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Original Article

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Comparison between Hamstrings Stretching Alone Versus Stretching and Neural Mobilization for Subjects with Moderate to Severe Hamstrings Tightness

Mohammed Aslam

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ABSTRACT

60 Patients included in the study as per inclusive and exclusive criteria. Subjects were included after the ethical committee approval. Informed consent obtained to conduct the study. Subjects were randomly divided in to three groups Group A, Group B and Group C with 20 subjects in each group. Group A and B assessed for neural and contralateral neural mobility and Group C assessed for hamstrings mobility. Four weeks interventions had given to each groups. Group A had given Hamstrings stretch + neural mobilization, Group B had given Hamstring stretch + contralateral neural mobilization, Group C had given Hamstring stretch. Five subjects dropped out, 2 males from Group A and 3 males from Group B. All the subjects reassessed by active knee extension test. Mean of the readings taken for final analysis. Results were calculated using 0.05 level of significance. When comparing the pre and post intervention hamstring mobility between the Group A, B and C results, it was found that hamstring mobility increased more in Group A as compared to Group B and C. From this we can infer that ipsilateral neural stretch accompanied with hamstrings stretch releases ipsilateral hamstrings restriction more compared to contralateral neural stretch accompanied with hamstrings stretching and isolated hamstrings stretch.

Keywords: Hamstrings; Stretching; Mobilization; Muscle tightness; Physical exercise.

INTRODUCTION

Evaluation of posture can be an integral part of physical assessment before both physical exercise and exercise prescription. Whole body assessment has been shown to reveal distinct posture types but local muscle tests are required to highlight specific muscle length changes.[1] Hamstring muscle tightness has been described as integral to the lordotic posture type. The tightness of the hamstring muscle is traditionally been measured using the SLR test. However the movement of the pelvis in this test make the test less specific to the hamstring and therefore raises questions of the appropriateness and reliability, in addition this test has been described as potentially more useful as a neurological test rather than muscle length test in a clinical setting.[2] The active knee extension test involve the movement at the knee joint but not the hip. While the SLR involves movements of both the hip and knee joint making it more difficult to

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control. Active knee extension (AKE) test is often used to measure the hamstring tightness as a part of the orthopaedic physical assessment with normal values of knee motion to within 20 degrees of extension lag being quoated.[1,2,4] AKE test is a measure of hamstring muscle length in a position of hip flexion similar to running and kicking activities. During this test hip is maintained at 90 degree of flexion and at the participant's limit of knee extension, the angle between the vertical and the tibia is recorded using an inclinometer.[5] Hamstrings are commonly injured muscles in athletic activities. Numerous investigations have been conducted to identify the causes of this frequently occurring injury. Most studies have concluded that lack of hamstring flexibility contributes to lower extremity injury. Although most researchers and clinicians agree that hamstring flexibility plays an important role in injury, there is a lack of agreement as to what is the most effective way to lengthen the hamstring group. Techniques previously investigated for improving hamstring flexibility include static stretching, exercise, heat, massage, and proprioceptive neuromuscular facilitation.[9] It was pointed out that along with the hamstrings, the deep fascia of the lower limb and the soft tissues of the pelvis, including neurologic tissue limit a straight leg raise test. In the same way, these non-contractile tissues can come under tension during passive or active movements of hip flexion or knee extension. If tension of non-contractile tissue limits indirect measures of hamstring flexibility, i.e. straight leg raise or active knee extension tests, then use of a stretching technique that emphasizes these tissues, along with the hamstrings, may be justified.[7] Maitland implicated the loss of movement of the dura matter and nerve roots sleeves within the vertebral canal as the cause of limited knee extension and ankle dorsiflexion range of motion during slump.[7] A neurodynamic test is a sequence of movements designed to assess the mechanics and physiology of that part of the nervous system by elongation of the nerve.[4] While trying to control all the elements of this test, clinicians may ask the patient to actively extend the knee to increase tension to the neural component. To check the hamstrings length the test is performed in the sitting position and the participant shall be asked to fully flex the cervical spine followed by thoracic and lumbar spines, then ankle dorsiflexion is added up and the participant extends the knee until a stretch or discomfort is felt. In this position the angle between the horizontal and the tibia is measured using the inclinometer.[5] Previous studies had investigated the measurement error and the reliability of measurements within trials on a single day and across days of knee AROM in a modified slump test position involving increased hip flexion, but these studies showed no significant differences across a two day interval.[4] Researchers examined the effect of neural tension producing movement of the cervical spine and lower extremity on knee extension ROM during the slump test. But the results indicated that limitations in knee terminal extension ROM may be considered as a normal response to the inclusion of cervical ROM, ankle dorsiflexion, medial hip rotation in the slump test in young healthy males.[3] A number of positive tests for both the upper limb neural tension test and the seated slump test was found to be high in the sample of asymptomatic healthy young adults.[6] Previous studies comparing the effect of non ballistic repetitive active knee extension movements performed in a neural slump sitting position with that of static stretching technique on hamstring flexibility showed no specific differences in uninjured subjects.[7] Structural differentiating maneuvers have a significant effect on neurodynamic test response in terms of range of movement even in normal asymptomatic individuals. These normal neurogenic responses to lower quadrant neurodynamic testing should be taken into account during the assessment clinical reasoning process, to avoid the development of management plans based on a false positive test result.[8] Contralateral movements of the nervous system can produce fascinating occurrences.[14] When a neurodynamic test is held stationary and same test is performed on the contralateral limb, the symptoms in the held limb often subside.[14] The cervical and lumbar nerve roots diverge from the spinal cord at an angle.[34] As the contralateral neurodynamic test is performed, forces enter the spinal cord through the contralateral nerve roots. The downward movement of the cord is most likely small but is sufficient to transmit a reduction of tension through ipsilateral held nerve root.[14]

METHODOLOGY

Sample

A total of 55 subjects (48 males and 7 females) participated in the study. All the subjects were recruited from different hospital of Dehradun.

Inclusion Criteria

- Age between 20-35 years.
- Both male & female subjects were included.
- Asymptomatic individuals.

- Subjects with moderate to severe hamstrings tightness.

Exclusion Criteria

- History of knee trauma.

- Any causes of immobilization of lower extremity.

- Neurological condition affecting lower extremity.

- Lower limb fractures.

- Hip and ankle joint pathologies.

- Knee stiffness.

- Moderate to severe plantar flexor tightness.

Study Design

- Experimental study.

Instrumentation

- Digital inclinometer (Baseline Digital 12-1057).

- Mulligan belt.

- Ankle foot orthoses (Fabricated).

Mulligan belt, digital inclinometer and ankle foot orthoses

Quadriceps table

- Quadriceps table (Biomed India).

Protocol

Based on inclusion or exclusion criteria subjects were recruited in the study. Assessment of hamstring tightness and neural mobility (slump test) was done initially for all the subjects. Three readings were taken with the help of a digital inclinometer and their mean was recorded. All subject were randomly divided into three group *i.e.* Group A, B and C by simple randomization. Group A was intervened with hamstring stretching and contralateral neural mobilization with ipsilateral knee in 900. Group B was intervened with hamstring stretching and contralateral neural mobilization with ipsilateral knee in extension. Group C was intervened with hamstrings stretching alone. Intervention was given for a period of four weeks for all the subjects. Pre intervention and post intervention readings were included for the final analysis.

RESULT

60 subjects with knee extension lag more than 35 degrees in active knee extension test with hip and knee in 90-90 position were selected. Right lower extremity was chosen for the study. Ankle foot orthoses was fitted to both the extremities to stabilize the ankle joint at 0 degrees. Subject was positioned in a supine position and hip in 900, maintained by a stool, the ipsilateral limb was actively taken to knee extension. The knee extension lag was measured and recorded using an inclinometer. The foot was placed in an ankle foot or thoses at 00 during the procedure. Then a therapist took the opposite lower

Active knee extension test

extremity into knee extension until R2 was felt, this position of the opposite lower extremity was maintained by the therapist and subsequently the patient was asked to extend the reference extremity again and angles measured and recorded. All the subjects were divided into 3 Groups randomly. All the subjects underwent an intervention for 4 weeks, 7 days a week (5 days intervention and two days home programme) once a day. A contra-lateral neural mobilization with ipsilateral limb in 900 flexion and ipsilateral hamstring stretching protocol

incorporated for Group A (experimental), contra-lateral neural mobilization with ipsilateral limb in terminal knee extension and ipsilateral hamstring stretching protocol Group B (experimental) and only ipsilateral hamstrings stretching protocol for Group C (control). During the intervention three drop outs were there. (2 male subjects from Group A and 3 male subjects from Group B) and the outcome measures were recorded again after the intervention using the already described method. The recordings were finally analyzed for difference between the Groups and influence of contralateral neural mobility within and between each Group.

