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Original Article

Effects of Active Release Technique Versus Mulligan Bent Leg Raise on Hamstring Tightness in Healthy Individuals; A Quasi-Experimental Study

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ABSTRACT

Background: Active Release Technique is a soft tissue method that focuses on relieving tissue tension via the removal of fibrosis and adhesions, which can develop in tissue as a result of overload due to its repetitive use. The Mulligan bent leg raise technique is used to improve the range of straight leg raises in subjects with low back pain or referred thigh pain and to improve the flexibility of the hamstring in individuals with hamstring tightness. **Objective:** To compare the effects of active release technique versus Mulligan bent leg raise in healthy individuals with hamstring tightness**. Methods:** This study was a quasi-experimental study with a sample size of 40 normal, healthy individuals aged between 18 to 25 years and normal healthy subjects free from any signs and symptoms of regional pathology, vascular insufficiency, low backache or radiculopathy. While exclusion criterion was any history of injury in the lower extremity in the past three months (upper and lower motor neuron lesions), participants must not be involved in gymnastics, sports activities, strength training, or yoga, and participants must not be taking any treatment of a musculoskeletal nature. Group A received a single session of the active release technique, and the other group B received that of the Mulligan bent leg raise. All the subjects were evaluated through the straight leg raise test and the popliteal angle through the active knee extension test as pre- and post-intervention measuring tools for hamstring tightness. **Results:** There was a significant difference between pre-values and post-values of popliteal angle ($p<0.001$) and passive straight leg raise test ($p<0.001$) between the active release technique group and the Mulligan bent leg raise group. The results also showed significant differences in popliteal angle and passive straight leg raise test post-interventional scores ($p<0.001$) within the groups. **Conclusion:** Both the active release technique and the Mulligan bent leg raise technique proved to be significant in improving hamstring tightness in healthy asymptomatic subjects in a single session, but active release technique proved to be more significant than the Mulligan bent leg raise in improving hamstring tightness immediately after the application of these comparative interventions.

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INTRODUCTION

Muscle flexibility is a physiological term to define joint excursion through its ROM that also involves contributions from joint and soft tissue structures[1], while tightness is defined as the decreased ability of that muscle to elongate from its neutral position.[2] Decreased hamstring flexibility can lead to hamstring injury or strain. Hamstring tightness is not pathology; it is itself a sign of hamstring strain and injury. A hamstring injury occurs when a person suddenly does any activity, such as running or jumping, without stretching or warming up. There is bruising and tenderness along the thigh of the person. When a person is involved in any type of strenuous activity, he can experience sudden pain along with pooping and snapping sounds.[3] According to a study in 2005, hamstring tightness usually starts in early childhood and gets worse with age, with men experiencing it more frequently than women. Tightness in children ages 5 to 12 years is between 30 and 40 degrees, and in adults ages 50 to 59 years, it can be as high as 52.6 degrees. It is believed that elasticity changes and a decrease in physical activity are the main causes of the ageing-related decrease in flexibility.

According to a 2018 study conducted at the College of Physical Therapy at the Dr Vithalrao Vitkhe Patil Foundation, hamstring tightness is very common in college students between the ages of 18 and 25.[4] Thus, promoting hamstring stretching is essential to avoiding musculoskeletal problems in the lower quadrant. The hamstring muscles occupy the posterior compartment of the thigh. The criteria for hamstring muscle are; the muscle should originate from ischial tuberosity where tendons attach at bone, at ischial tuberosity of hip and linea aspera of femur, 2nd criteria are that the muscle should inserted over the knee joint, 3rd criteria is that the muscle should be innervated by tibial branch of sciatic nerve and the 4th one is the muscle should participate in knee flexion and hip extension at beginning of each step. Those muscles which fulfil these four criteria are called true hamstrings. The hamstrings involve the bicep femoris long head most lateral hamstring), semitendinosus and semimembranosus.[5] The active release technique (ART) is a soft tissue method that focuses on relieving tissue tension via the removal of fibrosis and adhesions, which can develop in tissue as a result of overload due to its repetitive use. It was developed by a chiropractor, Dr. P. Michael Leahy.[6]

