

**Effects of ankle Joint mobilization with movement and weight-bearing exercise on knee extensors strength, ankle range of motion and balance in patients with chronic stroke**

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## ABSTRACT

**Objective:**To investigate the effects of ankle joint mobilization with movement on knee extensors strength, ankle range of motion, balance and compare with weight-bearing exercise in stroke patients.

**Methodology:** Thirty patients with chronic stroke (6-8 weeks after stroke) were divided into two groups: A (mobilization with movement group) n=15, B (weight bearing exercise group) n=15. Both groups attend physical therapy session three times a week for 4 weeks. Subjects randomly allocated by simple coin draw method in to group A, performed dorsiflexion of ankle joint in weight-bearing position and therapist simultaneously apply anterior glide with belt on ankle joint whilst participants in group B, performed weight-bearing exercise only without mobilization. Knee extensors strength, ankle range of motion and balance were evaluated before and after interventions by manual muscle testing, universal goniometer and berg balance scale.

**Results:** Knee extensors strength and balance increased significantly in both groups. However active and passive range of motion only increased significantly in group A.

**Conclusion:** Ankle joint mobilization with movement is more effective technique than simple weight-bearing intervention in improving range of motion in patients with chronic stroke with limited ankle motion.

**Key words:**Exercise program, weight bearing, Range of Motion, Balance

**INTRODUCTION**

According to WHO estimation, stroke was accounted 16 million first time event and 5.7 million death in 2005 and this amount may reach 23 million and 7.8 million in 2030 respectively. Stroke is second important cause of avoidable death worldwide and fourth important cause of absent efficiency in one's life(1).

Spasticity is common sign after stroke, seen in 30% of patient, and generally happen within first few days after event. Previous studies show that 25% of patient with stroke develops spasticity within 6 weeks after event and spasticity mainly affect the wrist (66%) elbow (79%) and ankle (66%).In upper limb most common pattern of spasticity is internal rotation, adduction of shoulder and flexion at elbow, wrist and fingers and in lower limb, adduction of hip, extension of knee with plantarflexion of ankle and equinovarus foot is most common pattern. Round about 30° of ankle ROM is necessary for performance of ADL'S such as walking, transfers and climbing stairs. Restricted ankle ROM not only affect the accomplishment of these necessary functional activates, but it also effect the initial placement of foot for standing and walking. Joint mobilization, or movement of articular surface, is a method usually used by physical therapist to help return normal accessory movement of joint when there is ROM restriction(2).

In recent study joint mobilization method apply to restricted ankle joint in patients with stroke was found effective in improvement of ROM. But, joint mobilization methods concentrate on improvement of passive ROM only, but functional activities require both AROM and PROM. Thus, intervention target at improvement of AROM is also require in addition to joint mobilization intervention.

Mulligan first projected MWMS (mobilization with movement) as a joint mobilization techniques. According to Mulligan weight bearing position is more effective for improvement of ankle ROM because, weight bearing MWM technique allow the subject to bear weight on the affected side which is crucial for hemiplegic patient after chronic stroke. In MWM technique for dorsiflexion loss patient stand with his effected foot on the chair, therapist place elastic belt around his hips and patient lower leg. Therapist pull tibia and fibula forward with the help of elastic belt and patient flex his knee forward to shift his center of gravity forward over effected foot(3, 4).

In weight bearing exercise patient stand with hemiplegic foot placed on stool and patient actively bend knee to shift COM forward on lower extremity of the affected side and slowly return to starting position(4).

In this study, the effect of ankle mobilization with movement on ankle ROM, knee extensors strength and balance investigated in patients with chronic stroke. Analyses also done to clarify improvement observe following intervention that applied in weight-bearing position is either the end result of weight bearing exercise on affected side only, or effect of mobilization applied on ankle joint in weight-bearing position.

## **METHDOLOGY**

### **Study Design**

Randomized Clinical Trial

### **Study Setting**

Physical therapy department of Sheikh Zayed hospital (public hospital), Rahim Yar Khan

### **Study Protocol**

Study involved two groups, group A (receive ankle mobilization in addition to weight-bearing exercise) and group B (receive only weight bearing exercise).A total of n=30 patients randomly

allocated by coin draw method in both groups include male and female of age 35-60 years with hemiplegic stroke of minimum 6 to 8 weeks post stroke and patients with marked spasticity was included in study and patient with positive red flags, joint hypermobility and cognitive, coordination deficit were excluded from study.