Intervention

Group A. (Experimental group)

Subjects were positioned comfortably on a quadriceps table with pelvis as close to back rest as possible. Popliteal fossa of lower limbs was placed at the edge of the table in sitting position. Hip joint was positioned in 90 degree flexion. Thigh was also stabilized with belt to avoid lifting off thigh from the quadriceps table during procedure. Ankle joint was placed in zero degree plantar flexion with the help of ankle foot or thoses. Subject was asked to slouch as much as possible and maintain the posture through out the procedure. In this position subjects were asked to go for active knee extension on the opposite side maintaining the ipsilateral knee in 900 of flexion. Three sets of eight repetitions, once a day for four weeks, (five times weekly and two days home programme). To control spinal flexion, the subjects were instructed to flex the trunk maximally to a point where they perceived a tolerable stretch sensation in the spine but no pain. Maximal

Contralateral neural mobilization with ipsilateral limb at 90º flexion

spinal flexion was then maintained with a strap fixing the thoracic and lumbar spine into flexion perpendicular to the seat. For each test, the starting position was 90° flexion at the knee joint with the ankle in neutral. Ipsilateral hamstrings stretching will be given - three sets of three repetitions each with 20 seconds hold once a day (five times weekly and two days home programme).

Group B. (Experimental group)

Subjects were positioned comfortably on a quadriceps table with pelvis as close to back rest as possible. Popletial fossa of lower limbs was placed at the edge of the table in sitting position. Hip joint was positioned in 90 degree flexion. Thigh was stabilized with belt to avoid lifting off thigh from the quadriceps table during procedure. Ankle joint was placed in zero degree plantar flexion with the help of ankle foot or thoses. Subjects were asked to slouch as much as possible and maintain the posture through out the procedure. In this position subjects were asked to go for active knee extension on the opposite side maintaining the ipsilateral knee also in terminal knee extension. Three sets of eight repetitions, once a day for four weeks, (five times weekly and two days home programme). To control spinal flexion, the subjects were instructed to flex the trunk maximally to a point where they

Contralateral neural mobilizaton with ipsilateral active knee extension

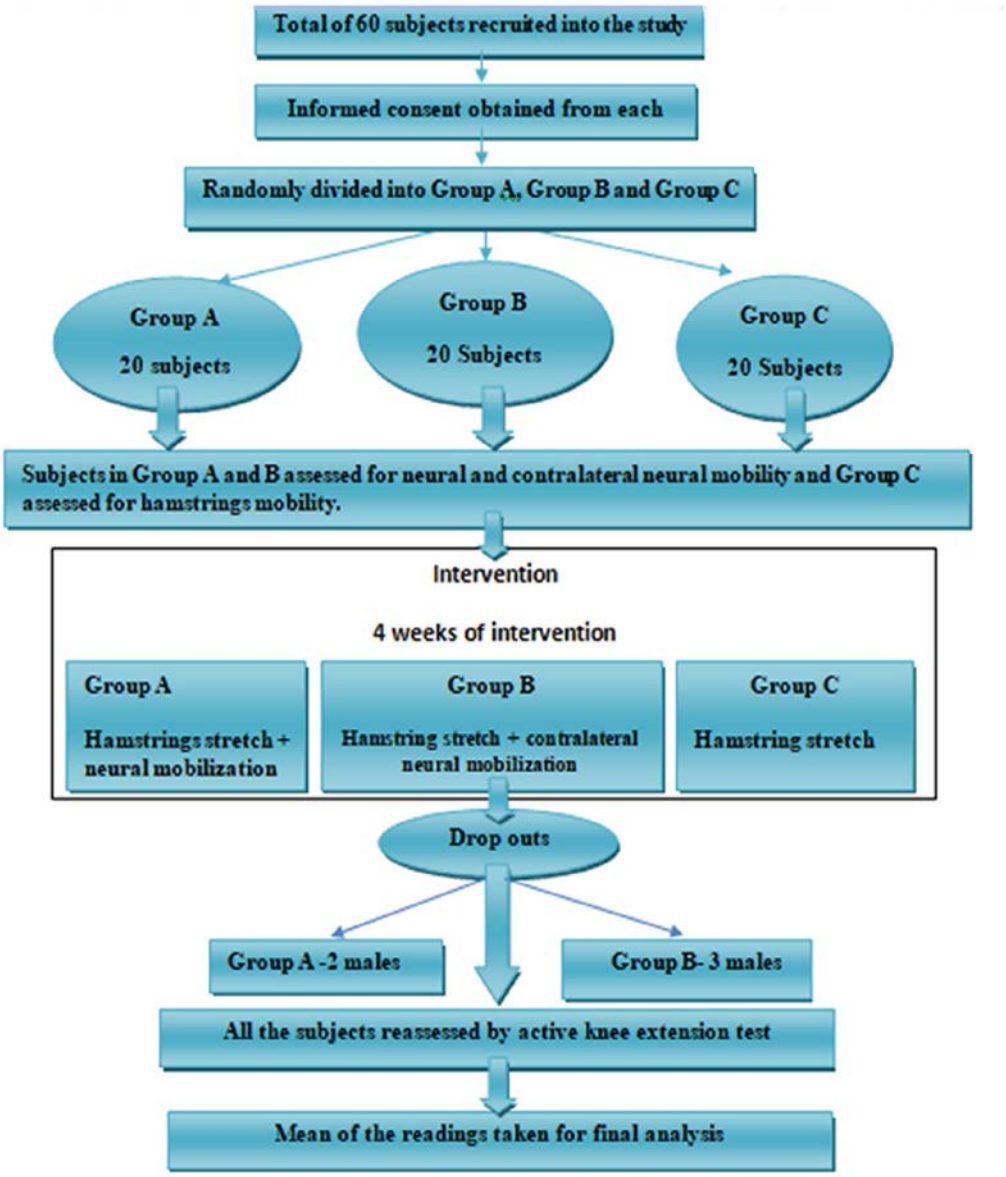
perceived a tolerable stretch sensation in the spine but no pain. Maximal spinal flexion was then maintained with a strap fixing the thoracic and lumbar spine into flexion perpendicular to the seat. For each test, the starting position was 90° flexion at the knee joint with the ankle in neutral. Ipsilateral hamstrings stretching was be given for three sets of three repetitions each with 20 seconds hold once a day (five times weekly and two days home programmed).

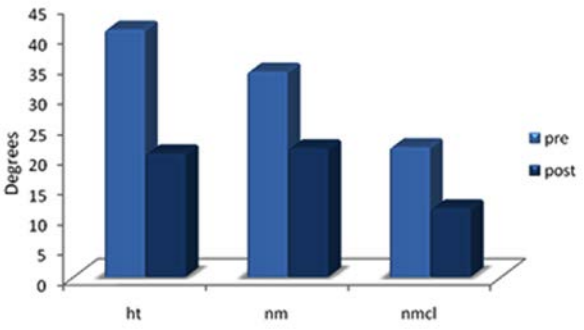
Group C (control)

Only ipsilateral hamstrings stretching were

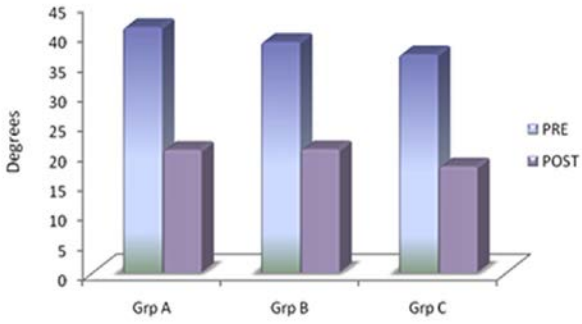
Isolated hamstring stretching

Flow chart for the procedure

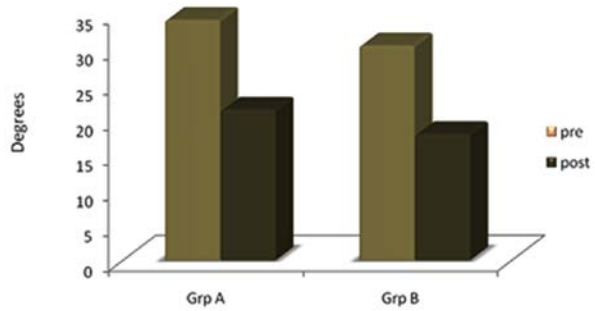




Group A: Comparison between pre and post intervention mean



Comparison of hamstring mobility between Group A, Group B and Group C.



Comparison of neural mobility between Group A and Group B.

incorporated as per the procedure described above.

