

Effect of Active Release Technique and Static Stretching on Hamstring Tightness in Normal Healthy Individuals

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Abstract: Hamstring muscle tightness mainly occurs due to inadequate levels of physical activity in normal healthy individuals. This study was carried out to investigate the immediate effect of Active Release Technique and Static Stretching on hamstring tightness. And to compare the effect of ART and Static Stretching. In a prospective comparative study, 50 participants were included. Participants were divided into two groups by a simple random sampling method. 25 participants in group A and 25 participants in group B were included. Material and instruments used in the study were Active Knee Extension test with a universal goniometer and Sit and Reach test with Sit and Reach box. Two different techniques applied to the participants in the study. For group A, ART, and for group B, Static Stretching was applied. The paired t-test was applied as a statistical test for groups A and B to compare AKE and Sit and Reach test within each group respectively. The unpaired t-test was applied to compare the pre- intervention and post-intervention mean the difference between the two groups. The result showed a significant increase in the range of popliteal angle and hamstring flexibility in group A ($p<0.0001$) and group B ($p<0.0001$). Comparison of mean difference of pre- intervention and post-intervention of AKE and Sit and Reach test showed both the groups improved range of popliteal angle and hamstring flexibility. But group A (ART) showed a marked increase in popliteal angle and hamstring flexibility than group B (Static Stretching) ($p<0.0001$). The single intervention of the ART can be used to improve hamstring flexibility and is considered as an effective, safe, and simple option to reduce hamstring tightness and to improve ROM so, it can be included in a routine protocol for treatment.

Key Words: Hamstring tightness, hamstring flexibility, Active Release Technique, Static Stretching, Normal healthy individuals.

1. INTRODUCTION:

Muscle tightness can be defined as a decrease in the range of motion at the joint result from a decrease in the capability of muscle to deform on which it acts (1). The insufficient proportion of physical activity in individuals leads to muscle tightness (2). Adaptive shortening of muscle due to the less physical activity, injury to the muscle, and genetic factors can be the causes of tightness of muscle (3). And one of the reasons for postural abnormalities is a modern sedentary style of living (4). The affected flexibility of soft tissues, especially at two joint muscles is due to prolonged sitting hours that is required at educational fields, setups, and most of the jobs (5). 18-25 years of age group shows high prevalence, as well as the young, healthy, asymptomatic university students having a long duration of sitting, has 82% of hamstring tightness prevalence (5,6,7). The hamstring muscle tightness is commonly linked with movement dysfunction at the lumbar spine, pelvis, and lower limbs, and has been coupled with low back pain and gait abnormality (8,9,10). Flexibility said to be the ability of a single joint or series of joints to move smoothly and easily through a pain-free range of motion without restriction (11). The ‘hamstrings’ refer to the main three muscles located in the posterior thigh. The semitendinosus (ST) and the semimembranosus (SM) are located at the medial side, and the biceps femoris at the lateral side (12). Active Release is a “hands-on” soft-tissue technique which helps to repair the alterations in tissue texture and tension. Dr. P. Michael Leahy, is the developer of this Active Release Technique. ART is a soft-tissue and non-invasive treatment method to break the scar and adhesions at the location of the scar tissue and adhesions which cause pain, stiffness, weakness, numbness, and physical dysfunctions (13). Many therapeutic interventions are designed to improve the mobility of soft tissues and consequently, increase ROM and flexibility. But stretching is the common therapeutic technique used to elongate or stretch any muscle. Static Stretching is an end-range stretch force that can be sustained or intermittent, applied with overpressure, and by manual contact or mechanical device (14,15). The benefits of stretching include prevention of muscle tightness and injuries, increase in flexibility, increase in ROM of joint, reduces muscle tension, increases muscle performance, reduces muscle soreness, enhance the ability to exert maximum force, enhance the efficiency of movement, improve body alignment and posture, improve self-image and as a warm-up or cool-down procedure in exercise regimen (16,17). Therefore, it is considered easy, safe, simple, and minimizes

the potential for tissue trauma (18,19). There are many studies done on proving the effectiveness of Active Release Technique on hamstring tightness individually and the effectiveness of Static Stretching on hamstring tightness but the comparison of ART and Static Stretching is the area where fewer studies are seen. So, the present study is planned to find out the effect of ART and Static Stretching on hamstring tightness.

