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Original Research Article

To Study Effects of Yoga Therapy on Balance in Post Stroke Hemiplegic Patients

Dr. Anupama Anant Paranjape[1], Dr. Archana Gore[2]

[1]Physiotherapist at Small Steps Child Development Centre &Morris Autism Centre, Deenanath Mangeshkar Hospital, Near Mhatre bridge, Erandwane, Pune 411004
[2]Assistant Professor at Physiotherapy Department, Seth GSMC & KEMH, 402, PT department, Dhrumal Bajaj Orthopaedic Centre, Opposite TATA Hospital, Seth GSMC & KEMH, Borges road, Parel, Mumbai 400012

Corresponding Author: Dr. Archana Gore

ABSTRACT

Introduction: Stroke is the common cause of chronic disability and it leads to balance impairments, frequent falls, improper gait and poor quality of life. The complexity of balance control and the need to be independent in functions with confidence and reduced falls lead to the need for studying effects of other approaches to the conventional rehabilitation for enhancing the balance control after stroke. Yoga has originated in ancient India and recent evidences show positive effects of yoga for people with range of other neurological disorders. So purpose of the study was to see effects of yoga therapy on balance in post stroke hemiplegic patients.
Objectives: To compare post therapy balance between conventional and yoga group and to assess pre and post therapy balance in both groups using Bergs balance scale (BBS) and Fullerton advanced balance scale (FAB)
Method: 30 post stroke hemiplegic subjects were randomly assigned into two groups, 15 in each group. Conventional group received six conventional balance exercises and yoga group received six yoga asanas for 40 minutes, 4 times a week for 3 weeks.
Results: Intra group pre and post therapy scores of BBS and FAB improved significantly in both groups ($p>0.001$) however intergroup post therapy BBS ($p=0.436$) and FAB ($p=0.512$) scores comparison did not show statistical significance.
Conclusion: Both conventional therapy and yoga therapy improve balance in post stroke patients.

Key words: Stroke, BBS, FAB, Yoga therapy.

INTRODUCTION

A stroke or brain attack is the sudden loss of neurological function caused by an interruption of the blood flow to the brain. Hemiplegia is severe or complete loss of motor function on one side of body. Stroke can be caused due to thrombotic or embolic infarction or due to haemorrhage, and it is the most common cause of chronic disability. [(1)] Main difficulties associated with hemiplegia are alteration in tone, loss of selective movements and balance reactions and improper ambulation. [(2)] Balance is an integral component of daily functional activities, and there are many factors such as sensory, neuro-motor, and musculoskeletal which lead to balance impairment, frequent falls, and add to disability and poor quality of life in these patients. [(3)] Hence post stroke balance rehabilitation is essential. For balance rehabilitation numbers of interventions have been published evaluating the effects of newer rehabilitation methods other than conventional therapy. Many studies used

new methods such as biofeedback therapy, short-form tai chi, kinaesthetic ability training device, virtual reality treadmill training for balance rehabilitation in stroke population. [4-7] As newer methods are being used in balance rehabilitation it has been proposed that yoga therapy which is less expensive and simple; can be used to improve balance in post stroke patients. [8] Recent non Cochrane review suggested that yoga can be used as a self-administered practice in stroke rehabilitation. [9]

Commonly, Yoga is translated to imply the union of body, mind, and spirit. Hatha yoga is one of the most well-known branches of yoga and which uses a combination of postures (asanas), breathing, and meditation. [10] According to International Association of Yoga, Yoga therapeutics is defined as the application of yoga for health benefits. [8] Yoga therapy consists of the application of yogic principles, methods, and techniques to specific human ailments. In yoga, the mind is encouraged to focus specifically on what is occurring in the body and where the body is in space, thus increasing awareness. On the physical level, yoga postures, called asana, which can be done alone, as the limbs of the body provide necessary weight and counterweight. Yoga therapy employs simple postural, breathing, relaxation and meditation practices, taking into account medical diagnoses and holistic factors. [11] There are several asanas in yoga therapy which can be used for improving balance.