DISCUSSION

In Group A when comparison was made between pre and post intervention with respect to hamstring mobility, neural mobility and contralateral neural mobility the active knee extension lag decreased. Within the Group A when comparison was made between pre and post intervention with respect to hamstrings mobility a significant increase in hamstrings mobility was found after the intervention. Within Group A neural mobility and contralateral neural mobility also increased after the intervention when assessed through active knee extension lag in both cases. Within Group B when comparison was made between pre and post intervention extension lags with respect to hamstrings, neural and contralateral neural mobility, a statistically significant increase was found after the intervention. From this we can infer that any loss of flexibility of not only the muscular structures but neural structures also contributes to active knee extension lag. Supporting this we found that when we individually stretched the neural and muscular components significant decrease in the lag was found after the intervention. It has been proved that static stretching of one repetition for 30 seconds three days per week increases hamstrings length in healthy subjects.[11] Six weeks of non ballistic repetitive active knee extension (30 repetitions twice daily) performed in a neural slump sitting position produces the same hamstrings flexibility as static stretching (30 second, twice daily).[7] It was proved that structural differentiating manoeuvres have a significant effect on neurodynamic test response in terms of range of movement even in normal asymptomatic individuals.[8] Progressive decreases in terminal knee extension ROM may be considered as normal response to the successive addition of cervical flexion, ankle dorsiflexion and medial hip rotation to the slump position in adult males without low back pain or injury.[3] The high prevalence of posterior lower extremity symptoms induced by the Slump test amongst asymptomatic subjects, which are relieved by cervical extension, suggests that neural structures may contribute to perceived hamstring tightness and the sensation of discomfort produced during hamstring stretches.[15] It was proven that knee extension AROM could be reliably measured across days in subjects without pathology and acceptable measurement error occurs.[4] From the results of our study we can hypothesize that active knee extension lag is a composite outcome measure for both neural and muscular structures and intervention involving neural and muscular components contributes in decreasing the lag. It is proven that musculo skeletal flexibility is well explained in mechanical terms rather than neural theories.[13] When the pre intervention and post intervention active knee extension lag in group C were compared our results revealed that hamstring mobility increased after hamstring stretching. This was found to be statistically significant. This could be because a proper stretch force directly stretched the connective tissue fibers of the muscles (endomysium and perimysium) and thus the effect.[12] Static tension placed on the muscle tendon unit has been shown to activate the GTO (Golgi tendon organ), which may produce autogenic inhibition of the muscle that is stretched. Static stretching has been shown to be very effective at increasing hamstring length.[11] When comparison of pre and post intervention neural mobility between Group A and B was done, results revealed that neural mobility increased more in Group A than Group B. This could be because contralateral mobilization must have stretched the dura which could have relieved the restriction in the ipsilateral nerve roots. The event of contralateral technique produces a change in symptoms in a limb that is held in neuro dynamic position constitutes evidence of neurodynamic mechanism to the symptoms. Treatment with contralateral neural mobilization is justified only if the technique produces improvement.[14] But since it was not found to be statistically significant we cannot predict this relationship. The pre and post intervention contralateral neural mobility was compared between the Group A and B results revealed that contralateral neural mobility increased more in Group B than Group A. This could be because in Group B ipsilateral hamstring stretch was followed by contralateral mobilization. The event of contralateral technique producing a change in symptoms in a position that is held in a neurodynamic position will constitute evidence

of neurodynamic evidence to symptoms.[14] The dura and nerve roots could have been placed in a stretch and thus the effect. But since statistically significant difference was not found we cannot predict this relationship. When comparing the pre and post intervention hamstring mobility between the Group A, B and C results, it was found that hamstring mobility increased more in Group A as compared to Group B and C. From this we can infer that ipsilateral neural stretch accompanied with hamstrings stretch releases ipsilateral hamstrings restriction more compared to contralateral neural stretch accompanied with hamstrings stretching and isolated hamstrings stretch. Since neural structures may contribute to perceived hamstring tightness and the sensation of discomfort produced during hamstring stretches.[15] But statistically significant was not found so we cannot predict this relationship. Comparison of hamstring mobility between the Group B and Group C, it was seen that AKE lag decreased more in Group C than Group B. From this we can infer that contralateral neural mobility exercise could not affect hamstrings mobility. This was not found to be statistically significant so we cannot predict this relationship. When pre and post hamstring mobility was compared between Group A and C results showed that Group A was more effective. So we can predict that neural mobility exercise has some effect on hamstrings muscle mobility. But since it was not found to be statistically significant we cannot conclude this.

An increase in group hamstrings mobility was found when comparing the pre and post intervention hamstring mobility between Group A and Group B. From this we can infer that neural mobility exercise must have contributed to hamstrings mobility compared to contralateral neural mobility exercises, but was not found to be statistically significant so we cannot predict this.

CONCLUSION

It was found that hamstring mobility increased more in Group A as compared to Group B and C. From this we can infer that ipsilateral neural stretch accompanied with hamstrings stretch releases ipsilateral hamstrings restriction more compared to contralateral neural stretch accompanied with hamstrings stretching and isolated hamstrings stretch.

Future Research

Comparison could be made across two groups with ipsilateral and contralateral neural mobilisation. Same study could be done on different muscle groups.

Relevance to clinical practice

Neural mobilisation protocol should be considered along with hamstrings stretching to improve the knee extension range of motion in subjects with mild to moderate hamstrings tightness.

Limitations of study

Less number of female subjects were included into the study.

Source of Funding: Self

Ethical Clarence; It is bonafied work done by me and have not taken any part of thesis from any where.

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A Comparative Study on Speed and Pulse Rate Between Two Mechanisms with and without Windlass on Two Different Terrains: Randomised Cross-Over Design

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ABSTRACT

Background: During the functional rehabilitation program (FRP), the significant difference in the speed and pulse rate between two walking mechanisms (with and without a windlass mechanism) on two different terrains, randomized cross-over trial.

Methods and materials: Twenty two students aged 18-22 years with normal physiques. Students in both groups were instructed to walk in bare foot with and without the windlass mechanism on floor and treadmill. The primary outcome was to increase the speed and decrease the time with the windlass mechanism in barefoot walking during the FRP. The secondary outcome was to reduce the effort by using the windlass mechanism in barefoot walking during the FRP.

Findings: The average time to complete 50 meters on the floor with a windlass mechanism is 30.7 seconds with a standard deviation of 0.91 seconds, whereas the average time without a windlass mechanism is 38.4 seconds with a standard deviation of 1.39 seconds. This difference in the mean is statistically significant ($p < 0.001$). After walking, the average post-radial pulse rate with and without mechanism was 120.3 bpm and 131.4 bpm, with standard deviations of 2.87 bpm and 1.09 bpm, respectively. This difference in the mean is statistically significant ($p < 0.001$). The average speed achieved for 120 seconds (2 minutes) with the windlass mechanism is 0.095 m/s with a standard deviation of 0.008 m/s, whereas the average speed achieved without the windlass mechanism is 0.066 m/s with a standard deviation of 0.007 m/s. This difference in the mean is statistically significant ($p < 0.001$). After walking, the average post-radial pulse rate with and without mechanism was 129.8 bpm and 135.1 bpm, with standard deviations of 2.33 bpm and 3.34 bpm, respectively. This difference in the mean is statistically significant ($p < 0.001$).

Interpretation: This study finds that there is an increase in speed with less effort (lesser pulse rate) while using a windlass mechanism on both terrains. This research study suggests that the windlass mechanism can be used during the FRP. BKL Walawalkar Hospital's Ethics Committee *(EC/NEW/INST/2020/320)* approved this study.

Keywords: Windlass Mechanism, Bare foot walking; Floor; Treadmill.

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INTRODUCTION

When walking under typical circumstances, such as at one's preferred speed and step

length, the biomechanics of human gait are well understood. On the other hand, when moving about in daily life, people can and do walk at a variety of other speeds and step lengths. It may be useful to describe and ascertain the mechanics of locomotion by considering the variation in biomechanics across different gait conditions.[1] Walking speed (WS) is a valid, reliable, and sensitive measure appropriate for assessing and monitoring functional status and overall health in a wide range of populations.[2] Walking speed and endurance, such as short distance walking 10 meters walk test or 30 meter walk test and long distance walking 6 minutes walk test are used often to predict and assess rehabilitation outcomes.[3]

Barefoot walking is a natural pattern and movement, that improves awareness of foot positioning, increases the strength of feet and leg muscles, and boosts flexibility in the feet and ankles.[4,5] Barefoot functional rehabilitation exercises help in adapting the foot to different surfaces. These exercises help in strengthening certain smaller muscles of the foot located at the bottom which helps in decreasing the navicular drop and foot function scores. Thus reduction in both scores decreases the flat foot structure.[6] The evidence for walking barefoot is to reduce the knee adduction moment in patients with Osteoarthritis (OA), Stroke, and Parkinson's disease during rehabilitation.[7-9] Gait stability and variability parameter depend on age, footwear, and terrain of walking.[10]

The plantar fascia supports the foot during weight bearing activities, and the windlass mechanism is a mechanical model that characterizes this support and offers details on the biomechanical pressures exerted on the plantar fascia.[11] Typically used to move large objects like an anchor on a ship, a windlass is a horizontal cylinder that turns with a crank to draw on a chain or rope that wraps around the cylinder. The metatarsal bone and tarsal bone pull together and transform into a hard structure as the metatarsophalangeal joints (MTP) joints hyper extend, which causes the aponeurosis to become taut as it coils around the MTP, causing the longitudinal arch to rise.[12] Only in the case of dynamic loading did it become apparent that arch rise and toe dorsiflexion were related. These outcomes raise issues.[13]

Due to the advantages of this windlass mechanism in barefoot walking, this can be used during functional rehabilitation program. To determine the feasibility, this study was done on healthy volunteers. The purpose of this research study was to compare the speed and pulse rate of barefoot walking between with windlass and without windlass mechanism on Floor and Treadmill.

