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Effects of various mulligan technique on hamstring muscle imbalance and lumbar spine mobility in marathon runners: A randomized control trial

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Abstract
Background: The hamstrings are an important muscle in running, but they tend to be neglected by runners in terms of stretching and strengthening. A tight hamstring is often the result of not stretching before running and could be indicative of strain. Brian Mulligan has developed most brilliant compilation of manual techniques such as Bent Leg Raise and Traction Straight Leg Raise in hamstring flexibility.
Objectives: To compare the effect of Bent Leg Raise and Traction Straight Leg Raise on hamstring muscle tightness and lumbar spine mobility.
Methods: Total number of 60 marathon runners between age 18-35 years of both genders with more than 1 year of experience were selected by simple random sampling, and were divide into three groups of 20each, Group A, B and C using envelop method. Subjects in Group A received Bent Leg Raise technique and static stretching, Group B received Traction Straight Leg Raise and static stretching, and Group C received static stretching. Participants were assessed for hamstring tightness with Active Knee Extension Test (AKET) and readings were noted and lumbar mobility was assessed using Modified-Modified Schober Test (MMST) and. Assessment was done on pre and post intervention on Day 1, 4, 7, 10 and 14.
Results: This study showed significant improvement in AKE RIGHT(3± 4.104),AKET LEFT(2.75±3.432), MMST FLEXION (6.495 ± 0.4936) and MMST EXTENSION (2.52 ± 0.3982) of Group A as compared to Group B AKE RIGHT (18.45± 9.741), AKET LEFT (17.75 ± 7.580), MMST FLEXION (5.89 ± 0.4866) and MMST EXTENSION (2.945 ± 0.3734) and Group C AKE RIGHT (26.3± 13.255), AKET LEFT (24.7 ±10.569), MMST FLEXION (5.390 ± 0.5839) and MMST EXTENSION (3.835 ± 0.7307).
Conclusion: Bent Leg Raise is more effective than Traction Straight Leg Raise in altering the hamstring muscle flexibility and lumbar spine mobility in marathon runners.

Keywords: Bent leg raise, traction straight leg raise, active knee extension test

1. Introduction
The most ingenious compilation of manual techniques has been developed by Brian mulligan. Unlike the other mobilization procedures, Mulligan performed while patients were performing a resisted muscle contraction or while they were moving, either actively or passively. Other than many other manual therapy approaches this technique is performed in symptom free range of motion a factor that probably makes it safer [1]. Traction Straight Leg Raise (TSLR) and Bent Leg Raise Techniques (BLR) has been described by Mulligan in patients with low back pain which are said to improve range of motion of hip flexion. The Traction Straight Leg Raise and Bent Leg Raise are painless interventions that are said to have immediate benefits [1]. For normal biomechanical function flexibility is considered an essential element. Hamstring tightness leads to high risk of recurrent injury, decreases the performances in athletes, lead to post- exercise soreness and decrease coordination among athletes. The hamstring muscles have been coupled with low back pain and gait abnormality and commonly linked with movement dysfunction at the lumbar spine, pelvis and lower limbs. Limited flexibility causes neuromusculoskeletal symptoms. These neuromusculoskeletal symptoms will lead to decrease in strength, stability, endurance and much more. All these will lead to recurrent injury and might affect psychosocial aspect of the athlete [2]. Running is one of the most popular and competitive, recreational, and fitness activities worldwide.

Marathon is an emerging sport, and for running in marathon, it requires strength as well flexibility of lower body. Certain studies suggest that in athletes the hamstring muscles gets tight due to recurrent overloading of the muscle. The highest risk factor injuries in runners are weekly mileage. In particularly, it is believed that the risk of injury significantly increases as the mileage threshold exceeds 40 miles per week. Additionally, higher weekly mileage is correlated with greater likelihood of tightness of muscle, the most commonly injured multi-joint muscle group in the body includes the hamstrings. Studies suggest that, the risk of various running injuries increases. As hamstring flexibility decreases [12]. Many advanced techniques are used by physiotherapists to manage the hamstring muscle imbalance. Our study focuses on comparing effects of two advanced techniques defined by Brian Mulligan on hamstring tightness. The results of our study may give out the finest approach to alter the hamstring flexibility.

