



A COMPARATIVE STUDY- AN IMMEDIATE EFFECT OF HAMSTRING FASCIA ACTIVATION THROUGH KINETIC CHAIN ACTIVATION TECHNIQUE (K-CAT) VERSUS CONVENTIONAL HAMSTRING STRETCHING TECHNIQUE TO IMPROVE HAMSTRING FLEXIBILITY IN COLLEGE STUDENTS USING SIT AND REACH TEST

Dr. Pinal Borsaniya

Master of Physiotherapy in Musculoskeletal and Sports
Parul Institute of Physiotherapy - Parul University
Waghodia, Vadodara, Gujarat, India

Abstract

Background & Purpose: Flexibility is the ability to move a single joint or series of joints smoothly and easily through an unrestricted pain free range of motion (ROM). Reduced hamstring flexibility due to prolonged sitting causes to produce tension in hamstring fascia, which can lead to dysfunction of the hip, SI, lumbar spine joints. Muscle distributes a large portion of their contractile or tensional forces onto fascial sheets. Fascia undergoes tension and ultimately reduces the overall functioning of the body movements. Thus, there is a need to create detention in this compensated fasciato overcome the symptoms caused bythem. Considering above facts, we want to document effectiveness of new methods of physiotherapy like K-CAT and hamstringstretching. By performing K-CAT, we are detentioning the hamstring which leads to reduction in tightness ofhamstring. Static hamstring stretching is a common technique which takes the muscle to its end range and maintains this position for a specified duration. The sit and reach test was used in this study which is used to measure hamstring flexibility.

Design:A Comparative Experimental study

Participants: 60 college students, 30 in each group.

Interventions: Group A received Kinetic Chain Activation technique (K-CAT) and group B received Conventional Hamstring Stretching Technique.

Outcome Measure: Sit and Reach test

Result: There was significant improvement in Sit and reach test with <math><0.001</math> in group A & group B. But in between group, there was more significant improvement in Sit and Reach test with $p<0.001$ in group A rather than group B.

Conclusions: Kinetic Chain Activation Technique (K-CAT) is moreeffective than the Conventional Hamstring stretching technique to improve Hamstring flexibility immediately after treatment in college students with hamstring tightness.

Keywords: Hamstring Flexibility, Sit and Reach Test, Kenitic Chain Activation Technique (K-CAT), Hamstring Stretching, College Students.

Introduction

Anatomy of Hamstring muscles

Hamstring muscles are situated at the back of the thigh. These muscles arise in the gluteal region and course through, the back of the thigh to be inserted into the region of the popliteal fossa. They are the semitendinosus, the semimembranosus, the long head of biceps femoris, and the ischial head of the adductor magnus.

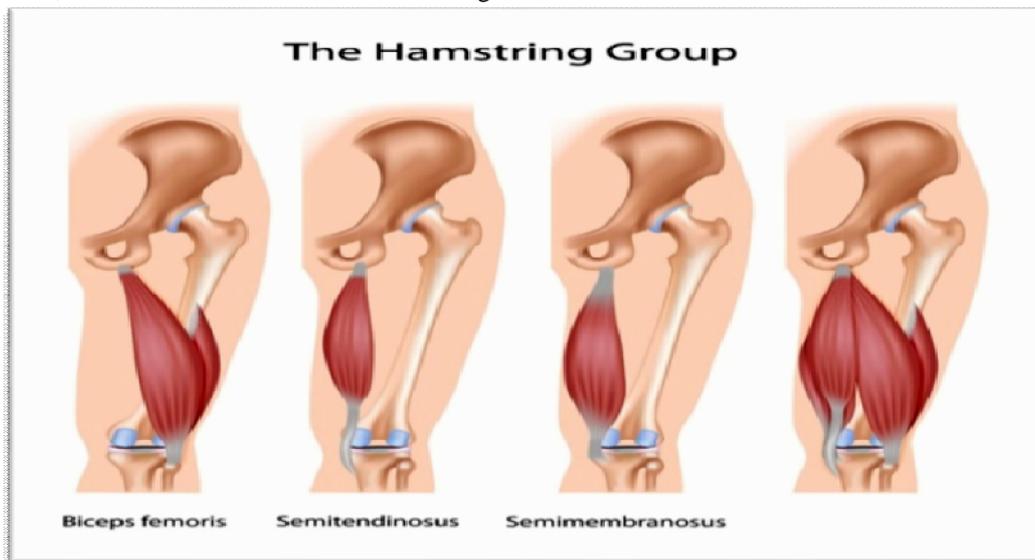


Figure 1:Hamstring muscles



Hamstrings are group of muscles that all originated on the ischium and posterior femur, cross both the hip and knee joints and insert into the tibia and fibula.² As the muscle span the back of the knee, they form the proximal lateral and medial margins of the popliteal fossa.³ The adductor magnus reaches only up to the adductor tubercle of the femur, but it included in hamstrings because the tibial collateral ligament of the knee joint is, morphologically, the degenerated tendon of this muscle.¹