The ART covers three tasks: to restore free and unimpeded motion of soft tissues; to release entrapped nerves, vasculature, and lymphatic vessels; and to re-establish optimal texture, resilience, and function of soft tissue.[7] The aim of this technique in hamstring tightness is to reduce the level of pain and immediate relief in hamstring tightness to restore the normal function capacity of the hamstring muscle.[8] The Mulligan bent leg raise (MBLR) technique is used to improve the range of the straight leg raise (SLR) in subjects with low back pain or referred thigh pain and to improve the flexibility of the hamstring in clients with hamstring tightness. This technique is an isometric contraction of the hamstring muscles. Isometric contraction of the hamstring is performed at different angles of knee flexion in pain-free ranges. If this technique cannot be implicated in pain-free ranges, then it should not be used.[9] The ART and MBLR have both been found effective in clinical practice for hamstring tightness. However, a single session of the ART is more effective as compared to the MBLR technique.[10] To address hamstring tightness in asymptomatic, healthy individuals in a single session, a comparative study between ART and MBLR was required. This study aimed to investigate and determine efficacious therapeutic interventions for common musculoskeletal problems. Treating

hamstring tightness early on can help avoid future injuries and enhance general physical function. It is a common issue that affects people from all walks of life, from athletes to inactive citizens. prevent future injuries and enhance general physical function. It is a common issue that affects people from all walks of life, from athletes to inactive citizens.[11] This study intends to offer important insights into the relative efficacy and usability of ART and MBLR, two well-known manual therapy procedures known for their potential efficacy in relieving muscle tightness and enhancing range of motion. In addition, the use of healthy people without symptoms in this study guarantees that the therapies are assessed in a controlled setting, reducing the possibility of confounding factors associated with pain or injury and facilitating a more precise evaluation of their direct effect on hamstring tightness.

The study's conclusions ultimately can guide clinical decision-making, helping medical professionals choose the best course of action for treating hamstring tightness in both preventative and restorative settings. Though hamstring strain is common and should be addressed in both athletes and non-athletes, there is a significant lack of research on direct comparisons between ART and the MBLR in healthy, asymptomatic individuals in a single session. Although the efficacy of ART and MBLR in enhancing hamstring flexibility and decreasing tightness has been studied separately, little research has directly compared these methods in a controlled experimental environment. Instead of explicitly contrasting the outcomes of different techniques, existing research frequently focuses on how effective one approach is over another or compares them to placebo therapies.[12] Furthermore, the majority of research on these methods has been carried out in populations with certain musculoskeletal disorders or injuries, which limits the applicability of the results to those who do not exhibit any symptoms. Therefore, to clarify the relative efficacy of ART and MBLR in a single session, comparative trials directed especially at asymptomatic, healthy people are needed. By filling in this gap in the literature, we can gain important knowledge on the relative effectiveness, viability, and use of different manual therapy methods, which will improve the treatment of hamstring tightness and influence clinical practice standards.

METHODS

It was a quasi-experimental study and the sample was collected under a convenient sampling technique with a sample size of 40 persons from the general population. The duration of the study was three months. All the subjects were given an informed consent form. Normal healthy individuals aged 17 to 25 years were selected based on inclusion and exclusion criteria, which had been processed through the initial screening methods of these individuals by measuring pre-interventional scores of SLR and popliteal angle. The subjects were then divided into two groups. Group A had received a single session of the ART, while Group B had received a single session of the MBLR. Immediately after the application of the relative interventions, post-interventional scores of straight legs raise and popliteal angle were recorded. The inclusion criteria for the study were a minimum score of 70 or less in SLR[13], age of 18 to 25 years, and normal healthy subjects free from any signs and symptoms of regional pathology, vascular insufficiency, low back pain, or radiculopathy. While the exclusion criterion was any history of injury in the lower extremity in the past 3 months (upper and lower motor neuron lesions)[14], participants must not be involved in any gymnastics, sports activities, strength training/yoga, and participants must not be taking any treatment of a musculoskeletal nature.