Measurement of recovery after stroke is important with the advent of new treatment options under investigation in stroke rehabilitation and research. Bergs Balance Scale (BBS) is a 14 item objective measure designed to assess static and dynamic balance in stroke patients. Excellent interrater and intrarater reliability and construct validity have been demonstrated for BBS. Thus the BBS is highly recommended as a clinical and research tool for evaluating improvement in balance in stroke. [12] Fullerton Advanced Balance Scale (FAB) is another scale used to assess static and dynamic balance under varying sensory conditions. Some components of FAB are more challenging to perform than BBS.FAB has been determined to be valid and reliable in stroke. [13]

There are several studies showing effects of yoga therapy on individuals without any pathology and there are studies which have showed effects of yoga therapy in other neurological disorders. [14, 15] Yoga is originated in India but very few Physiotherapy centers offer yoga therapy for stroke patients. Very few studies have been done to see effects of yoga in stroke and in the published research; study sample sizes are small, biased and non-randomized. [16] Thus well-designed studies may provide some important guidelines. Hence aim of this study was to know effects of yoga therapy on balance in post stroke hemiplegic patients. Objectives were to compare post therapy balance between conventional and yoga group and assess pre and post therapy balance in conventional and yoga group using BBS and FAB.

MATERIALS AND METHODS

Approval for the study was taken from the Institutional ethics committee of Seth GSMC & KEMH and the approval committee of Maharashtra University of Health Sciences Nasik.54 post stroke hemiplegic subjects from physiotherapy OPD of GSMC & KEMH hospital were screened according to inclusion criterion in period of January 2014- August 2015. Inclusion criterion was patients with onset of stroke 3 months to 1 year period, ambulatory with or without aid and with BBS score less than 45, FAB score less than 30. An informed consent form was signed by subjects who were ready to participate and were randomly assigned using computer generated table into two groups, 15 in conventional group and 15 in yoga group. All subjects were assessed for outcome

measures BBS and FAB scales by principal investigator (PI). Both scales have been determined to be valid and reliable to use for assessment of balance in stroke patients. Conventional group received conventional therapy and yoga group received yoga therapy for 40 minutes a day, 4 days a week for 3 weeks. Reassessment was done after 3 weeks of intervention.

Intervention:

Conventional therapy included routine exercises like Sit to stand from a chair, Half kneeling (floor/mat) to standing, Forward lunges, Tandem stance, Heel raises and One leg standing postures and movements. [(1,17,18)] First week subjects were given minimal assistance by PI if required and asked to maintain each position for 10 sec and repeated5 times. Constant verbal feedback was given by PI for postural correction and motivation. Whenever required, tactile cues were also given to make their performance better. Gradually, in second week subjects were asked to maintain each position for 15 sec and repeated 5 times. Then in third week subjects were asked to do all exercises independently and maintain each position for 20 seconds and repeated 5 times. Constant supervision was given for each session. For some subjects, one leg standing was difficult to maintain on affected leg independently, so it was allowed to perform with minimal support. Subjects were supervised and advised against breath holding.

In Yoga therapy; the asanas were explained to the subjects of this group by demonstration and showing images by PI. Asanas involving muscle work similar to muscle work required for improving balance were selected. They were selected in view of ease of understanding, performing and ability to challenge balance in an individual with stroke. Following asanas were included for yoga therapy group: Ekpadahastasana, Utkatasana, Veerasana, Trikonasana, Tadasana and Vrukshasana. [(19-21)]

1. Ekpadahastasna is a hand to one foot pose. This started by individual standing erect and keeping one foot forward. Upper limbs were raised above the head, and keeping the knee straight they started to bend forward slowly through trunk. They tried to touch fingers to toes. Normal breathing was maintained while maintaining this posture for 15- 30 seconds. While coming back to starting position individuals were asked to raise the body gradually by taking up the trunk, the neck and the head. Same procedure was asked to be repeated with other leg ahead. In this asana posture is asymmetrical with narrow base. Hands being raised the centre of mass also is higher. Bending requires eccentric control of back extensors and concentric work of oblique abdominals. Muscles of lower extremity are also put under static work to maintain stance. Coming up requires concentric work of back extensors, hip extensors and static work of foot intrinsic. PI constantly supervised the subject for maintaining shoulders square, pelvis obliquity, knee extension, and toes firmly on ground especially of affected limb and breath control. Individual was also given cues to maintain adequate weight bearing on each limb rather than more on non-affected side.

2. Utkatasana resembles a chair pose. Individual stood with feet shoulder width apart and hands placed ahead in forward flexion. He /she slowly squatted down as if sitting on a chair, maintained this position for 15 - 30seconds and then slowly came up to standing position with hands slowly moving down. Performing this asana required static work of back extensors and foot intrinsics. Hip extensors, quadriceps and plantar flexors eccentrically contract to lower the body to chair pose. Maintaining this posture required good coordination between these muscles along with co contraction of back extensors and abdominals. Rising up is brought by concentric work of hip extensors, quadriceps and plantar flexors. The

individuals were supervised for symmetry of posture, synchrony of movement, breath control and maintenance of balance. Constant motivation was provided to increase the time of holding this asana.