METHOD

2.1 Study Design

Randomized Cross-over design

2.2 Participants

The study protocol was approved by the institutional scientific and ethics committee. This research study was conducted at the SVJCT's BKL Walawalkar college of Physiotherapy campus, Sawarde, Maharashtra, India in October 2022. The total sample size for this study was 22 Physiotherapy students with a normal physique.

Intervention

Before the trial, students attended a session with a physiotherapist to learn how to effectively maintain the windlass mechanism in barefoot walking. The training protocol for the windlass mechanism and both terrains comprised the standardized educational and exercise components.

The inclusion criteria were age between 18 and 22 years. Students were monitored for normal gait in both genders including that with no recent injury or lower extremity pain from almost six months and they had no history of foot and ankle surgery in their lifetime. The exclusion criteria were, students having, pes cavus, pes planus, plantar fasciitis, musculoskeletal injuries from the last six months, any mental disorders, and limb length discrepancy.

The study was conducted in a spacious and ventilated room. Each student's height, weight, and BMI weremeasured. The students were demonstrated windlass walking by an Instructor for 50 meters walking on the floor and walking for 2 minutes (120 seconds) on Treadmill.

Based on the cross over design, Out of twenty two students, 11 underwent windlass mechanism followed by without windlass mechanism, and the remaining 11 students underwent without windlass mechanism followed by with windlass mechanism on both the terrains on the same day. Between these two mechanisms, a washout of four hours was given. After a reserve day, the study groups were reversed with two mechanisms (with and without windlass) on both terrains on the same day.

Before the trial, the floor was cleaned with proper sanitation by sweepers. The students were asked

to clean and dry the foot to prevent any sweating which may cause them to slip on the floor during walking. The 11 students were asked to walk casually barefoot on the mosaic floor for 50 meters one by one. Before barefoot walking with the windlass mechanism, the student was asked to relax and calm down to settle down their pre-walking radial pulse and that was noted down. The student was advised to maintain the windlass mechanism throughout the 50 meters in length. After walking, the post-walking radial pulse was also recorded. The stopwatch was used to measure the time taken to complete 50 meters of walking. After the completion of barefoot walking, proper relaxation and refreshment had been given to students. Later, the remaining 11 students were asked to walk casually barefoot on the floor without the windlass mechanism according to the same guidelines that were followed with the windlass mechanism.

Before the trial, the treadmill was calibrated by a skilled biomedical engineer, and the students were instructed to walk on treadmill. The WESLO CADENCE 1020 treadmill was used for this study. The treadmill was placed on an even surface. The 20^{o} of up inclination was maintained in treadmill. The length of the belt was 3 meters, and it took 120 seconds for 90 revolutions. The safety key clip was attached to the student's cloth to stop thetreadmill in any emergency. Each session consisted 2 minutes. Before barefoot walking with the windlass mechanism, the student was asked to relax and calm down to settle down their pre-walking radial pulse and that was noted down. The student was advised to walk casually and to maintain the windlass mechanism throughout the 2 minutes. After walking, the speed of the treadmill and the post-walking radial pulse of the student were recorded. After the completion of barefoot walking, proper relaxation and refreshment were given to students. Later, the remaining 11 students were asked to walk casually barefoot on a Treadmill without a windlass mechanism according to the same guidelines that were followed with the windlass mechanism.

Outcome measures

Primary Outcome

The primary outcome was to measure the speed with and without windlass mechanism in barefoot walking among healthy volunteers.

Secondary Outcome

The secondary outcome was to measure the effort by pulse rate between with and without windlass mechanism in barefoot walking among healthy volunteers.

Data analysis

Collected data were entered in excel software and analyzed using R software version 4.0.1. Continuous variables were presented as mean and standard deviation and categorical variables were presented as count and percent. Paired t-test was done to compare the means with and without windlass mechanism. $p < 0.05$ were considered

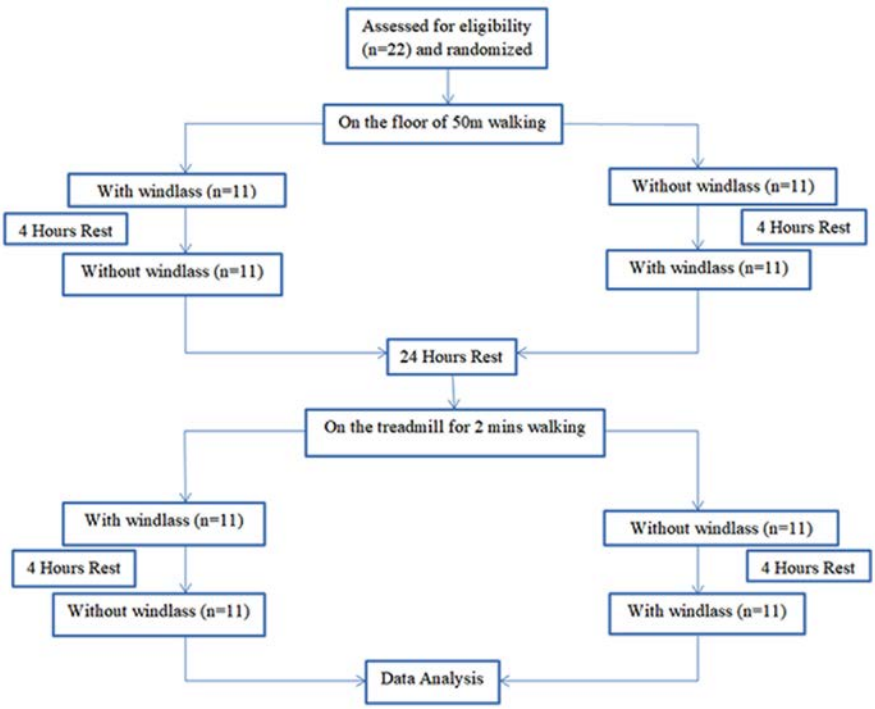

Fig. 1: Consort diagram illustrating the study design

statistically significant.

RESULTS

Out of 22 students, 5 male (22.7%) and 17 female (77.3%) students took part in this study. The average age was 20.04 with standard deviation 0f 0.82 years. Their average BMI was 21.4 with a standard deviation of 3.00.

Table 1: Descriptive for out come variables on the floor terrain

Variables	With Windlass		Without Windlass		p value
	Average	SD	Average	SD	
Time (Seconds)	30.7	0.91	38.4	1.39	< 0.001
Pre-walking Radial Pulse Rate	75.1	1.61	74.9	1.38	0.423
Post-walking Radial Pulse Rate	120.3	2.87	131.4	1.09	< 0.001

Table 1 provides values of outcome variables done on the floor. The average time taken to complete 50 meters with the windlass mechanism is 30.7 seconds with a standard deviation of 0.91 seconds, whereas the average time was 38.4 seconds without the windlass mechanism with a standard deviation of 1.39 seconds. This mean difference is statistically significant, $p < 0.001$. The Radial Pulse rate was measured before the commencement of walking, the average pre-radial pulse rate with and without the windlass mechanism were 75.1 bpm and 74.9 bpm with a respective standard deviation of 1.61 bpm and 1.38 bpm. This mean difference is statistically not significant, $p = 0.423$. The radial pulse rate was measured after the commencement of walking, the average post-radial pulse rate with and without mechanism was 120.3 bpm and 131.4 bpm with a respective standard deviation of 2.87 bpm and 1.09 bpm. This mean difference is statistically significant, $p < 0.001$.

Table 2: Descriptive for outcome variables on the treadmill terrain

Variables	with Windlass		without Windlass		p value
	Average	SD	Average	SD	
Speed (meter/second)	0.095	0.008	0.066	0.007	< 0.001
Pre-walking Radial Pulse Rate	78.5	1.96	77.6	2.11	0.329
Post-walking Radial Pulse Rate	129.8	2.33	135.1	3.34	< 0.001

Table 2 provides values of outcome variables done on the treadmill. The average speed achieved for 120 seconds (2 minutes) with the windlass mechanism is 0.095 m/s with a standard deviation of 0.008 m/s, whereas the average speed achieved was 0.066 m/s without the windlass mechanism with a standard deviation of 0.007 m/s. This mean difference is statistically significant, $p < 0.001$. The Radial Pulse rate was measured after the commencement of walking, the average pre-radial pulse rate with and without the windlass mechanism was 78.5 bpm and 77.6 bpm with a respective standard deviation of 1.96 bpm and 2.11 bpm. This mean difference is statistically not significant, $p = 0.329$. The radial pulse rate was measured after the commencement of walking, the average post-radial pulse rate with and without mechanism were 129.8 bpm and 135.1 bpm with a respective standard deviation of 2.33 bpm and 3.34 bpm. This mean difference is statistically significant, $p < 0.001$.