2. Material and Methodology

2.1 Methodology

Randomised Control Trial was the Study design. Study setting was sports clubs in and around Pune. Total number of 60 marathon runners Total number of 60 marathon runners between age 18-35 years of both genders with more than 1 year of experience were selected by simple random sampling. Active Knee Extension Test and Modified-Modified Schober Test outcome measures were used pre and post intervention.

2.2 Exclusion Criteria

- People not willing to participate
- Individuals using lower limb prosthetic or orthotic devices
- Others sport players like kabaddi player

2.3 Outcome Measure

- Active Knee Extension Test [20]
- Modified- Modified schobber's Test [25]

2.4 Procedure

Ethical clearance was taken from institutional ethical committee of Tilak Maharashtra Vidyapeeth, department of physiotherapy. Various sports clubs were approached and permission was taken to conduct the study. Samples were selected according to the inclusion and exclusion criteria. The aim and procedure of the study was explained to the selected participants and written consent was taken. Participants were divided by envelop method in three groups, Group A Group B and Group C using simple random sampling. Subjects in Group A received Bent Leg Raise technique and static stretching, Group B received Traction Straight Leg Raise and static stretching, and Group C received static stretching. Participants were assessed for hamstring tightness with Active Knee Extension Test (AKET) and readings were noted and lumbar mobility was assessed using Modified- Modified Schober Test (MMST). Assessment was done on pre and post intervention on Day 1, 4, 7, 10 and 14. Assessment was done by a blind assessor in all session for 2 weeks. Intervention was given thrice per week and thrice per session for two weeks. Data was collected and got subjected for statistical analysis

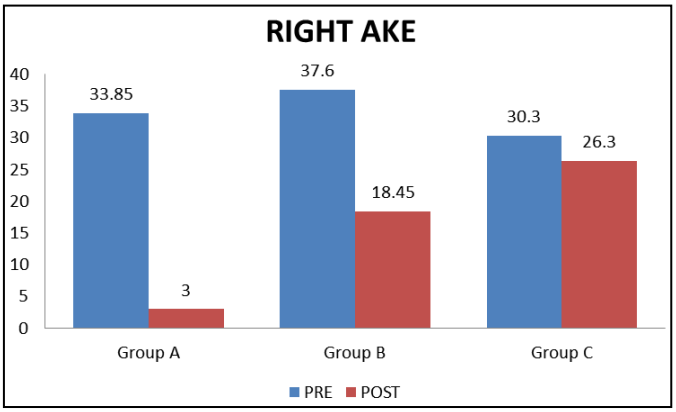
- Mulligan's Bent Leg Raise: Therapist stands at the limited hamstrings flexibility side of the supine subject on the plinth. Therapist place the subject's flexed knee over his (therapist's) shoulder and now asks the subject to push the therapist with his leg and then relaxes. At this point therapist push his (subject's) bent knee up as far as possible in the direction of his (therapist's) shoulder on the same side. Sustain this stretch for 30 seconds and then lower the leg to the plinth and repeat for 3 repetitions, and 1 minute rest between each stretch. And same procedure is done for the other side of limited hamstrings flexibility [2].
- Traction Straight Leg Raise: This technique involves sustained traction applied to the limb with the knee extended. The subject is in supine lying on a very low bed or on the floor and therapist stand facing subject's affected side. Subject actively does the SLR and therapist note the range. Therapist now grasp subject lower leg proximal to the ankle joint and raise it off the bed to a position just short of the painful range. Therapist flexes his knees and holds the clasped leg to his (therapist's) chest. When the therapist extend his knees this will effectively apply a longitudinal traction to the leg provided the bed is low enough and the therapist is tall enough. Sustain this traction and undertake a straight leg raise as far as it will go provided there is no pain. If there is pain slightly rotate, abduct or adduct the hip while raising the leg. When pain free SLR with traction is given for three times [7].
- Static Stretching: It was given in supine position by performing passive SLR and end range was hold for 30 seconds [26].
- Final readings were statistically analyzed.