2. LITERATURE REVIEW:

Shraddha Kothawale, Keerthi Rao in 2018 conducted study on “Effectiveness of Positional Release Technique Versus Active Release Technique on Hamstrings Tightness” 60 participants with hamstrings tightness were allocated into two groups: Group A: PRT, Group B: ART, with 29 participants in PRT group and 29 in ART Group. Pre-intervention and post-intervention AKE and sit to reach test was measured. The result showed a highly significant ($p<0.01$) improvement in AKE and sit to reach test for Group A, Group B. She concluded that ART can be used as an effective physiotherapeutic intervention in reducing hamstrings tightness instantly (14).

Vijay Kage, Rakhi Ratnam in 2014 conducted study on “Immediate Effect of Active Release Technique versus Mulligan Leg Raise in subjects with Hamstring Tightness: A randomized clinical trial” 40 normal healthy subjects divided into two groups. Group A (n=20) given single session of ART and group B (n=20) given a single session of Mulligan Bent Leg Raise technique for hamstring tightness. Popliteal angle and sit and reach flexibility tests were measured pre-intervention and post-intervention. The result showed that group treated with ART showed significant improvement in Popliteal angle ($p<0.001$) and sit and reach flexibility test ($p<0.001$) as compared to MBLR technique. They concluded that a single session of ART is better as compared to MBLR technique to improve hamstring flexibility and ROM (20).

Karthikeyan Rajendra in 2016 conducted study on “static stretching vs hold relax (PNF) on the sustainability of hamstring flexibility in sedentary living college students” their result was a significant improvement on hamstring flexibility after one-time static stretching for right leg among sedentary lifestyle college students they concluded that static and PNF stretching significantly effective in improving hamstring muscle ROM when compared from pre-test with first-minute post-test. The gained hamstring flexibility does not sustain longer on 15th minute and 30th-minute measurement it gradually reduces when compared with post-test 1st minute. There was no significant effect between both the stretches by one-time stretching session (16).

Mamta Boora in 2016 conducted a study on “Effectiveness of static stretching and massage on hamstring flexibility in normal adults.” 45 subjects were included in the study and randomly divided into three groups by using a simple random sampling method. Group A given static stretching, Group B given massage and Group C given combination of both. which were statically significant at the level of $p<0.05$ ANOVA indicated a significant interaction between the three groups and test in degrees of knee extension. This study concluded that static stretching and massage both are equally effective to increase the hamstring flexibility but combined therapy exhibits significant improvement as compared to static stretching and massage group (21).

3. MATERIALS AND METHODS:

Approval for the study was obtained from the institutional Ethical Committee. Prospective Comparative study was conducted on 50 participants meeting with the inclusion and exclusion criteria. The participants were divided into two groups by simple random sampling, 25 participants in group A (ART) and 25 participants in group B (Static Stretching). Study conducted at Orthopaedic Physiotherapy OPD at Dr. A.P.J. Abdul Kalam College of Physiotherapy Department, Pravara Institute of Medical Sciences, Loni, Taluka- Rahata, District-Ahmednagar, Maharashtra state, India.

The materials used for the study were;

Consent form, Data collection sheet, Plinth, Belt, Universal Goniometer, Sit and Reach box.

Inclusion Criteria:

- Healthy and normal individuals (20),
- Both male and female participants,
- Participants within the age group of 18-25 years (16,20),
- Individuals with popliteal angle less than 70 degree (14).

Exclusion Criteria: Any history of injuries to lower limb (20).