Hamstrings are the major knee flexors and also aid in hip extension.^{4,5} They are weak extensors of the hip particularly in walking. When the knee is semiflexed and hip is extended the biceps femoris is a lateral rotator of the leg, while semitendinosus and semimembranosus are medial rotator of the leg.¹ Hamstrings contribute to posture stabilization and the control of the pelvis region. Hamstring muscles have the ability to generate high forces rapidly through their eccentric and concentric contractions due to their high composition of type 2 muscle fibers. A hamstring muscle's length can change by up to one third as a result of eccentric or concentric contraction and is subject to high forces in closed and open kinetic chain activities.^{6,7}

Causes of Hamstring Tightness

Many people suffer with hamstring tightness. Therefore, it is very important that an understanding is established regarding hamstring tightness and the treatment used to increase hamstring flexibility.² Hamstring tightness increase apparently from childhood up to age of 40-49 years and its incidence is higher in males than females.^{8,9}

Reasons for hamstring tightness are:

- 1) protective tension of the hamstrings
- 2) neural tension
- 3) previous hamstring strain
- 4) acute hamstring strain/ tendinosis¹⁰
- 5) the classic muscle imbalance¹¹
- 6) might be because of poor hip stability
- 7) might be because of poor control of hip movement
- 8) poor posture of hip joint¹²
- 9) nerve entrapment^{13,14}
- 10) anterior pelvic tilt
- 11) lumbar disc herniation¹⁴

The hamstring muscles are found to be most prevalent for the tightness in the body. Tightness of these muscles produces decrease ROM and reduced flexibility of the pelvis, hip, and knee joints. Muscle tightness is a limiting factor for optimal physical performance including daily activities and an important intrinsic factor for sports injuries.¹⁵

Muscle tightness is caused by a decrease in the ability of the muscle to deform, resulting in decrease in the ROM at the joint on which it acts. The term has also been used to denote a slight to moderate decrease in muscle strength; usually the movement in the direction of the elongating muscle is limited.¹⁵

Flexibility

Flexibility is the ability to move a single joint or series of joints smoothly and easily through an unrestricted pain free ROM. Flexibility is related to the extensibility of muscle tendon units that cross a joint, based on their ability to relax or deform and yield to a stretch force.¹⁵

2 Types of Flexibility

Dynamic Flexibility

Also referred as active mobility or active ROM, is the degree to which an active muscle contraction moves a body segment through available ROM of a joint.¹⁵

Passive Flexibility

Also referred as passive mobility or passive ROM, is the degree to which a body segment can be passively moved through the available ROM and is dependent on the extensibility of muscles and connective tissues that cross and surround a joint.¹⁵

Basic functions like standing from sitting, and walking, as well as more complex tasks are dependent on co-ordination between the trunk and lower extremity for which hip joint flexibility is necessary.¹⁶ Flexibility and effectiveness of movement that helps in minimizing and preventing injury allows the tissue to accommodate more easily to stress, to dissipate shock impact and improve efficiency. Hamstring muscle has tendency to shorten even under normal circumstances.^{17,18,19}



Benefits of increased flexibility include a decrease in injury rate and an increase in athletic performance. Flexibility exercises are designed to increase tissue elasticity, thereby increasing ROM of specific joints.²⁰ Flexibility is considered as an essential element of normal biomechanical functioning. It prevents post exercise soreness and improves co-ordination.^{4,21}

The hamstring muscles are the most commonly involved muscular injury of the pelvis, hip and thigh. An explanation for hamstring tightening that could potentially lead to a pulled hamstring is proposed by Beckman and Block.^{22,23} Decreased flexibility around the hip joint causes weight bearing forces and movement to be transmitted to the spine rather than absorbed by the pelvis. Tight hip extensors cause increased lumbar flexion.¹⁵ Reduced hamstring flexibility has been implicated in lumbar spine dysfunction and showing strong positive correlation between decreased hamstring flexibility and low back pain.^{5,24} Inadequate hamstring flexibility can cause low back pain, alter the lumbar pelvic rhythm, posterior pelvic tilt, reduce lumbar lordosis, decrease lumbar and thoracic flexion.^{17,9}

Any changes in joint arthrokinematics, muscular balance and muscular control affect the functioning of the entire kinetic chain, that leading to abnormal compensation and adaptation. If a particular joint has lost its normal arthrokinematics, the muscle around that joint attempt to minimize the stress at that involved segment.^{25,26}

The prevalence of hamstring tightness is very high in college going student of age group 18-25, especially the students having prolong sitting hours.²⁷ So, in this study, college students are included.

What Is Fascia?

Muscle distributes a large portion of their contractile or tensional forces onto fascial sheets. Fascia is an uninterrupted viscoelastic tissue which forms a functional 3- dimensional collagen matrix. It is virtually inseparable from all structures in the body and acts to create continuity amongst tissues to enhance function and support.²⁸ Fascia undergoes tension and ultimately reduces the overall functioning of the body movements. Thus there is a need to create detension in these compensated fascia to overcome the symptoms caused by them.