Results and Discussion

Tables and Figures

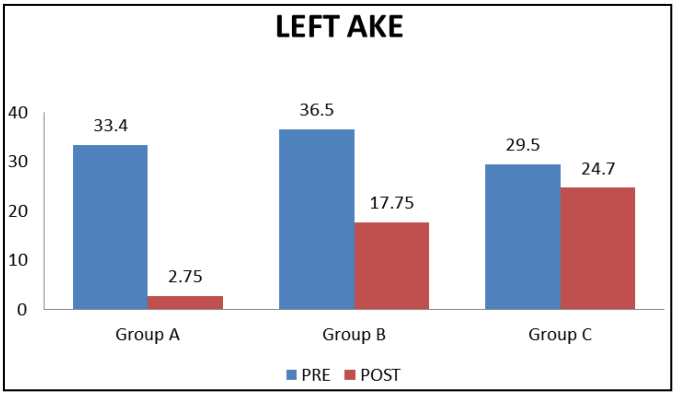
Table 1: Represents Age, gender, pre and post intervention values of AKET (right and left) and MMST (flexion and extension)

Outcome Measure	Group A (Mean ± SD)	Group B (Mean ±SD)	Group C (Mean±SD)	P Value
Age	25.5 ± 5.277	23.65 ± 4.344	25.6±3.872	0.3169
Gender	Male=12, Female=8	Male=15, Female=5	Male=14, Female=6	
AKET Right: Pre	33.85 ± 10.912	37.6± 15.480	30.3±14.492	0.2535
Post	3 ± 4.104	18.45 ± 9.741	26.3±13.255	<0.0001
P value	<0.0001	<0.0001	0.3681	
AKET Left: Pre	33.4 ± 10.065	36.5 ± 14.296	29.5±11.799	0.1993
Post	2.75 ± 3.432	17.75 ± 7.580	24.7±10.569	<0.0001
P value	<0.001	<0.0001	0.1834	
MMST Flexion: Pre	4.825 ± 0.5379	4.81 ± 0.6206	5.005±0.6848	0.5427
Post	6.495 ± 0.4936	5.89 ± 0.4866	5.390±0.5839	<0.0001
P value	<0.0001	<0.0001	0.0633	
MMST Extension: Pre	3.69 ± 1.062	4.91 ± 0.7203	4.180±0.6986	0.0001
Post	2.52 ± 0.3982	2.945 ± 0.3734	3.835±0.7307	<0.0001
P value	<0.0001	<0.0001	0.1352	



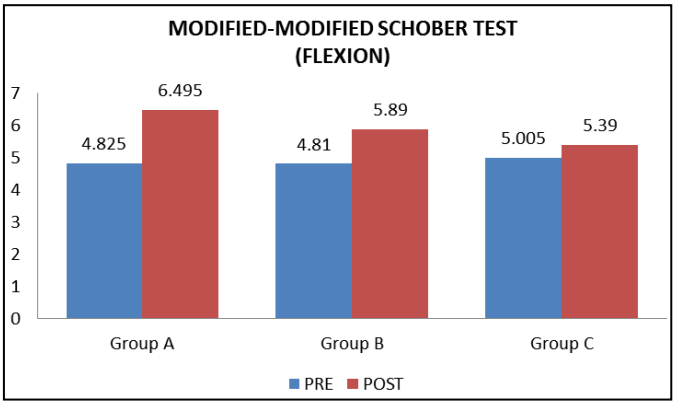
Graph 1: Pre and post intervention values using AKET (Right)

Interpretation: Graph 1 shows, Group A included 20 participants whose mean hamstring tightness pre-treatment was 33.85 and mean hamstring tightness post treatment with BLR was 3. Group B included 20 participants whose mean hamstring tightness pre-treatment was 37.6 and mean hamstring tightness post treatment with TSLR was 18.45. Group C included 20 participants whose mean hamstring tightness pre-treatment was 30.3 and mean hamstring tightness post treatment with hamstring stretch was 26.3.



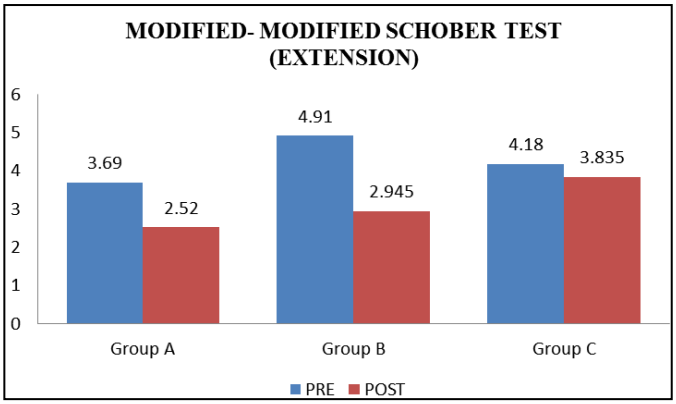
Graph 2: Pre and post intervention values using AKET (Left)