Interventions: Group A received a single session of ART. The subject was in a prone-lying position with his or her foot at the edge, hanging off the treatment table. Initially, the tightness and texture of the soft tissues were evaluated in the posterior thigh through palpation of the hamstring muscles to check where the maximum tightness could be felt. The therapist then applied tension to the tight hamstring muscle bellies longitudinally at a specific tension while asking the patient to work eccentrically on these muscles by extending the knee. This protocol was repeated five times, as per the ART protocol. The proximal hamstrings were treated in supine lying with the hip and knee in 90-degree flexion, and two treatment passes were applied there. The adductor magnus and gluteus maximus were also evaluated to see the tightness of these muscles.[15]

Figure 1: Active Release Technique

Group B had received a single session of MBLR. The subjects were lying supine on the treatment table, and the tested limb position was 90 degrees of hip and knee flexion and heel off the plinth. The therapist in the walk-stand position approached the tested limb and placed his inner shoulder under the popliteal fossa of that limb. The therapist grasped the lower end of the femur and applied longitudinal traction on the femur longitudinal axis. Then he moved it towards the position of increasing hip flexion while the knee remained in 90 degrees of flexion. The therapist identified the first resistance or pain barrier and applied isometric contraction by asking the patient to gently push his or her shoulder towards him. The component of hip abduction and external rotation was also added if the patient complained about pain during the session. The isometric contraction was applied in five progressive positions of increasing hip flexion and repeated three times in a single session.[16]

Figure 2: Mulligan Bent Leg Raise

Outcome measures:

Straight leg raise test: To determine SLR, the participants were lying supine on a normal examination table. It is important to ensure that the lumber spine is flat against the table; if necessary, place the non-tested limb in knee flexion and the foot on the table to achieve this. Then the therapist moved the tested limb in the direction of hip flexion with the knee fully extended and the foot in a neutral position until the stretch resistance was felt or the pelvis began to tilt. Holding that position, place the goniometer axis on the greater trochanter with its stationary arm aligned with the lateral line of the pelvis and moving arm with the lateral line of the femur, using the lateral epicondyle as a reference. Record the measurement.[17]

Popliteal angle: To measure the popliteal angle, an active knee extension test was applied. The subjects were lying supine with the testing limb in 90º hip and knee flexion and the non-testing limb in an extended and

Figure 3: Straight Leg Raise

neutral position. The pelvis should be stabilized to control any tilting, as it can alter the results. Then the subjects were asked to extend the testing knee as far as a stretch sense was felt while keeping the hip in 90º flexion. Holding that position, a goniometer axis was placed on the lateral condyle of the femur, with the stationary arm aligned with the line of the femur referencing the greater trochanter and the moving arm aligned with the lower leg referencing the lateral malleolus. Record the measurement. The popliteal angle was measured as the 180° knee extension angle.[13] A t-test was applied to compare means within and across the comparative groups. This study was conducted with approval from Government College University Faisalabad's ethical committee. Factors related to culture and religion were taken into account when collecting data. First and foremost, a consent form was provided to each research participant to obtain their consent for ethical reasons. Subsequently, the researcher

Figure 4: Popliteal angle

maintained the privacy of every subject's personal information, including address, contact number and identity. When gathering data from the subjects, care was taken to ensure that their comfort zone and sense of self-worth were not compromised. The allocation of subjects was carried out without discrimination based on age, gender or occupation following ethical norms.

RESULTS

In our study, 40 participants were enrolled. Out of which, 22 were males and 18 were females. The mean age was 22.65±2.71. The mean BMI of the subjects was 23.29±4.37. The categories to access hamstring flexibility through popliteal angle were: 20-25º "excellent", 26-30º" very good", 31-35º "good", 36-40º "fair", 41-45º "poor", 46-50º "very poor" and >50º "contracture". The categories to access hamstring flexibility through straight leg raises were: 50–55 "marked tightness," 56–60 "very poor," 61–65 "poor," 66–70 "fair," 71–75 "good", 76–80 "very good," and >80 "excellent". Descriptive statistics for popliteal angle and passive straight leg raise in the active release technique group showed most of the individuals lie in the "poor" category for Hamstring flexibility was measured through popliteal angle with a mean value of 42.80±4.61 pre-intervention and in the "good" and "fair" categories with a mean value of 32.25±4.67 post-intervention. For the straight leg raise variable in the active release technique group, most of the individuals lie in the "poor" category with a mean value of 59.5±4.44 pre-intervention and in the "good" category with a mean value of 71.65±6.53. For the straight leg raise variable in the mulligan bent leg raise group, most of the individuals lie in the "very poor" and "poor" categories with a mean value of 61.00±3.64 pre-interventional and in the "poor" category with a mean value of 64.20±3.96. To compare means within and between the groups, a