DISCUSSION

This randomized cross-over design is the first to compare the speed of barefoot walking and to compare the pre-walking radial pulse rate and post-walking radial pulse rate with and without the windlass mechanism on the Floor and Treadmill. In this study the students walked with windlass mechanism reached their destination promptly than without windlass mechanism and the Welte L *et al* stated that the people experience some difficulties walking quickly when receiving rehabilitation for stroke, Parkinson's disease, osteoarthritis, diabetes, and various sporting events. People would utilize a windlass mechanism to walk at that time to cover more ground in a shorter amount of time. Walking barefoot or in shoes is not as crucial as the foot striking pattern.[14] While walking with barefoot windlass mechanism, the students felt more push-off in their foot, Welte L *et al* briefed that when running barefoot, a forefoot striking (FFS) pattern gives the runner more sensory feedback from the foot ground contact as well as increased energy storage in the arch.[15] During windlass mechanism walking, the rearfoot strike was common among the pupils in this trial, Williams LR stated when compared to the prestance period of the rearfoot strike, the activity of the biceps femoris (BF) and

gastrocnemius medialis (GM) increased (RFS). During the Pre-Stance Phase, the Tibialis Anterior (TA) declined more in the FFS than the RFS Pattern.[16]

The extension of metatarsal phalanges was common in windlass mechanism that naturally stretched the plantar fascia among youths and Chan CW *et al.* stated that the plantar fascia stretching was delayed by toe plantar flexion at foot striking, which likely alters how the stress was distributed among other arch tissues. After that, the windlass mechanism shortens the plantar fascia, which probably increases arch recoil during push-off.[17] In this trial, the young people felt that their foot was robusted with windlass mechanism while walking Nüesch C *et al.* that the rotational axis of the mid foot was changed by this windlass engagement, which likely positioned the arch spanning structures closer to their resting length and increased their compliance. This work offers new proof that the windlass and arch spring processes interact to control the amount of energy stored in the foot.[18] Due to the stretching of the plantar aponeurosis while walking with windlass mechanism, Mejia Cruz Y *et al.* stated that although the plantar aponeurosis was not a solid cable, it probably has some flexibility that influences how well the windlass mechanism works. Foot coupling was unaffected by arch structure, indicating that static arch height or arch flexibility.[19]

The speed of the gait was increased while walking with windlass mechanism in this study and Rose DK *et al*. stated that with up to 36 sessions of locomotor training or strength and balance exercises, participants who lived in communities generally exhibited gains in gait speed and walking distance at both 2 and 6 months following stroke.[20] This study took place indoor environment and Leppä Het al concluded that when environmental enablers for outdoor mobility are lost (during COVID-19), older individuals who perceive walking difficulty may be at risk of becoming house bound and should be the focus of interventions.[21] Through this study, the speed of walking was achieved with low radial pulse rate in windlass walking mechanism Nascimento LR *et al.* finalized that the benefits achieved by equivalent doses of center based exercises after stroke are anticipated to be comparable to the effects of home based prescribed exercises on walking speed, balance, mobility, and participation.[22]

In this study, the students experienced the tension in the plantar aponeurosis while walking with windlass mechanism and Caravaggi P *et al.* suggested that subjects' early stance phase plantar aponeurosis (PA) tension was considerably higher than the rest ($p < 0.01$), supporting the PA-preloading hypothesis. From medial to lateral, the PA slips' maximum elongation and preloading are both reduced.[23] In this trial, while extension of all meta tarsal phalanges joint in windlass mechanism pupils recognized more movement at their foot and Manfredi-Márquez MJ *et al.* stated that according to kinematic analysis, the more extension there is, the more movement will be produced. The more distant a structure is from the 1st Metatarsal Phalangeal Joint (MTP), which affects the entire leg, the less impact it has. The impact couldn't be precisely measured since the kinematic system employed wasn't appropriated.[24] Walking with windlass mechanism on mosaic floor and treadmill was effective by more propulsion on students foot while Song S *et al.* briefed that walking on flexible feet used more energy than walking on rigid feet. According to preliminary findings, the compliance that the windlass mechanism embeds was not the source of the energy saved by its introduction. The windlass mechanism's ability to save energy was more closely tied to how it helped shorten the effective foot length when swinging than to how it helps with stance compliance.[25] Biomechanically, the MTP Joints were in extension during windlass mechanism and Kappel-Bargas *et al.* suggested that the first metatarsal phalangeal extension was passive when the windlass mechanism was activated.[26]

Students were not able to sustain their arch foot for prolong time during windlass mechanism when Gelber JR *et al.* concluded that the capacity to raise the arch from the toe-flat to an extended position was diminished in the Diabetes Mellitus and Peripheral Neuropathy (DMPN) severe and low groups.[27] Before this trial, the windlass mechanism was demonstrated and practised by students when Fuller EA *et al.* concluded that using mechanical engineering principles, the anatomy and mechanical operation of the foot's windlass mechanism were examined. Following an explanation, the free-body diagrams and force couple concepts were used to model the foot.[28] Windlass mechanism can be performed only in bare foot and Lin SC concluded that the right footwear for treating conditions like plantar fasciitis by efficiently lowering the windlass effect was the rocker sole shoe (RSS), which was effective footwear in minimizing the windlass effect regardless of the type of insole inserted.[29] In this study, healthy normal physique students were participated and Lucas R In contrast to individuals who had a working windlass mechanism, those without one had a more pronated foot posture, a

lower dorsal arch height, and a broader mid foot breadth.[30]

In this study, on the floor, the average walking time was less with the windlass mechanism than without the windlass mechanism. On the treadmill, the average speed wasmore with the windlass mechanism than without the windlass mechanism. Moreover, the post-walking pulse was less with the windlass mechanism than without the windlass mechanism on both terrains.

Limitations

This study has a few limitations that there was on a smaller group of healthy volunteer students and this windlass mechanism was used a single time for this study.

CONCLUSION

This study finds that there was an increase in speed with less effort (lesser pulse rate) while using the windlass mechanism on both terrains. This finding suggests that the windlass mechanism can be used during the FRP. The windlass mechanism may help the patient and increase their cooperation with the Physiotherapist. Further studies are required to confirm this result with the patient population during the rehabilitation process.

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Conflict of Interest

There is no conflict of interest among the authors.

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Original Article

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Effectiveness of Bobath Approach Along with Core Stability Training in Stroke Patient

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ABSTRACT

Introduction: Physiologically stroke is an acute, focal injury of the central nervous system of a vascular origin, contributing to a local or systemic neurological insult.

Stroke one side of the upper and lower limbs are affected but trunk muscle are affected on both sides leading to insufficient trunk rotation and difficulty in maintain balance. Restoration of trunk control and balance is one of the important goals in rehabilitation of stroke patients.

Neuro developmental therapy (NDT) is one of the preferred methods of stroke rehabilitation, also known as bobath concept. With the fine control and proper weight transfer, it is possible to secure and protect the body in upright posture and in the achievement distal functional movements.

*Purpose of Study: I*n comparison to limb muscles weakness, trunk muscle are also impaired in both ipsilateral and contralateral side of the body, thus weakness of the trunk muscle leads to loss of balance, stability and increase functional disability. This limits the patient's activities, such as rolling in bed, transferring, putting on a shirt and bending to reach his feet to put on shoes and socks, etc. So my aim is to focus on the trunk function and balance in stroke patient in order to eliminate individual trunk impairment affecting various functions performed by the patients. Hence the purpose of the study to evaluate the effectiveness of the stroke patient.

Methodology: Total 15 patients were included in the study by simple random sampling method. Group A (Experimental group) was received bobath approach and core stability training exercises.

Conclusion: Bobath approach along with core stability training shows more improvement in trunk function and sitting balance after 4 week therapy.

Keywords: Stroke; Bobath Approach; TIS; BBS; Core Stability.

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INTRODUCTION

Stroke is a major disease that can cause disability in adults and is the second leading cause of death in the world.[1]

The term stroke was coined by the William Cole in the last 17th century. Physiologically stroke is an acute, focal injury of the central nervous system of a vascular origin, contributing to a local or systemic

neurological insult.[2]

Stroke survivors often have multiple dysfunctions which seriously affect their daily life, work and social communication. Following stroke one side of the upper and lower limbs are affected but trunk muscle are affected on both sides leading to insufficient trunk rotation and difficulty in maintain balance.[3]

Trunk impairment, restricted balance and impaired postural control in patient with stroke are correlated with increasing risk of falls and impaired mobility. This creates disability and dependency in their activities of daily living. Sitting balance and trunk control are strong predictors for functional outcome after stroke.[4,5]

Core acts as an anatomical basis for motion of distal segment. Core stability involves the ability to control motion of trunk over pelvis and lower limb in order to maintain stability of spine. Training of the stability of core muscles can improve the balance function of stroke patient. Core stability is defined as the ability of the lumbopelvic-hip complex to prevent the buckling of vertebral column and return it to equilibrium following perturbation. In general core stability involves the muscular control required around the lumbar spine to maintain functional stability.[6]

Today Neuro developmental therapy (NDT) is one of the preferred methods of stroke rehabilitation, also known as bobath concept. NDT approach was developed in the 1940 through 1960 by Dr. Karel Bobath and Berta Bobath. NDT uses physical handling techniques and key points of control directed at supporting body segments and assisting the point in achieving active control. The trunk is at the heart of the treatment program for hemiplegic patient using the bobath concept. With the fine control and proper weight transfer, it is possible to secure and protect the body in upright posture and in the achievement distal functional movements.[7]