Procedure:

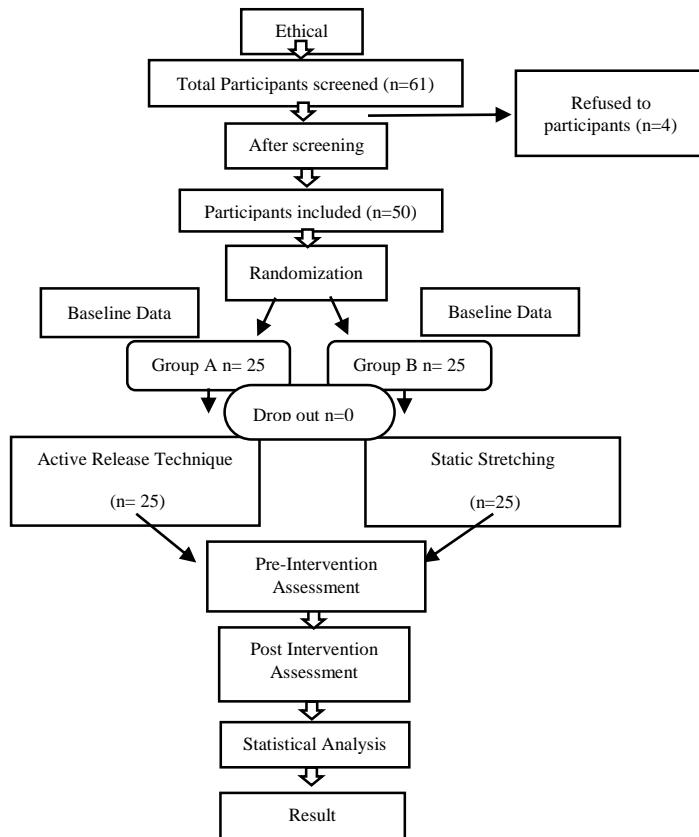


Figure 1. Flow Chart representing the procedure of selection of participants.

Outcome Measures:

- Active Knee Extension Test (AKE)
- Sit and Reach Test

Active Knee Extension Test: Participant taken into supine position with hips flexed 90° and knee flexed. The position of femur was monitored and maintained by stabilization belt tied across frame of bed to lower end of femur just above the knee joint line. The lower extremity not being measured was secured on table with the help of stabilizing belt. Universal goniometer was used to measure knee ROM (popliteal angle). The fulcrum of the goniometer was centred over lateral joint line of the knee with proximal arm placed parallel to femur and the distal arm placed parallel to tibia. The participant was then asked to extend knee actively as far as possible until a mild stretch sensation was felt in hamstrings. A universal goniometer was then used to measure the angle of end range knee extension. And range was taken (20,21,22).

Sit and Reach test: This test is taken with the wooden box with the following dimensions: length of base 30 cm, width 30 cm, height 30 cm and length 53 cm. To standardize, a measuring tape was placed on the sit and reach box for each test. The participants sat on floor in long sitting with fully extended legs so that sole of foot was flat against end of the box. Participants were told to extend their arms forward, placing one hand on top of the other, with palms down, they informed to reach forward with both the hands-on top along the measuring tape as far as possible without bending knee. Throughout testing, heel should remain at box. Three trials were performed. And the score was noted (20,23).

Intervention:

Group A (Active Release Technique):

Participant was informed to lay in supine position on plinth, with tested leg was taken into 90 degrees of hip flexion and other leg is stabilized with stabilizing belt. With hamstring in shortened position i.e. knee in flexion. Tender or adhesed point was palpated and gentle tension or pressure was applied to adhesed point on hamstring muscle. Then participant was informed to move lower leg actively from knee flexion to extension (shortened position to lengthening) till the mild stretch was felt. Similarly, gentle tension was applied at origin and insertion of the hamstring muscle and around adductors and gluteus muscle because hamstring connects to these muscles and that could be the source of hamstring tightness (20,22).