Interpretation: Graph 2 shows, Group A included 20 participants whose mean hamstring tightness pre-treatment was 33.4 and mean hamstring tightness post treatment with BLR was 2.75. Group B included 20participants whose mean hamstring tightness pre-treatment was 36.5 and mean hamstring tightness post treatment with TSLR was 17.75. Group C included 20 participants whose mean hamstring tightness pre-treatment was 29.5 and mean hamstring tightness post treatment with hamstring stretch was 24.7.



Graph 3: Pre and post intervention values using MMST (Flexion)

Interpretation: Graph 3 shows, Group A included 20 participants whose mean lumbar mobility pre-treatment was 4.825 and mean lumbar mobility post treatment with BLR was 6.495. Group B included 20 participants whose mean lumbar mobility pre-treatment was 4.81 and mean lumbar mobility post treatment with TSLR was5.89. Group C included 20 participants whose mean lumbar mobility pre-treatment was 5.005 and mean lumbar mobility post treatment with hamstring stretch was 5.39.



Graph 4: Pre and post intervention values using MMST (Extension)

Interpretation: Graph 4 shows, Group A included 20 participants whose mean lumbar mobility pre-treatment was 3.69 and mean lumbar mobility post treatment with BLR was 2.52. Group B included 20 participants whose mean lumbar mobility pre-treatment was 4.91and mean lumbar mobility post treatment with TSLR was 2.945. Group C included 20 participants whose mean lumbar mobility pre-treatment was 4.18 and mean lumbar mobility post treatment with hamstring stretch was 3.565.

Discussion

The purpose of this study was to compare effects of BLR and TSLR on hamstring muscle imbalance and lumbar spine mobility in marathon runners. In this study, 78 participants were approached out of which 8 participants were excluded according to the inclusion and exclusion criteria and 10 participants dropped out of the study. The pre and post intervention results of AKET (right and left), MMST (flexion and extension) for group A and B was extremely significant with p-value <0.0001. The results of the present study shows that there is significant improvement of hamstring flexibility by Mulligan Bent Leg Raise as compared to Mulligan Traction Straight Leg Raise which is supported by the study done by P. Phansopkar *et al.* in which it is stated that in Mulligan BLR and TSLR stretching, the muscle is slowing elongated to tolerance and the position is held with the muscles in its greatest tolerated length [2]. Another study done by Vijay Kage, Rakhi Ratnam supports the present study by stating that Mulligan BLR increases immediate post-intervention hamstring flexibility and range of motion [14]. The mechanism involved for the increase in flexibility might be that the intervention consists of contract relaxes cycles applied to hamstrings that provide peripheral somatic input by the way of contracting muscles and the cutaneous contact of the therapist. Changes in alpha and gamma motor neuron activity (influencing the hamstring muscles) at a segmental level are likely following this technique that are similar to those effects observed following the implementation of proprioceptive neuromuscular facilitation (PNF) techniques and this may affect the subject's perception of their straight

leg raise (SLR) limit [15, 1]. The mechanism under increase in flexibility of hamstring muscles after traction straight leg raise may be various receptors exert an inhibitory influence on lower limb alpha-motoneuron activity [16]. Golgi tendon organs around the knee, hip. And spine probably initiates various segmental reflex pathways during traction of the limb. Likewise, Golgi tendon organs are activated during large amplitude stretching movements such as SLR [17]. This processing of information in the nervous system may inhibit the activity of the muscles being lengthened during SLR by dampening the afferent activity of type II muscle spindles [18, 19]. Hence, improvement in range of SLR may be directly related to inhibition of the hamstring muscles rather than to changes to stretch tolerance [23].

Conclusion

In this study we conclude that Bent Leg Raise is more effective than Traction Straight Leg Raise in altering the hamstring muscle flexibility and lumbar spine mobility in marathon runners.

Limitation and future scope of study

It was not a funded study. Sample collection within limited area. Less study duration. Comparison of the two mulligan techniques can be evaluated in different sports. Applying for funding to the All India Marathon Federation for better access to the equipment and to do a larger study.

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