### **Intervention Protocol**

Group A received mobilization with movement technique, mobilization applied on talocrural joint as describe by Mulligan, subject placed the unaffected leg on the floor and hemi paretic leg on the stool (height of 30 cm), subject's distal tibia, fibula and pelvis of therapist wrapped by using non-elastic belt, subject actively maintained dorsiflexion with the forward shift of the center of mass (COM); at same time, therapist performed anterior glide on the tibia by using belt, for effective sustained gliding, Grade III glide sustained for 10 second with slow active dorsiflexion to end of pain-free range, Three sets of 10 repetitions performed, with 1-minute break between each sets. Patients in WBE group, lower extremity of the affected side placed on stool and asked to patient actively bend knee to shift COM forward with lower extremity of the affected side. All participants in both group receive 30 minute of WBE and MWM, with inclusion of warm-up or cool-down period for 5 minute that include deep breathing or active limb exercises, intervention was applied 3 times a week for 4 weeks, patient was receive total of 12 treatment session.

Maximal contraction of knee extensors was measure manually with manual muscle testing, to measure passive and active dorsiflexion range of motion universal goniometer was used, that made of plastic, to observe effect of intervention on balance observational scale "Berg Balance Scale" was used.

### **Outcome Measures**

Data was collected through patient evaluating form that involve 3 part, first part involve characteristics of participants that analyzed statistically at baseline such as age, gender, side involved, duration passed after stroke, weight, Modified ashworth scale to measure dorsiflexors spasticity. Second part involve dorsiflexion range of motion and knee extensors muscle strength measured at the start and end of 12 session, third part involve balance measured by berg balance scale, all data is analyzed statistically by SPSS.

### Ethical Consideration

The study was ethically approved from Al-Shifa Hospital Ethical Committee IRB# ASC-PT-056/06/2022. The study had followed the guidelines of Helsinki declaration of human subject. Before enrolling the participants in the study consent was taken and complete information regarding the study protocol were given to all the participants. Further the fundamental principles as laid down in Belmont report regarding the principles of beneficence, autonomy and confidentiality was strictly followed.

### RESULTS

In this study data is collected through questionnaire that have three part, first part involve characteristics of participants at baseline (table 1)

**Table:1 Characteristics of participants at baseline**

<b>Variables</b>	<b>MWMMean ± SD</b>	<b>WBEMean ± SD</b>	<b>P-value</b>
<b>Age (years)</b>	49.3± 4.57	48.4± 6.2	0.87
<b>Gender (M/F)</b>	12/3	11/4	0.90
<b>Hemiplegic side (R/L)</b>	9/6	10/5	0.67
<b>Disease duration</b>	2.23 ± 0.76	2.45 ± 0.68	0.61

<b>(months))</b>			
<b>Weight (kg)</b>	77.3 ± 8.23	73.1 ± 9.27	0.80
<b>MAS (0 to 4)</b>	3.11 ± 0.13	3.17 ± 0.17	0.87

Table 1 shown mean ± standard deviation or frequency distribution of all the characteristics of participants, that involve in both groups A and B at the baseline such as age, gender, hemiplegic side, disease duration, weight and spasticity scored by Modified Ashworth scale.

Further Paired t-test was used to analyze data with in group A and B and independent t-test was used to analyze data statistically between group A and B. In this study in MWM group ankle PROM and AROM significantly increase after intervention, the mean difference of PROM and AROM was 8.60 and 7.86 respectively that show the marked difference after intervention and in group B was 1.33 and 4.00 respectively that shown no marked difference after intervention, and when compare between group value of p was 0.00 that show significant difference between groups. (table 2)

In MWM group knee strength increase after intervention mean difference of knee extensors strength before and after intervention was 1.46 with p value 0.00 that shown the marked difference between pre and post intervention and in WBE group was 1.46 with p value 0.00 that also shown marked difference between pre and post intervention and when compare between groups value of p was 1.00 that shown no significant difference between groups. Knee extensors strength increase in both group markedly (Table 2, Figure 1)

The mean difference of balance in MWM group when calculated before and after intervention was 9.93 with value of p 0.00 that shown the marked difference between pre and post intervention, in WBE group mean difference was 7.46 that also shown marked difference

between pre and post intervention and between group value of p was 0.46 that shown no significant difference between groups. Balance increase markedly in both MWM and WBE group.

