47	28.945	0.001*
TUG	37.60	8.01	29.93	8.27	7.67	1.63	4.69	18.183	0.001*

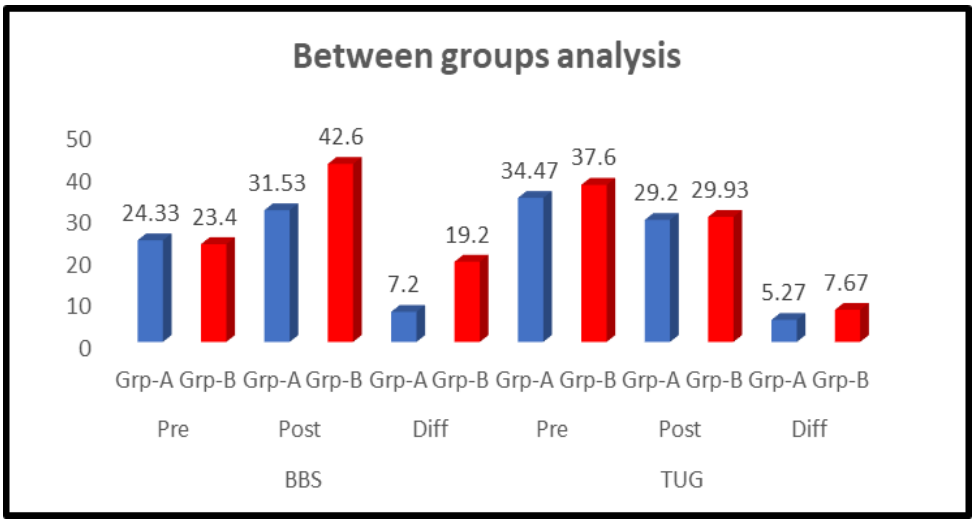
Table no 2: shows the pre and post mean, standard deviation, difference, t-value, p-value of berg balance scale and time up and go test in group B



Graph no 2: shows the pre and post mean and difference of berg balance scale and time up and go test in group B

Variable	Time frame	GROUP	Mean	SD	t-value	p-value
BBS	Pre	Grp-A	24.33	7.02	0.425	0.674
		Grp-B	23.40	4.82		
	Post	Grp-A	31.53	6.61	4.666	0.001*
		Grp-B	42.60	6.38		
	Difference	Grp-A	7.20	1.47	15.692	0.001*
		Grp-B	19.20	2.57		
TUG	Pre	Grp-A	34.47	11.19	0.882	0.385
		Grp-B	37.60	8.01		
	Post	Grp-A	29.20	10.77	0.209	0.836
		Grp-B	29.93	8.27		
	Difference	Grp-A	5.27	1.62	4.036	0.001*
		Grp-B	7.67	1.63		

Table no 3: shows pre and post analysis between berg balance scale and time up and go test in group A and group B (mean, standard deviation, t-value, p- value)



Graph no 3: shows pre and post analysis between berg balance scale and time up and go test in group A and group B of mean and difference

Variable	Group A Effect size	Group B Effect size	Remarks
BBS	4.89	7.47	Group B is better
TUG	3.24	4.69	Group B is better

Table no 4: shows the comparison between berg balance scale and time up and go test in group A and group B (level of significance)

Results from analysis:

- From the above within group A analysis using paired sample t test, it is observed that BBS mean value indicated changes post treatment and higher mean values are recorded for post treatment outcome (table no. 1, graph no.1).
- From the above within group A analysis using paired sample t test, it is observed that TUG mean value indicated changes post treatment and lower mean values are recorded for post treatment outcome (table no. 1, graph no.1).

- From the above within group B analysis using paired sample t test, it is observed that BBS mean value indicated changes post treatment and higher mean values are recorded for post treatment outcome (table no. 2, graph no.2).
- From the above within group B analysis using paired sample t test, it is observed that TUG mean value indicated changes post treatment and lower mean values are recorded for post treatment outcome (table no. 2, graph no.2).
- From the above table it is observed that between groups analysis is significant for BBS at post and difference values but for TUG it is only significant for difference at 5% level significance since p-value is less than 5% level(i.e.,0.001<0.05)
- Thus, it is inferred that there is a substantial statistically significant difference between the groups and group B is better based on the higher mean values at post and difference as observed from the above table.

DISCUSSION

This study was intended to compare the effectiveness of Otago exercise versus Task oriented progressive resistance strength training on balance and functional performance in stroke patients. Thirty patients were divided in two groups of 15 participants each. In my study there was inclusion of both male and female participants and pre and post assessment of Balance and Functional mobility was done by 1.) BBS and 2.) TUG test respectively. BBS was taken by assessing the ability of patients to perform functional task which has 14-items scale to measure balance of older adults and TUG was used to evaluate a person's mobility and it necessitates both static and dynamic balance.