Figure: 2 Starting position of ART



Figure 3: End Position of ART

Group B (Static Stretching):

Participant informed to lay in supine lying. Hip and knee took into 90 degrees of flexion; the other leg stabilized with the stabilizing belt. Then the knee was taken from flexion to extension passively until the participant first reported a mild stretch sensation. 30-second hold was maintained at knee extension, and then leg was lowered slowly this was performed 4 times. And 15 second rest period was given between each stretch (20,23).



Figure 4: Static Stretching

4. ANALYSIS:

Microsoft excel 2010 and GraphPad Instat. were used for statistical analysis. Paired t test was performed for the analysis of group A and group B respectively. For the comparison between two groups unpaired t test was performed. The study was conducted to find out the immediate effect of ART and Static Stretching in normal healthy individuals with hamstrings tightness. The results were analysed on the basis of data obtained from pre and post intervention by using AKE and Sit and Reach test.

5. FINDINGS AND RESULT:

Table 1: Baseline demographic and clinical data among both group A and B

Demographic Characteristics	Group A	Group B
Age (years)	20.56 ± 1.47	20.08 ± 1.28
Height (cm)	161.64 ± 6.41	162.4 ± 8.43
Weight (Kg)	56.84 ± 12.17	56.44 ± 8.50
BMI (kg/m^2)	21.79 ± 3.71	21.35 ± 2.90

According to table 1, baseline demographic data and clinical data among both the groups were similar.

Table 2: Comparison of mean score of AKE and Sit and Reach test within group A

Group	Outcome Measures	Pre- Intervention	Post Intervention	t value	p value	Interference
Group A	AKE (degree)	46.74 ± 9.16	58.78 ± 9.11	31.44	$p < 0.0001$	Highly Significant
	Sit and Reach Test (cm)	10.84 ± 4.56	17.72 ± 5.18	15.09	$p < 0.0001$	Highly Significant

Statistical Test used: Paired t test

According to table 2, On comparing within the group A, the AKE test showed marked increase in the range of popliteal angle with 24 degree of freedom, ($p<0.0001$, $t=31.44$), Sit and Reach test also showed increase in flexibility of hamstring with 24 degree of freedom, ($p<0.0001$, $t=15.09$). It suggests that there was an extremely significant difference in both the outcomes. (Table 2).

Table 3: Comparison of mean score of AKE and Sit and Reach test within group B

Group	Outcome Measures	Pre-Intervention	Post Intervention	t value	p value	Interference
Group B	AKE (degree)	46.92 ± 8.12	52.76 ± 8.23	21.60	$p < 0.0001$	Highly Significant
	Sit and Reach Test (cm)	10.84 ± 5.2	15.6 ± 5.97	10.99	$p < 0.0001$	Highly Significant

Statistical Test used: Paired t test

According to table 3, On comparing within the group B, the AKE showed increase in the range of popliteal angle with 24 degree of freedom, ($p<0.0001$, $t=21.60$), Sit and Reach test also showed increase in hamstring flexibility with 24 degree of freedom, ($p<0.0001$, $t=10.99$). It suggests that there was an extremely significant difference in both the outcome measures in group B. (Table 3)

Table 4. Comparison of mean difference of AKE test and Sit and Reach test among group A and group B

Outcome measures	Group A	Group B	T value	P value	Interference
AKE Test	12.04 ± 1.91	5.84 ± 1.35	13.22	$P < 0.0001$	Highly Significant
Sit and Reach Test	7.08 ± 2.04	5.08 ± 1.18	4.23	$P < 0.0001$	Highly Significant

Statistical Test used: Unpaired t test

According to table 4, On comparing AKE and Sit and Reach between group A and B both the group showed improvement in both the outcome measures but group A ($p<0.0001$, $t=13.22$) had marked increase in AKE range of popliteal angle as well as Sit and Reach hamstring flexibility than group B ($p<0.0001$, $t=4.23$).