Approximately 15% strokes are hemorrhagic (including intra-cerebral hemorrhage and sub-arachnoid hemorrhage) and 85% are ischemic. The mortality rate for hemorrhagic stroke can be as high as 50% and is approximately 20% for ischemic strokes of all types, but ultimate outcome and function are related to the sub-type of stroke.[8]

Stroke, with a high prevalence and long term disabilities is a major health problem in the world and it was reported that about 2 million people suffer from stroke each year. Impairment including loss of strength, sensation and coordination abilities, which results in walking difficulties, balance disorders, and limb function disturbances, occur in 70-80% of stroke patient.[9]

Niraj Kumar *et al.* showed decrease Anxiety& Depression, increase Quality Of Life and Mindfulness than Group-B study. When we compared with Mean ± SD it was found that 0 week showed in significant, 4 week showed significant and 8 week showed highly significant in diabetic frozen shoulder patients.[10]

Hypertension was the leading risk factor followed by diabetes, hypercholesterolaemia, and cardiopathies. Patients with ischaemic stroke had a higher prevalence of hypercholesterolaemia and cardiopathies, especially atrial fibrillation, Patients with intracerebral haemorrhage were more likely to be heavy drinkers and those with sub arachnoid haemorrhage to be smokers, although these two risk factors are probably underreported as is usually the case. The frequency of previous primary preventive medication use for vascular risk factors was low in this high risk population.[11]

The management comprises of 4 week intervention of core stability training along with bobath approach and conventional therapy with the help of trunk impairment scale and berg balance scale were used as outcome measure to assess trunk function and standing balance in patient, pre treatment and after 4 weeks of intervention.

The core is the central to almost all kinetic chains in human body. The core is describe as a box in the trunk with the abdominals, paraspinal, and gluteals; diaphragm and pelvic floor and hip girdle musculature serving as the front wall, back wall, roof and bottom, respectively, makes up the largest part of the body and controlling movement of daily living.[12]

A strong and stable trunk provides a solid foundation for the torques generated by the limb. At present, core muscular training is often used as a clinical treatment for stroke and can potentially improve neuromuscular control of the trunk and lower limb.[13]

One of the studies was reported that core stability enhancing exercises are effective in improving muscle activities of the lower trunk, which are affected by stroke. At present; core stability training is often used as a clinical treatment for stroke. Core muscle training can potentially improve the neuromuscular control of the trunk and lower limb.[14]

One of the effects of CNS damage is often increased/decreased muscle tone, influencing the

motor possibilities of the patient. Rehabilitation using NDT-Bobath method can be effective way to solve patient's problems in this area.[15]

The bobath concept is currently defined as a problem solving approach to the assessment and treatment of individual and disturbances of function, movement and postural control due to lesion in CNS. The concept provides a way of observing, analysis and interpreting tasks performance.[16]

Operational Definition

Stroke

Stroke is defined by the World Health Organizations A clinical syndrome consisting of rapidly developing clinical signs of focal (global) disturbances of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than avascular origin.[17]

Core stability training

Core stability is defined as the ability to control the position and motion of the trunk over the pelvis to allow optimum production, transfer and control of force and motion.[18]

Bobath approach

The bobath concept is defined as a problem solving approach to the assessment and treatment of individuals with disturbances of function, movement, and postural control due to lesion of the central nervous system.[19]

Aims

The aim of the study is to see the effectiveness of bobath approach along with core stability training on trunk function and sitting balance in stroke patients.

Objectives

To find the effect of bobath approach along with core stability training in improving trunk function and sitting balance in stroke patient.

To find which treatment is better in improving the trunk function and sitting balance in stroke patient.

Need of the Study

The need of study is to improve the effect of treatment with core stability training along with bobath approach in stroke patient. Although many studies has been done on core stability but none has done the comparative study between bobath approach along with core stability trainingon trunk function and sitting balance in stroke patients.

Hypothesis

Experimental hypothesis

There may be significant difference between the effectiveness of bobath approach along with core stability training on trunk function and sitting balance in stroke patient.

Null hypothesis

There may not be significant difference between effectiveness of bobath approach along with core stability training on trunk function and sitting balance in stroke patient.

2. Review of Literature

Thromboembolic stroke may occur at any moment in the human life cycle. It is a principal cause of morbidity and death in middle and late life. The clinical diagnosis and treatment of stroke, as well as investigations into the underlying patho-physiology of the disease, hinge on inferences from the anatomy of the stroke lesion.[20]

Vertebral and Basilar Artery

The VAs supply the posterior circulation of the brainstem, cerebellar hemispheres, and posterior cerebral hemispheres. These arteries typically arise from the SCAs bilaterally. The BA supplies the anterior inferior cerebellar arteries, the brainstem perforators, the superior cerebellar arteries, and finally the PCAs.[21]

Arterial supply of different areas:

a. *Cerebral Cortex:* Cerebral cortex is supplied by branches of all three cerebral arteries.

All the three surfaces receive branches from all three arteries.

- Middle cerebral is main artery on superolateral surface.
- Anterior cerebral artery is chief artery on medial surface.
- Posterior cerebral is principal artery on inferior surface.

b. *Cerebellum:* The little brain is supplied by:

- Superior cerebellar, anterior inferior cerebellar, posterior inferior cerebellar arteries.

c. *Blood supply of the brain stem:*

- The mid brain is supplied by branches from the posterior cerebral arteries, including their central branches, both posteromedial and posterolateral.
- The pons is supplied by the pontine

branches of basilar artery.

- The medulla is supplied by the medullary branches of the vertebral artery and branches from the posterior inferior cerebellar artery.[22] (Fig. 1)

Strokes are classified by etiological categories

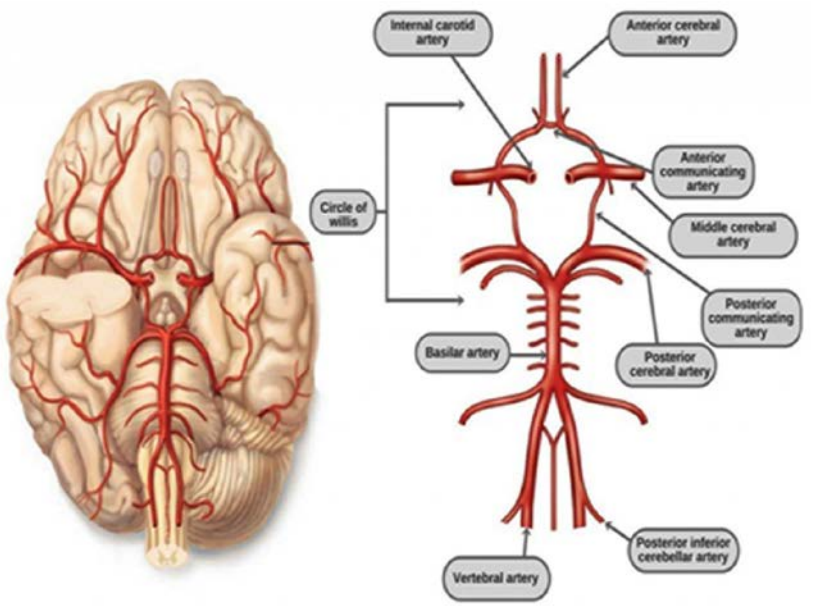

Fig. 1: Blood Supply of Brain

(thrombosis, embolus, or hemorrhage), specific vascular territory (anterior cerebral artery syndrome, middle cerebral artery syndrome, and so forth), and management categories (transient ischemic attack, minor stroke, major stroke, deteriorating stroke, young stroke). (Fig. 2)

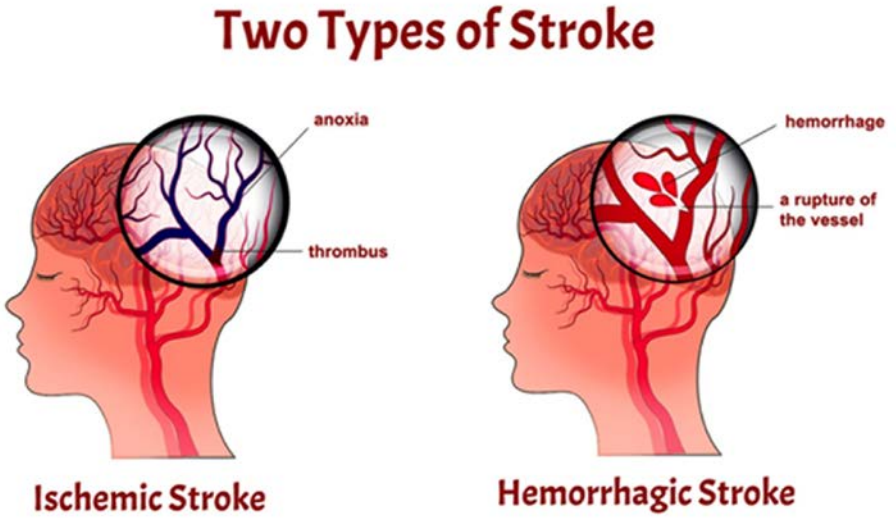

Fig. 2: Types of Stroke

Author's Study Description

Tamaya Van, Steven Truijen (Jan 2019) *et al.* Conducted a study on the effectiveness of trunk training on trunk control, sitting and standing balance and mobility in post stroke patient.