3. Veerasana resembles warrior pose. Individuals in standing position took one leg as ahead as possible bending the anterior knee. The posterior leg was extended at knee. Both hands were taken together overhead and they extended their trunk and the neck to look up. They maintained this posture for 15 – 30 seconds. While releasing the asana, trunk and head returned to neutral position followed by hands and leg. They repeated the same asana taking other leg forward.

This asana involves asymmetrical standing with narrow base of support and higher center of mass bringing about more muscle work. It causes spinal stretch along with challenge to balance causing greater postural awareness. Breathing normally in this posture brings about a better mind body connect. Looking upwards in challenged posture caused reduced visual reliance for balance to allow better integration of proprioception, vestibular and tactile senses. The PI supervised the individual for maintenance of trunk extension without increased lumbar lordosis, assisting affected upper limb elevation and prevented them from closing eyes.

4. Trikonasana resembles triangle pose. Individual stood with feet apart. They raised their upper limbs to horizontal position, bent through trunk laterally as much as possible so as to touch the ground with that side hand. Individuals were asked to breathe out while bending to the side. Other hand was elevated and touched the head laterally. The posture was maintained for 15-30 sec. The same activity is repeated on other side. The individuals were supervised for adequate weight bearing equally on both lower limbs, to prevent knee hyperextension and prevent breath hold. This asana causes body weight to be distributed asymmetrically causing co-contraction of hip abductors, abdominal obliques and quadriceps. Weight bearing on affected side creates better body awareness and positive schema.

5. Tadasana resembles palm tree pose. The individuals stood with feet apart, raised hands together above head and raised body upwards standing on toes. They were asked to feel stretch in the body from toes to finger tips. They maintained this posture for 15- 30 seconds and then released it slowly, taking heels and hands down simultaneously. This asana brings about a greater challenge to balance in an individual with stroke due to postural control maintained on toes only. Maintaining trunk erect with upper limbs in elevation also creates greater co contraction in various muscles of entire body along with better postural awareness. PI supervised the individual for creating optimal plantar flexor concentric work, neutral pelvis obliquity and synchronous breathing. Gentle touch was provided to reduce fear of fall as and when required. Also they were coaxed to maintain balance in this posture for longer than 15 seconds.

6. Vrukshasana is a pose that resembles a tree. The subjects stood with feet apart, one foot over the opposite leg's thigh, in abducted and externally rotated position. Both hands were placed overhead together. They maintained this position for 15-30 seconds on both sides alternately. This position had to be held with high center of mass over one foot thus challenging balance. PI supervised the subjects for preventing hyperextension especially of affected leg and also gave verbal feedback to ascertain elevation of upper extremities and maintenance of posture for longer time. The posture had to be maintained on one foot causing intrinsic muscle work of both sides, concentric work of abductors, elevators of arm and co contraction of trunk muscles especially on affected side.

Progression-In second week, subjects were instructed to do asanas

independently, with 2 repetitions and hold time was 60 seconds. Third week all asanas were maintained for 120 seconds and repeated twice. Few subjects could not maintain Vrukshasana for long time on affected side, so minimal support was given to maintain correct posture.

Statistical Analysis:

Statistical analysis was performed using SPSS (Statistical Package for Social Sciences) for windows, version 17. Baseline characteristics of the two treatment groups' namely conventional group and yoga group were compared to evaluate the success of randomization. Depending on the results of the Kolmogorov- Smirnov test for normality; if the data was found to be normally distributed, baseline characteristics were compared by unpaired t test, if found not normally distributed then Mann-Whitney U test was used and Fisher exact test was used for categorical data. Median (range) was calculated to summarize the scores of BBS and FAB for balance assessment.

For within group (intra group) analysis of pre and post intervention scores of BBS and FAB, Wilcoxon matched- pairs signed rank test was used. For between-group (inter group) analysis of the post intervention scores of BBS and FAB, Mann-Whitney U test was used.

All the tests were carried out at 5% significance

RESULTS

The baseline characteristics of the conventional group and yoga group are shown in Table 1.

There were no significant differences between the two groups with respect to demographics (age, gender) p value > 0.005, stroke characteristics i.e. time since stroke, type of lesion, side of paralysis) p value > 0.005, baseline score for BBS p value =0.683, and baseline score for FAB p value =0.838.

Table 2 & 3 show BBS and FAB scores pre and post intervention in conventional group and yoga group. In both groups post therapy scores improved significantly (p<0.001)

Table 4 shows comparison of BBS and FAB scores post intervention between conventional and yoga group. Comparison of scores between the groups was not statistically significant (p value of BBS- 0.436 and FAB- 0.512)

Table1. Baseline characteristics of conventional and yoga groups.