Table 1: Within Group Analysis

	ART Mean ± SD (95% CI)		MBLR Mean ± SD (95% CI)		p-value
	Pre-test	Post-test	Pre-test	Post-test	
SLR	59.5 ± 4.44	71.65 ± 6.53	61.00 ± 3.64	64.20 ± 3.96	<0.001
PA	42.80 ± 4.61	32.25 ± 4.67	43.01 ± 6.53	39.25 ± 6.03	<0.001

Table 2: Intergroup Analysis

	ART Mean ± SD (95% CI)		MBLR Mean ± SD (95% CI)		Mean difference		p-value
	Pre-test	Post-test	Pre-test	Post-test	Pre-test	Post-test	
SLR	59.5 ± 4.44	71.65 ± 6.53	61.00 ± 3.64	64.20 ± 3.96	-1.50	7.45	<0.001
PA	42.80 ± 4.61	32.25 ± 4.67	43.01 ± 6.53	39.25 ± 6.03	-.20	-7.00	<0.001

Note: ART=Active Release Technique MBLR=Mulligan Bent Leg Raise SD=Standard Deviation SLR=Straight Leg Raise Test PA=Popliteal Angle. The table values are expressed in Mean±SD with a 95% confidence interval. The p-value < 0.05 is considered significant.

paired sample t-test and an independent sample t-test were applied, respectively, with the p-value set at 0.001 of significance.

DISCUSSION

This study was conducted to see the effectiveness of two therapies on hamstring tightness improvement in a single session. A convenient sampling strategy was utilized to gather the study's sample, which consisted of 50 participants, 25 of whom were male and 25 of whom were female. Over three months, information was obtained from Government College University in Faisalabad. The study's primary goal was to enlist healthy, normal people between the ages of 17 and 25 while closely following the inclusion and exclusion criteria. All possible participants were given informed consent papers, which they had to read and sign to be allowed to participate. The subjects were then split into two groups: Group B underwent one session of MBLR, and Group A underwent one session of ART. Both techniques proved to be effective in improving hamstring tightness immediately after a single application of these comparative interventions. The popliteal angle and straight leg raise scores were improved in both groups post-intervention. The ART proved to be more effective in improving tightness immediately after its application than the MBLR group. A randomized clinical study was conducted in 2014[10] to evaluate the single session best technique to improve hamstring tightness by both techniques and they have proven to be effective in improving hamstring tightness immediately after a single session. However, the active release technique proved to be more

effective in improving hamstring tightness in a single session.

An earlier pilot study to investigate ART effectiveness in 2006[8] suggested that there was a significant difference between the pre- and post-values of the sit and reach score (P =.0015). These findings concluded that a single session of active release techniques had a significant impact on improving hamstring flexibility in a healthy, physically active, and asymptomatic male participant with no current or previous history of lower extremity injury. The active release technique has also been proven to be effective in long-term hamstring injury rehabilitation through sport-related activities. The athlete was assessed through three trials of functional testing, and he was able to complete all trials in a pain-free and comfortable manner. This study concluded that ART is efficient for a hamstring strain, and there is a difference in amount, frequency, and duration for applying this technique to the athletic and non-athletic populations.[18]

In 2006[19], another preliminary randomized control trial was conducted to check the effectiveness of MBLR after a single session. There was no significant difference in the post values between the two groups immediately. However, after 24 hours, a significant difference of average 7º was seen in the BLR group. However, the pain intensity was confined to only a one-point reduction in the BLR group compared to the placebo group. A randomized controlled trial, to evaluate the long-term effects of MBLR versus myofascial release on hamstring tightness was conducted. Where the mulligan bent leg raise technique was proved to be more significant in reducing tightness of the hamstring muscle[20] There are several noteworthy distinctions and parallels between the results of the research on ART versus MBLR in asymptomatic healthy individuals and the study on the suboccipital muscle inhibition technique against MBLR in younger adults. The latter trial addressed younger people, possibly with different baseline levels of hamstring tightness, whereas the investigation concentrated on a population without musculoskeletal problems at the time. Despite these variations, a comparative design was used in both trials to assess the immediate effects of manual treatment modalities on hamstring tightness. The second study looks at the effectiveness of the Suboccipital Muscle Inhibition Technique in conjunction with MBLR, whereas the current research adds to the body of literature by directly comparing two commonly used techniques, ART and MBLR, in a single session.