CONCLUSION

There is a strong amount of evidence showing that trunk training is able to improve trunk control,

sitting and standing balance.[23]

Xiaofeng Chen, Zhuohui Gan (Dec 2019) *et al.* Conducted study on the effect of rehabilitation training of core muscle stability on stroke patient with hemiplegia. The patient divided into two groups: control group and observational group. Both group received conventional group and in addition observational group received core muscle stability training. The patient were assessed pre and post intervention through Berg Balance Scale (BBS), Brunnstrom staging and fugl-meyer motor assessment scale and 10 minute walk test. rehabilitation training of core muscle stability can effectively improve the balance function and walking speed of stroke patients.[24]

G Varadharajulu (mar 2017) *et al.* conducted a study on the effect of bobath concept and conventional approach on the, functional outcome in the Post stroke Hemiplegic Individuals and suggested that Bobath improved the quality of life in post stroke hemiplegic individual when compared with conventional physiotherapy approaches.[25]

Seung-heon (2017) *et al.* Conducted a study on the effect of trunk exercise on mobility, balance and trunk control of stroke patients. A randomized pre-test and post-test control group design was initially used, with subjects randomly assigned to the selective trunk exercise group (n=15) and a control group (n=14). All groups underwent physical therapy based on the neuro-developmental therapy (NDT) for 30 minutes a day, five times per week for four weeks. Additionally, the Selective Trunk Exercise (STE) group did the trunk exercise for 30 minutes a day, three times per week for four weeks. The timed up and go tests (TUG), Berg Balance scale (BBS) and Trunk Impairment Scale (TIS) were used for assessment. The combined STE and NDT showed improvements in measures of mobility, balance and trunk control in chronic stroke patients. These results suggest that STE should be considered to be included in the treatment program for patients with chronic stroke.[26]

Julee Das, Dr. R Raja (Dec 2016) *et al.* concluded that following 5 weeks of trunk rehabilitation programme, the increased scores of trunk impairment scale and forward reach distance measured using's it and reach test signifies that the trunk control and dynamic sitting. following 5 weeks of trunk rehabilitation programme, the increased scores of trunk impairment scale and forward reach distance measured using sit and reach test signifies that the trunk control and dynamic sitting.[27]

Muhammed kilinic, Fatmaavcu (Oct 2016) *et al.* Conducted a study on the effectiveness of bobath based trunk exercise on trunk control, functional capacity, balance and gait. The patient were divided into two group, study groups performed individual training program and in control group only conventional therapy were given. The patients were assessed pre and post intervention Scale (BBG), functional reach test (FRT), time up and go test (TUG). Individual developed exercise programs in the Bobath concept significant improve trunk performance, balance and walking ability in stroke patient.[28]

Raikan Buyukavec, Fusum Sahin (Oct 2015) *et al.* Conducted a study on the impact of additional trunk balance exercises on balance, functional condition and ambulation in early stroke patients. A total of 65 patients were included in this double blinded randomized controlled study. Patients were assigned to two groups as experimental group (n-32) who performed trunk exercises two hours/day/ three weeks accompanied by conventional exercise program, control group (n=32) who received only conventional exercise program during the three weeks. Balance, trunk balance, functional level and ambulation were assessed by Berg Balance Scale, Trunk Impairment Scale, Functional Independence Measurement, Revirmead Mobility Index respectively. Conclusion: according to the result of the study, in early stroke patients conventional exercises or conventional exercises plus trunk balance can provide significant improvement in balance, functional condition and ambulation. However, the level of the improvement is better for the group which was applied trunk balance exercises to conventional exercise.[29]

Rosa cabanas-Valdes, Caritat Bagur-Calafat (Oct 2015) *et al.* Conducted randomized control trail on the effect of additional core stability exercise on improving dynamic sitting balance and trunk control for sub-acute stroke patient. Eighty patients were randomly assigned into two groups. Both groups underwent conventional therapy and in addition experimental group performed core stability exercises. The patient were assessed before and after intervention through trunk impairment scale (TIS), function in a sitting test, berg balance scale, tinetti, brunel balance assessment, postural assessment scale and barthel index. Core stability exercise in addition to conventional therapy improves trunk control, dynamic sitting balance, standing balance, gait and ADLs in stroke patient.[30]

Hanan Helmy, Tamer Emara (July 2014) *et al.* Conducted the study on impact of of trunk control

on balance and functional abilities in chronic stroke patients. Forty adult post stroke ambulant patients participated in this study. The testing protocol included assessment of trunk control by Trunk Impairment Scale (TIS), evaluation of balance ability by Biodex Balance System and assessment of functional performance by Functional Independence Measure (Motor subscale). The trunk performance is still impaired in most of the chronic stroke patients and it strongly affects their balance and functional abilities. The dynamic sitting balance component of the TIS is a reliable clinical indicator of balance and functional recovery.[31]

Niraj Kumar *et al.* The Numerical Pain Rating Scale is a subjective measure in which individuals rate their pain on an eleven point numerical scale. The scale iscomposed of 0 (no pain at all) to 10 (worst imaginable pain). It has been shownthat a composite scoring system including best, worse, and current level of pain over the last 24 hours was sufficient to pick up changes in pain intensity withmaximal reliability.[32]

Seong-Hun yu (June 2013) *et al.* Conducted the study on the effect of core stability strength exercise on muscle activity and trunk impairment scale in stroke patients. The control group (n=10) underwent standard exercise therapy, while the experimental group underwent both the core stability enhancing exercise and standard exercise therapy simultaneously. The standard exercise therapy applied to the two groups included weight bearing and weight shifts and joint movement to improve flexibility and the range of motion. The core stability enhancing exercise was performed 5 times a week for 30 min over a period of 4 weeks. The activity and stability of the core muscles were measured using surface electromyography and trunk impairment scale (TIS). Core stability enhancing exercise is effective in improving muscle activity of the lower trunk, which is affected by hemiplegia.[33]

SudhaDhami, Niraj Kumar, Niranjan Kumar *et al.* (2019) did stufy on mirror therapy and repetitive facilitation was found to be effective in improving functional independence in upper limb post sub – acute stroke. When mirror therapy and repetitive is administe 3rd to patient suffering from sub-acute stroke over a period of 4 weeks, it results in an improvement in reaching forwards, grasping, manipulating objects and also improves others ne motor functions of the hand.[34]

Niraj Kumar, Navneet Badoni[2], Siddhartha Sen *et al.* (2022) did study on Mindfulness Based Stress Reduction (MBSR) program, Stabilization Exercise and Moist Heat Therapy (MHT) showed significant improvement in Anxiety & Depression, Quality of Life and Mindfulness in 4th week & 8th week of treatment programme but 8 weeks results showing extremely significant as compared to 4 weeks at p values.[35]

METHODOLOGY

Study Design

The total of 15 subjects with stroke. Group A (experimental group): received core stability training along with bobath approach. Each patient were received the treatment for 5 days a week for 4 weeks. The time duration will be given 40 minutes for each session. All the participant took a part in the experiments on a voluntary basis after signing the consent form and a demographic data was collected from each subject. The purpose of the study was explained to all the subjects. In this study simple random sampling technique was used. These subjects were solicited from the Shri Mahant Indiresh Hospital, Department of Physiotherapy, Patel Nagar, Dehradun (Uttarakhand) and selected according to inclusion and exclusion criteria. Inclusion Criteria - Age 40-65, Both genders, Definite diagnosis of stroke on CT and/or MRI, A supratentorial lesion and hemispheric lesion, More than 1 month or less than 6 months since onset of stroke, GCS: 13-15, MMSE: More than 24, Exclusion criteria, Medically unstable patient, Psychiatric patients, Any orthopaedic pathological condition and fracture, Other peripheral and CNS dysfunction. *Outcome Measures*- Trunk Impairment Scale (TIS) Berg Balance Scale (BBS). Material used as Couch, Chair, Pillow, Data collection sheet and recording and Patient consent form.

Procedure:

15 patients between the age group of 40-65 year were included in study after a written consent forms either the patient or the relatives. Patients were made aware of the research study & the procedure to be followed. Group A would receive bobath approach along with core stability training on trunk balance. Both groups were undergone rehabilitative exercise programme. The study was of 4 weeks, 5 days per week at department of neurology in Indresh hospital, during hospitalization of patient. Examination included assessment which was performed on first and last day of treatment & data was recorded.

Bobath approach:

The technique was developed during the 1940's

by a couple and their work focused on patients with neurological dysfunction and stroke. These approaches emphasize on retrieving postural control and normalizing an impaired muscle tone. Postural alignment and stability are facilitated while excessive tone and abnormal movements are inhibited. Sensory stimulation used as facilitation and inhibition via proprioceptive and tactile inputs is needed during a treatment.

Position of the patient in sitting:

Position of the patient's adequate postural support to appropriate alignment and stability of the trunk and limbs. Use towel fold under the affected side pelvis, thigh and upper limb. These are reduced fixation and improve the trunk activity. It provide proprioceptive and sensory input to facilitate the exploration of postural movement control within an improvement alignment and interaction of base of support.