Variable	Conventional group (n=15)	Yoga group (n=15)	Statistical Test	P value
Age (years)	53.06 (6.922)	52.3 (4.287)	Unpaired t test	0.730(ns)
Gender Male (%) Female (%)	 10 (66.7%) 5 (33.3%)	 9 (60%) 6 (40%)	Fisher's Exact test	1.0000(ns)
Time since stroke (months)	10 (8,18)	10 (8,18)	Mann Whitney U test	0.269(ns)
Type of injury Ischemic (%) Haemorrhagic (%)	 10 (66.7%) 5 (33.3%)	 11 (73.3%) 4 (26.7%)	Fischer's Exact test	1.0000(ns)
Paretic side Right (%) Left (%)	 10 (66.7%) 5 (33.3 %)	 9 (60%) 6 (40%)	Fisher's Exact test	1.0000(ns)
BBS	40(21,45)	41(26,45)	Mann Whitney U test	0.683(ns)
FAB	22(8,30)	20(12,30)	Mann Whitney U test	0.838
Note : Values are mean (_+Standard deviation), number of subjects (%), or median (range), (ns) = not significant				

Table2. BBS and FAB scores in conventional group pre and post intervention

Conventional group	Pre Intervention		Post Intervention		Wilcoxon matched pairs signed rank test	
	Median (range)	95% Confidence Interval	Median (range)	95% Confidence Interval	p value	Remark
BBS	40(21,45)	[32.46-41.28]	49(27,52)	[39.00-47.93]	<0.001	Significant
FAB	22(8,30)	]17.06-24.27]	25(14,36)	[21.72-28.27]	<0.001	Significant

Table3. BBS and FAB scores in yoga group pre and post intervention

Yoga group	Pre Intervention		Post Intervention		Wilcoxon matched pairs signed rank test	
	Median (range)	95% Confidence Interval	Median (range)	95% Confidence Interval	p value	Remark
BBS	41 (26,45)	[33.83-41.36]	50 (34,55)	[41.35-49.58]	<0.001	Significant
FAB	20 (12,30)	[17.60-23.59]	26 (18,36)	[23.19-29.74]	<0.001	Significant

Table4. BBS and FAB score in conventional and yoga group post intervention

	Conventional group		Yoga group		Mann Whitney U test	
	Median (range)	95% Confidence Interval	Median (range)	95% Confidence Interval	p value	Remark
BBS	49 (27,52)	[39.00-47.93]	50 (34,55)	[41.35-49.58]	0.436	Not Significant
FAB	25 (14,36)	[21.72-28.27]	26 (18,36)	[23.19-29.74]	0.512	Not Significant

DISCUSSION

Stroke results in significant changes in balance and patients typically exhibit delayed, varied or absent balance responses with impairments in latency, amplitude and timing of muscle activity. [(1)] Lower limb muscle weakness and slowed force build up are associated with functional disability, immobility, poor standing balance and high anticipatory, on-going, and responsive postural adjustments and risks of falls. [(3)] Lord and Colleagues(2007), summarizing the current evidence from 44 randomized controlled trials, point out that effective exercise programs for preventing falls comprised of challenging and progressive balance exercises performed in weight bearing positions which minimize the use of upper limb support. [(22)] There is an increase in evidence that challenging balance exercises in standing with feet close together and practicing controlled movements of centre of mass, is an optimal way to improvebalance during performance of everyday actions when performed with sufficient dosage and without reliance on upper limbs. [(22)] Sherrington et al in their study showed exercises like sit to stand activity, lunges, heel raises, one leg stance, and tandem stance can be used to improve coordination, strength, and endurance and balance in older adults. [(17)] For stroke patients exercise intervention to prevent falls, enhance mobility and improve physical activity in community dwellers, which involves weight bearing exercises like sit to stand, forward or lateral step-ups, heel raises which challenge balance and improve lower limb muscle strength. [(18)] Another correlation study related to sit to stand movement and its correlation to falling in stroke patients, showed that rate of rise force and greater postural sway while rising or sitting down, and asymmetric weight distribution may be useful in identifying stroke patients who are at risk of falling. [(23)]

Balance improvement in conventional group in all patients could be attributed to, increase in strength of weak muscles concentrically and eccentrically and improving segmental limb control, creating a loading response and activating extensors activity, improving symmetrical weight shifts, increasing flexibility and lower limb range of motion, eventually enhancing motor activity, functional mobility and walking. [(17,18,22,23)]