6. DISCUSSION:

The present study aimed at finding out the effect of ART and Static Stretching in improving the range of popliteal angle and hamstring flexibility by using the AKE test and Sit and Reach test in participants with hamstring tightness. The results of the present study showed that there was a highly significant difference in the range of popliteal angle with the AKE test and hamstring flexibility with the Sit and Reach test in both the groups after the intervention of ART and Static Stretching respectively. In Group A, table 2 shows the result of ART, there was an increase in the mean value of the AKE test from 46.74 ± 9.16 to 58.78 ± 9.11 . And as well as an increase in the mean value of the Sit and Reach test from 10.84 ± 4.56 to 17.72 ± 5.18 . As the ART is the site-specific manual pressure technique in which particular movement like flexion or extension is used, which makes ART distinctive to other manual therapy. The patient's active movement denotes A in ART. The therapist utilizes their hands to assess soft tissue and for breaking up the scar tissue, it allows muscle to lengthen as well as increases ROM at a popliteal angle. After breaking up scar, it allows muscle to move freely and relieves pain (13).

ART works to remove "adhesions" and reduces tissue tension which stops cumulative injury cycle. Shortening or knots are common at hamstring muscle if it is not stretched regularly. The mechanism behind this shortening or knots is increased tissue stiffness or tension due to cumulative injury cycle. Events occur in this cycle are increase in friction leads to more tension within the myofascial structures because of repetitive micro-injury in a tight muscle. And cycle describes how acute injuries to the soft tissues becomes chronic problems, it is also called as self-perpetuating cycle (14,24). The cause of chronic irritation to soft-tissue is the irritation which creates friction and pressure, which eventually leads to small tears within the soft tissue. These in turn cause inflammation, decreased circulation and edema. The constant internal pressure caused by soft-tissue injury limits circulation to affected tissues, resulting in decreased delivery of oxygen. Decreased oxygen, or hypoxia, causes several biochemical changes in body including increased production of mRNA and alpha-1 procollagen. These biochemical changes cause an increase in chemotaxis, proliferation of fibroblasts, and leads to formation of adhesions and scar tissue. These adhesions and scar tissue, in turn,