The results of these two trials are clinically significant, providing information about the relative effectiveness of these methods for treating hamstring tightness in various populations.[21] There are several differences and similarities between the results of research on ART versus MBLR in asymptomatic healthy persons and the research on Remote Myofascial Release versus Mulligan's Bent Leg Raise on hamstring and lumbar spine flexibility in college-bound students. The latter study examined the short-term effects of remote myofascial release and MBLR on both lumbar spine and hamstring flexibility, while the current research concentrated on evaluating the immediate effects of manual therapy techniques within a single session in a population without pre-existing musculoskeletal complaints. Both studies utilized a comparative design to assess the effectiveness of manual therapy therapies routinely used to address flexibility concerns, despite variances in study demographics and intervention techniques. While the previous study offered more insight by using lumbar spine flexibility as an outcome metric, the current study offers important insights into the relative efficacy of ART and MBLR for reducing hamstring tightness in asymptomatic

healthy people.[22]

In chronic low back pain patients with hamstring tightness, both the hold relax proprioceptive neuromuscular facilitation technique and the active release technique proved to be significant in improving hamstring flexibility, pain intensity reduction, and disability over time, but the hold relax PNF technique was more effective than ART.[23] A study was conducted in 2015 to determine the reliability of two commonly used tests for hamstring flexibility: the active knee extension test (AKE) and the SLR, and also to check the correlation between these two tests. These findings conclude that there was excellent intra-rater reliability for both AKE and SLR and a moderate-to-strong and significant correlation between these tests[24] A study was conducted in 2008 to check the concurrent validity of four clinical tests. Based on the results of this study and by reviewing the literature available at that time, the researchers recommended adopting the knee extension angle test as a gold standard to measure hamstring flexibility.[25]

For future researchers who want to conduct studies related to our topic, it is recommended that they explore the long-term effects of ART and MBLR in the symptomatic population. The sample size they would use should be large enough for more accurate conclusions. In our study, we only used young adults ages 18 to 25. So, it is recommended for future researchers to broaden the age criteria in their studies. The effects of these comparative therapies should also be tested on athletic and other populations. The researcher should use the best available clinical tests of their time to assess hamstring flexibility. The researcher should also explore the single best intervention to improve hamstring tightness in the future. The knowledge about the long-term effectiveness of both techniques is limited by the study's emphasis on assessing the immediate effects of both interventions during a single session. It is difficult to determine the long-term effects of these therapies on hamstring tightness in healthy people who are asymptomatic without periodic follow-up evaluations. The study's conclusions might not apply to groups with pre-existing musculoskeletal disorders or athletes who engage in more strenuous physical activity because it only looks at asymptomatic, healthy adults. As a result, the results may not be as applicable to larger patient populations or clinical contexts. The combined advantages of ART and MBLR therapies may not be completely appreciated by evaluating their efficacy in a single session. Multiple-session longitudinal studies would offer a more thorough understanding of their therapeutic efficacy and potential variations in outcomes over time.

CONCLUSION

Based on statistical analysis, both the active release technique and the mulligan bent leg raise technique proved to be significant in improving hamstring tightness in healthy, asymptomatic subjects in a single session. However, the active release technique proved to be more significant than the mulligan-bent leg raises in improving hamstring tightness immediately after a single application of these comparative interventions. The mean difference in measuring tool variables between the two groups was 7.45 for passive straight leg raise and -7.00 for popliteal angle post-interventional.

DECLARATIONS

Consent from participants: The patient's written consent to participate had been obtained. All methods were carried out by the applicable guidelines and regulations.

Availability of data: Data will be provided upon request. All data files will be submitted by the corresponding author.

Conflicting interests: Nil.

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