An independent gait increases the confidence of an individual and makes life more productive. The ankle strategy and hip strategy shows an improvement with the practice of Otago exercise. Hence, the body can move as a single entity about the ankle when the foot muscle is activated on the ground. When the body travels faster as the distance between them grows, the hip technique is adopted. Walking, posture control with relation to movement correction and muscle activation pattern, and balance control with reference to the base of support are all benefits of the Otago exercise.[3,18]

More importantly, the task-oriented progressive resistance strength training programme can improve lower extremity strength and functional performance, and the lower extremity strength gain is significantly associated with gain in functional tests such as gait velocity, cadence, stride length, six-minute walk test, step test, and timed up and go test.[14]After analyzing the results of this study, we found that task-oriented circuit training improved gait endurance in subacute stroke patients.[2]

Sebin Jose et al (2018) This study was an experimental approach to find the effectiveness of Otago exercise program on improving balance, quality of life and reducing fall risk in hemiplegic patients. The mean age of the subjects was 68.2 and 67.53 in group A and group B respectively. In this study 8males and 7 females participated in group A and 9 males and 6females participated in group B who were diagnosed with hemiplegia for 6 months. The mean BMI in group A and group B was 23.03 and 23.14 respectively. Group A subjects were given conventional treatment and Group B received an Otago exercise program (OEP) plus conventional treatment, for 4 weeks, three days per week, and each session was of 50 minutes. The Berg Balance Scale was used for balance assessment, SF-36 Questionnaire for quality of life, and Timed Get up and Go Test to estimate fall risk. Both groups showed improvement, a significant improvement was shown by Group B that is experimental group where OEP along with conventional physiotherapy significantly improved Balance, Quality of Life and Risk of Fall in hemiplegic patients.

Another study by Yea-Ru Yang, Ray-Yau Wang et al (2006) aimed that Task-oriented progressive resistance strength training improves muscle strength and functional performance in individuals with stroke. This study included Forty-eight subjects at least one year post stroke. Participants randomly divided two groups, control (n=/24) and experimental (n=/24). Control group subjects did not receive any rehabilitation training. Subjects in the experimental group received a four-week task-oriented progressive resistance strength training. The progressive resistance strength training programme has been demonstrated to improve muscle strength post stroke. In the present study, the task-oriented progressive resistance strength training programme improved lower extremity strength and also resulted in reductions in functional limitations. These results suggest that it is possible for task-oriented progressive resistance strength training to induce increases in muscle strength that can be transferred to improved functional performance.

Ali Dadgari, Tengku Aizan Hamid et al conducted a study to examine the effects of OEP to decline the incidence of falls among elderly community dwellers. The study's key benefit was that it was conducted on a normal community population, which included all senior persons of both sexes from both rural and urban areas. Subjects of the study (n = 317) were recruited from elderly senior citizens at public health centres. Block systematic random sampling was applied to divide the subjects in experimental and control groups. The experimental group (n = 160) received OEP

which was for six months and was compared with the control group (n = 157) who received general health training. Subjects were recruited from a population of elderly people with experience of at least one episode of fall. The OEP is a programme that combines muscular development, balance training, and walking to help senior persons avoid falling. The results of this study states that a six-month home-based exercise training program, with supervision of a trained family member as a caregiver, can improve physical functioning and functional balance among elderly community-dwellers.[13]

Another study by Ha-Na Yoo, Eung Jung Chung et al aimed that the effect of augmented reality- based Otago exercise on balance, gait, and fall efficacy of elderly women. The subjects were 21 elderly women who were divided into two groups: augmented reality-based otago included 10 subjects, and Otago exercise included 11 subjects. Subjects were evaluated pre and post for balance (BBS), gait parameters (velocity, cadence, step length, stride length) and fall efficacy. For 60 minutes, 12 weeks, three times per week. In addition, as muscle mass declines and postural sway increases, the motor nerve's reaction time slows, resulting in changes in balance control, which increases the frequency of falls. The result of this study suggests the feasibility and suitability of augmented reality-based Otago exercise for elderly women.[18]

In the present study the comparison between Otago exercise and Task oriented progressive resistance strength training was done on 30 stroke patients. The results shows that both the protocols are useful to improve balance and functional performance. Higher the effect size outcome is better recovery or health improvement post intervention. So, the effect size for group A is 4.89 for BBS and 3.24 for TUG and the effect size for group B is 7.47 for BBS and 4.69 for TUG. Hence, the study shows that Otago exercise (group B) is more significant than task oriented progressive resistance strength training (group A).

CONCLUSION

Otago exercise and Task oriented progressive resistance strength training were significant in terms of clinical outcome and both shows equal p- value of 0.001.

The effect size for group A is 4.89 for BBS and 3.24 for TUG and the effect size for group B is 7.47 for BBS and 4.69 for TUG. So, the effect size of group B for BBS and TUG is more as compared to group A BBS and TUG, which shows group B is more effective.

Hence the study conducted that the Otago exercise and Task oriented progressive resistance strength training are effective, simple and easy to apply to improve balance and functional performance in stroke patients. As a result, it can also be used in clinical settings.

The Limitations of the study are:

1. Proper distribution of side of hemiparesis can be mentioned.
2. The study can be done on chronic stroke patients

Suggestions for further studies:

1. Comparison between male and female can be done.
2. Study can be done on larger population.

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Ethical Approval: Approved

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