In yoga therapy group also, BBS and FAB scores showed significant improvement. Leslie Kaminoff internationally recognized specialist in fields of yoga and breathe anatomy, studied yoga anatomy under the team of Human Kinetics. He analysed asanas and proposed effects of asanas on muscular system. According to his analysis standing asans like Ekpadahastasana, Utkatasana, Veerasana, Trikonasana, Tadasana and Vrukshasna increase activity of lower limb muscles such as gluteus medius and minimus, adductor group, quadriceps,

tibialis anterior and soleus, and intrinsic muscles of the feet. [(21)] George Saleman studied physical demand profiles of hatha yoga postures performed by older adults by quantifying biomechanically using 3D motion analysis, force platforms and electromyography (EMG). Surface electromyography signals (EMG) were collected from lower limb muscles like gluteus medius, hamstrings, vastuslateralis and gastrocnemius. Results showed that there was appreciable increase in core activity in all postures, increase in quadriceps activity in Utakastasana, Veerasana and Trikonasna. Increase in activity occurred in gluteusmedius, minimusand maximus muscles in Vrukshasana. [(24)]

Increase in isometric muscular endurance could be attributed to holding poses for prolonged period of time with controlled breathing implies the mind and body to focus on active muscles responsible for stabilizing the body in the various poses and alternating recruitment of different motor units to execute the specific task. Repetitive stretching and force resistance movements of yoga postures increase blood circulation to muscles and connective tissues and also improve proprioception by stimulating intrafusal and golgi tendon organ feedback mechanism. [(24)]

Hip abductors are important stabilizers of pelvis and their muscular performance is correlated with balance and fall risks in seniors. Hip flexors are important in pulling the limb forward during the swing phase of the gait and their performance is related to walking speed and fall recovery in older adults. [(25)] Core stability is important because it influences trunk orientation which in turn affects hip, knee and ankle position during yoga practice and joint kinematics during ambulation. Traditionally important aspect of yoga practice is increase in flexibility of upper and lower limb muscles. Increase in flexibility can be attributed to static stretching nature of the asanas. Increase in range of motion is due to increase in length of connective tissue due to property of plastic elongation and muscle tissue length due to addition of sarcomere to the ends of muscle fibres. [(26)] Mark D Tran et al found out in a study that with stretching there is decrease in neuromuscular activity in antagonist muscles and increase efficiency in agonist group of muscles and stretching is associated with increase in capillarization and oxidative enzymes. [(27)]

A study done by Julie Bastilleto see effects of yoga therapy in chronic post stroke hemiparesis, in which4 subjects participated in 8 week yoga program, outcome measures being BBS and Timed Movement Battery (TMB), results showed 3 subjects improved in TBM and 2 subjects improved in BBS score. [(8)] Another RCT done by Arlene A, post stroke balance improved with yoga, in which between group comparison showed no significant difference in BBS score, but within group comparison showed significant difference in BBS score in yoga group. In this study mean BBS score in yoga group improved by 6, which means clinical meaningful improvement and according to authors this improvement is larger than what is found in the older adult yoga literature. [(28)] In our study, in yoga therapy group; mean increase in BBS score was 8 which indicates, clinically meaningful improvement.

There are similarities between asanas and some rehabilitation exercises that are intended to correct faulty motor patterns for example movement and instructions for performing Utakatasa and rehabilitation exercise like rising from chair pose are essentially the same. There are similarities between Veerasana and forward lunges, Vrukshasana and one leg stance pose. But main difference is; rehabilitation exercises require multiple repetitions to learn and develop a motor pattern whereas in yoga, a pose has to be achieved slowly and held for a longer duration. Holding poses for prolonged period of time along with controlled breathing is one of the important aspects of yoga. [(11)] Latest studies suggest that along with increase in balance

which ultimately reduces the risk for falls; yoga is also beneficial in reducing state of anxiety, depression and asanas may possess depressive symptoms reduction benefits particularly as life stressors increase. [29-31] So improvement in balance in yoga group could be attributed to increase in strength and endurance of abdominals, back extensors, hip abductors, hip flexors, quadriceps, ankle plantar flexors, lower limb range of motion, spine flexibility, increase in concentration and awareness of oneself and surroundings. [21, 24-28]

In this study both conventional and yoga therapy group showed significant improvement. That means both interventions seem to have an equal potential for an intervention period of 3 weeks. Both groups showed significant results which could be because of similarities in postures attained in both groups.

CONCLUSION

This study suggests that both conventional therapy and yoga therapy enhance balance in post stroke patients at the end of3 weeks of treatment. However, there was no statistically significant difference between conventional group and yoga group on the outcome measures at the end of 3 weeks treatment. Yoga therapy can be used as an alternative approach to conventional training in stroke patients in sub-acute and chronic stages of recovery.

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