create further restrictions, muscle imbalances, inflammation, and swelling. This cycle repeats itself, and escalates in pain, inflammation, and new injuries caused by the restrictive scar tissue, with the intervention of ART which acts on the principle that is by maintaining contact on the adhesion, with muscle in a shortened position and elongating the muscle along its fiber orientation to break up the adhesion to regain hamstring flexibility for functional use (25). It acts by combining the use of pressure, tension, and motion to force the layers of muscle and tissue to work together properly (13). And it focuses on more than just the chief area of complaint. ART also acts on the Law of Repetitive Motion, which alters the key variables creating problem by removing constant pressure and tension that results from the formation of adhesions or scar tissue. Muscles that are restricted, tight, and adhesed cannot relax. By releasing these restrictions, ART can help to achieve better muscle function, and prevent the return or reoccurrence (26). The result of the group A showed, there was marked improvement in AKE test and Sit and Reach test immediately after the intervention. It was supported by study done by Vijay Kage that effective in reducing hamstring tightness in terms of Popliteal angle and Sit and Reach Test (20). The present study shows the same result there is a significant improvement in popliteal angle and hamstring flexibility within the group A ($p < 0.0001$) immediately after the intervention of ART. In group B, table 3 shows the result of Static Stretching, there was an increase in the mean value of the AKE test from 46.92 ± 8.12 to 52.76 ± 8.23 . And as well as an increase in the mean value of the Sit and Reach test from 10.84 ± 5.2 to 15.6 ± 5.97 . Static Stretching is one of the commonly used techniques to reduce muscle tightness. It is considered easy, safe, simple, and minimizes the risk of tissue trauma (15,18). It affects both the contractile and the noncontractile elements of the muscle by taking muscle into slow elongation and holding it into stretched position till participant feel the tissue resistance for a prolonged period of time with a sustained stretch force (15,16,27,28). The stretch force is transmitted both longitudinally and laterally. The initial elongation was credited to the elastic properties of connective tissues whereas the tension rises in muscle (15). After a point there is a mechanical disruption of the cross-bridges as the filaments slide apart, causing rapid lengthening of the sarcomeres commonly known as “sarcomere give” (15,16). The process of elongation is achieved by either elastic or plastic deformation. Elastic deformation is where the stretched muscle returns to its resting length once load or stretch is removed. Plastic deformation is where the stretched muscle assumes a new and greater length once load or stretch is removed. If a stretch force is applied for an extended period of time, creep deformation takes place at muscle. Creep deformation is a property of a muscle to deform over time due to applied external forces. So, the mild stretch is given to the muscle while stretch force is given. Stress-relaxation is a phenomenon whereby a decrease in the force is required to hold the target muscle in its stretched position which is a viscoelastic quality of connective tissue (11,15,18,30). The Static Stretch given to the muscle must be slow owing to a muscle's neurophysiological response to stretch. A protective mechanism offered by Golgi Tendon Organ (GTO) located near the musculotendinous junction of a muscle, inhibits tension in the muscle in which it lies. This principle is termed as “Autogenic inhibition”. During static stretching when a muscle is stretched and maintained in a lengthened position, the GTO which has a high threshold for firing fires, inhibiting alpha motor neuron activity and reducing the tension in muscle causing relaxation. Stretching inhibits the reflex activity in the muscle, which reduces the resistance offered by the muscle during movement thereby it improves ROM (15,18). In the study of Wasim M. said that mechanical response of muscle to stretch result of change in viscoelasticity wherein passive static stretching fires the GTO and it inhibits the tension in the muscle, allowing the sarcomeres of the muscle to lengthen. Hence, Static Stretching showed improvement in popliteal angle and hamstring flexibility in normal healthy Indian collegiate males (31). The result of group B showed the same result there was an increase in range of popliteal angle of AKE and hamstring flexibility i.e. Sit and Reach test immediately after the intervention of Static Stretching with the significance of ($p < 0.0001$).

Table 4, shows the comparison of mean difference of pre-intervention and post-intervention between AKE test and Sit and Reach test among group A and group B. When mean difference of pre-intervention values and post-intervention values for AKE test was observed among group A and group B, there was an increase in AKE test values between both the groups. The mean difference of the AKE test in group A was 12.04 degrees and, in the group, B was 5.84 degrees, it shows group A (ART) was more effective than group B to increase range of popliteal angle. The Mean difference of the Sit and Reach test in group A was 6.88 cm and group B was 4.76 cm, it shows an increase in the hamstring flexibility in both groups. But group A (ART) showed more improvement than group B (Static Stretching). Group A, showed marked improvement in popliteal angle as well as in hamstring flexibility because ART alters the tissue structures by breaking up the restrictive cross-fiber adhesions (which cause adjacent tissues to stick together) and restores normal function of the soft-tissue areas. It uses a combination of pressure, tension, and motion to force the layers of muscle and tissue to work together properly (13). And static Stretching inhibits alpha motor neuron activity at Golgi Tendon Organ, reduces the tension in the muscle and causes relaxation of hamstring muscle (15). Thus, the Active Release Technique is more effective than the Static Stretching in improving range of popliteal angle and hamstring flexibility.

7. RECOMMENDATIONS:

Further studies, with the longer follow up duration could be undertaken.

8. CONCLUSION:

Present study concludes that ART and Static Stretching both are effective in improving range of popliteal angle and flexibility of hamstring muscle. The study also concludes that ART shows better improvement in popliteal angle and hamstring flexibility when compared with Static Stretching.

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