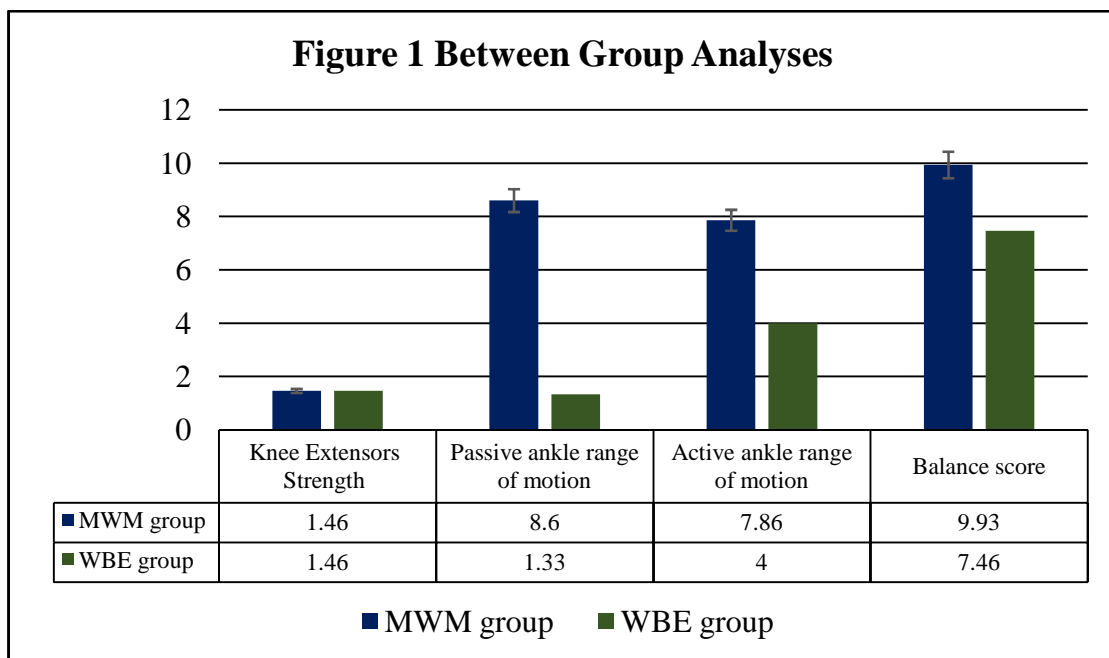
Parameters	MWM group Mean difference	WBE group Mean difference	Between group Mean difference	P-value
Knee extensors strength	1.46	1.46	.000	1.00
Passive ankle range of motion	8.60	1.33	5.800	.000
Active ankle range of motion	7.86	4.00	3.60	.000
Balance score	9.93	7.46	.800	.467

Values expressed as mean difference

< 0.05 = significant difference between WBE and MWM group



**Graphical Representation illustrating between group Analyses**



**DISCUSSION**

This study showed that ankle range of motion markedly improve in mobilization with movement group only, knee extensor strength and balance improved markedly in both groups

According to previous study, MWM approach, that include anterior glide of tibia on talus combined with dorsiflexion movement that actively performed by patient, proved effective for

improvement of dorsiflexion. Improvement of ankle range of motion is more remarkable when MWM is done in weight-bearing position(5).

A study by An and Won, 2016 AROM (6.1°) and PROM (4.7°) increase considerably in MWM group, when compare to WBE and control groups, the reason of this result was forward gliding of tibia by therapist with the help of belt, perform concurrently with MWM exercise, cause a forward shifting of COM further and increase contraction of plantar flexors and dorsiflexors(4).

Previous study by An Jo, 2017 report that PROM in dorsiflexion direction increase significantly in the MWM group when compared to control group. Plantarflexors strength increased significantly in MWM group when compared to control group. But, strength of dorsiflexors, knee extensors not markedly different and increase in both group(6).

Moreover, study by Shields et al., 2010 demonstrate that squat exercises with single leg improve muscle strength of quadriceps. It was shown in previous study that repeated contraction of muscles of knee while shift COM to the lower extremity of affected side effective for improvement of knee extensors strength in both MWM and WBE intervention. However, knee strength differences before and after intervention was higher in MWM group than in WBE group(7).

According to previous study, balance and gait parameters measure in patients with chronic stroke before intervention, patient shown considerably decrease in ability to shift the weight on paretic limb and decrease step length, significant escalation in balance is observed inMWM group, when compared to other two groups this is due to improved muscle strength of effected extremity and due to improved ankle ROM when compared to other two groups(8).

## CONCLUSION

With the help of this study we concluded that 12 session of the mobilization of talocrural joint with the help of belt in combination with single leg lunges cause statistically significant improvements in muscle strength, active and passive range of motion in dorsiflexion direction and its overall impact on balance in the MWM group, muscle strength and balance markedly increased in both group but active and passive range of motion only increase in

MWM group. In short MWM is a better treatment option for a patients with chronic stroke with limited dorsiflexion range of motion.

**Conflict of interest:**N/A

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