Facilitate trunk extension:

Trunk facilitation was given with slight downward compression in upper and mid thoracic area and lumbar region to increase trunk extension until therapist hand could be with drawn and patient could stabilize independently.

Training of lumbar spine stabilizers:

Assisting the patient to do the pelvic bridging helps them to achieve selective independent bridging and also increases stability at the pelvis which allow him to improve control in forward translation of the knee that provides stability to knees and ankle together with activation of proximal hamstrings, gluteal muscles and abdominal muscles.

Functional reach out:

Functional reach out was given in the right, left and anterior directions. Functional reach out was done with clasping the hand in front of him, and elbow extended. In forward reaching the therapist stand in hemiplegic side of the patient and right and left reach out therapist in front of the patient and stabilize the patient legs to prevent compensatory movement. Reach out should be done in the shoulder level.

Rotation and counter rotation:

Patient is made to lye in crook lying, therapist supports the affected leg and stands in front of the foot. Patient is asked to move the legs right and left (Fig. 3 & 4).

Core stability training:

1. The core stability enhancing program was performed as follows. Patient was lying rightly on the bed. After extending the hip and knee joints, both the hip and knees were supported by a pillow to maintain this posture. Next, the blade bone was retracted such that the shoulder girdle is positioned in abduction, and a towel was placed below the blade bone to prevent the pectoralis major from performing a compensatory action via relaxing both shoulders. Another preparatory step is enhancing the stability of the neck region. For this, the head was lifted and held in this position by flexing the abdominal region. At the same time, the neck was pulled down to prevent the column from bending. Maintaining this posture, the upper part of the back was lifted as much as possible and twisted slightly in a diagonal direction so that the right hand can face the left knee. This position was maintained for a moment before lowering the back. At this moment, the left arm was aligned, and therapists lead them in right direction and provide minimum help for patients who have difficulty in doing it due to weak abdominal muscle in order that they can control it by themselves. This exercise was repeated; only this time the left hand faced the right knee for enhancing the abdominal muscles on the left. While maintaining this position, the jaw should be on the middle of the chest, and care should be taken that the jaw is not twisted. All these exercises enhanced the stability of core muscles.

Fig. 3: Functional reach out

Fig. 4: Trunk Extension Facilitation

2. Abdominal drawing in maneuver (ADIM)- patients were instructed to draw the lower part of the abdomen up and in towards spine, without movement of trunk or pelvis while continuing to breath normally. It was performed in a crook lying position, then in a static sitting and dynamic sitting (anterior-posterior tilt; lateral tilt and transverse rotation) position.

All these exercises holds for 5,10, 15, 20 sec which enhanced the stability of core muscles (Fig. 5 & 6).

Data Analysis

This chapter deals with the statistical analysis

Fig. 5: ADIM with trunk rotation

Fig. 6: Core Strengthening Exercises

of the 2 outcome measures that are TIS and BBS, between group A and within group A. The data was analyzed by SPSS software version.[20] Paired t-test used to compare pre and post treatment scores of TIS and BBS within group A.

RESULT

This chapter deals with the result of data analysis of the data of two outcome measures that is TIS and BBS, within group A and between group A. The score were analyzed and interpreted to determine which intervention is more effective in improving trunk function and sitting balance in stroke patients.

Paired t-test was used to analyze and compare pre and post treatment score within the group A

and group B. Significant level of 0.05 was used for data analysis.

Explanation:

From the above table we can check the value of mean is less in Pre TIS. It shows that improvement in trunk function and sitting balance in Post TIS as

Table 1. T-Test

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	Egpretis & Egposttis	15	.773	.001

Table 6.1: Comparison of Tis Eg (Group A)

Paired Samples Test									
		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Egpretis - Egposttis	-4.867	1.727	.446	-5.823	-3.911	-10.917	14	.000

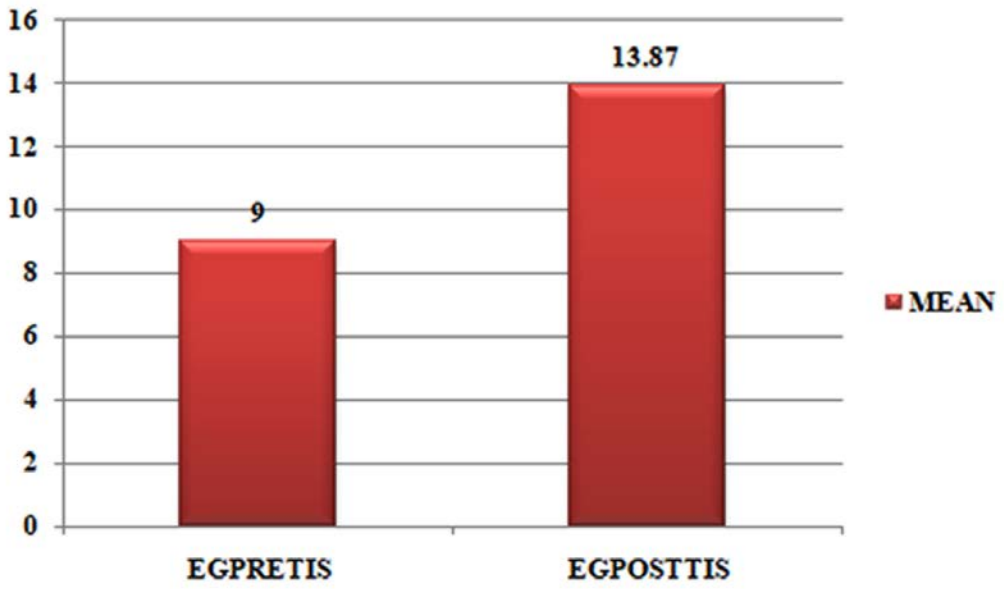

Fig 7: Comparison of Tis Eg (Group A)

compared to PRE TIS in experimental group of TIS (Group A).

Analyzing TIS revealed significant difference in group A post treatment (experimental group), Mean and standard error of mean (13.07±0.703) when compared to group A pre treatment, Mean and standard error of mean (9.00±0.543).

DISCUSSION

The study was conducted to effectiveness of bobath approach along with core stability training on trunk function and balance in stroke patients. The study was conducted on 30 subjects with the age group of 40-65 according to inclusion criteria and was randomly divided into two groups: group A (Experimental group) and group B (Control) group. Based on random sampling method. Group A received bobath based trunk exercises along with core stability exercises and group B received bobath

based trunk exercise along with conventional therapy.

The result of the present study showed thatbobath approach along with core stability training improves trunk function and have a positive impact on balance and mobility. In the literature, there are many studies of the Bobath concept in stroke patients. One of the review state that there are 15 well-designed RCT or CT studies of the Bobath concept, but none of them investigated trunk function. Additionally, since 2003, there has only been the study by Verheyden, which used neuro developmental therapy on the trunk. However, Verheyden used a standard treatment protocol and not an individualized approach.

This study is based on the on the trunk training of stroke patients in which individual treatment was planned and implemented on the base of the Bobath concept. In addition, performing the trunk exercises not just for the trunk but also for the upper and lower extremities, balance, and gait performance to reach a higher quality of function, makes this study different from others. In this regard, it can be suggested that individually developed exercise programs according to the Bobath concept improve trunk performance, balance, and walking activities in stroke patients.

The effects of trunk training on sitting balance and trunk performance were evaluated by TIS. The TIS as a primary outcome showed a significant change in total score and suggest improvements in comprehensive functions.

In our study, core stability training also improved trunk balance and mobility. Van Nes *et al.* reported that lateral trunk control might be a primary target for rehabilitation, since lateral balance was more affected by stroke than that balance in anterior posterior direction and shoed the strong association with the berg balance scale (BBS).

Additionally, spine stability depends not only on muscular strength but also sensory input that alters the central nervous system about interactions between the body and environment, providing constant feedback allowing refinement of movements. Previous studies have added 10 hours of core stability exercises in their intervention group, and the result were of a similar magnitude to this study, leading us to conclude that core stability exercises are relevant factor to explain the benefits observed in this study.

Thus, the results showed improved trunk function, increased balanced and mobility. These results offer evidence that intervention aimed at trunk muscle activation based on bobath approach and core stability theory results in positive effect for patient with stroke.

Limitation of Study

The duration of the study was only 4 weeks due to covid 19 pandemic; patients are hospitalized only for short period of time. So further prognosis and long term effects of intervention could not be recorded.

The sample size was small i.e., 15 patients & Specific gait training exercises and limb exercises are not concentrated.

Proper follow-up was not done due to covid 19 pandemic.

Future Research

Further studies are recommended to minimize the limitation in such a way that large sample size of both sexes that include various age groups of people can be studied.

Longer duration of intervention with long term follow-up, so that long lasting effect can be studied. Duration of the study can be increased.

CONCLUSION

This study concluded that significant improvement in trunk function and sitting balance in stroke patients. Thus, the alternate hypothesis that the effectiveness of core stability training along with bobath approach on trunk function and sitting balance in stroke patient is accepted.

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