Kinetic Chain Activation Technique

A kinetic chain is the notion that these joints and segments have an effect on one another during movement. When one is in motion, it creates a chain of events that affects the movement of neighboring joints and segments. Sequenced physiologic muscle activations in the upper and lower extremity result in an integrated biomechanical task. This sequencing is known as the kinetic chain.²⁹

By performing K-CAT, we will detensioning the hamstring fascia which will lead to reduction in tightness of hamstring.

Hamstring Stretching Technique

Static hamstring stretching is a common technique which takes the muscle to its end range and maintains this position for a specified duration. It facilitates the golgi tendon organ which may produce autogenic inhibition of the muscle that is stretch.³⁰

Sit and Reach Test

The sit and reach test will be used in this study. It is a field test used to measure hamstring and low back flexibility. Shephard and Berridge found intraclass test/retest correlation $r=0.83$ for sit and reach test.³¹

Need of Study

The hamstring muscles are found to be most prevalent for the tightness in the body. Tightness of these muscles produces decrease ROM and reduced flexibility of the pelvis, hip, and knee joints. Available literature suggests that Hamstring stretching techniques and Myofascial release techniques are effective in subjects with hamstring tightness for improvement in hamstring flexibility. But there is no evidences for hamstring fascia activation through Kinetic chain activation technique (K-CAT) to improve hamstring flexibility. So, need of the study is to check an immediate effect of K-CAT and to compare it with Hamstring stretching technique to check which technique is more effective or both are same effective or not.

Objective of The Study

- To determine an immediate effect of K-CAT on hamstring flexibility in college students with hamstring tightness.
- To determine an immediate effect of Hamstring stretching technique on hamstring flexibility in college students with hamstring tightness.
- To compare an immediate effect of K-CAT and Hamstring stretching technique for improvement in hamstring flexibility in college students with hamstring tightness.



Study Design and Setting

Study Design & Study Duration

- A Comparative Experimental study.
- 1 Year (For immediate effect)

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Population

- College students with hamstring tightness between 18-25 years of both sexes.

Selection Criteria

Inclusion Criteria

1. Age: 18-25 years
2. Both males and females
3. College students (who have minimum 3-4 sitting hours)
4. Bilateral Hamstring tightness
5. Subjects who are willing to participate in the study
6. Popliteal angle less than 125° in 90-90 SLR test (measured with a goniometer)

Exclusion Criteria

1. Subjects with any other orthopedic / neurological problems (e.g., Fracture, Rheumatoid arthritis, sciatica, soft tissue injuries of hip and knee etc)
2. Subjects under fitness program, dancers, athletes.

Sampling Method and Sample Size

- Sampling Method: Simple Random Sampling
- Sample size: 60

Material Used

- Plinth
- Consent form
- Sit and Reach box
- Pen
- Pencil
- Paper
- Goniometer
- Comfortable clothes

Sit and Reach Box



Evaluation Tools

90-90 SLR test: The patient was in supine lying. Then the patient was instructed to flex both hips to 90° with the knees bent at 90° . Then the patient was asked to extend each knee actively in turn as much as possible and the popliteal angle was measured with a goniometer. If the angle is less than 125° , the hamstrings were considered to be tight.³²



Outcome Measure

Sit and Reach test:

To perform this test, all subjects sat with their heels firmly against the testing box. Subjects kept their knees extended and placed their right hand over the left, with the long fingers even, and reached forward as far as they could by sliding their hands along the measuring board indicated in centimeters how far beyond the toes each individual reached. The score (in centimeters) is the greatest distance contacted by the fingertips past the toes. 3 trials were performed, and the average was used for data analysis.³³

Procedure

Subjects were included in this study after initial assessment and who fulfill the inclusion criteria. The consent form was obtained after explaining the intervention from all participants. Then a detailed physiotherapy assessment was taken & the following tools was used for measurement of the outcome.

• Sit and Reach Test

Group-A (Hamstring Fascia Activation Through K-Cat Technique)

- 30 subjects had taken in group A.
- Sit and reach test was done before giving the hamstring fascia activation through K- CAT.
- Patient position: prone lying on a plinth with hip and knee neutral.
- The therapist activated the hamstring fascia by tapping with hands on the hamstring area for 7-8 seconds.
- After this, the instruction to the patient was to flex the knee until they can do and then extend. This was done for 15 times.
- Same procedure was done for opposite lower extremity.
- Immediately after the treatment, again sit and reach test was performed.



Image: 2 Sit and Reach test



Image: 3 Hamstring fascia activation with tapping on hamstring(K-CAT)



Image: 4 Knee flexion and Extension

Group –B(Conventional Hamstring Stretching Technique)

- 30 subjects had taken in group B.
- Sit and reach test was done before giving the conventional hamstring stretching technique.
- Patient position: supine lying on a plinth and had been instructed to relax.



- To stretch the right hamstrings, the right hip was passively flexed to 90° and the knee passively extended until the subject reported a strong but tolerable stretch.
- This stretch held for 30 seconds and this was performed 3 times.
- The same procedure was then performed with the opposite lower extremity.
- Immediately after the treatment, again sit and reach test was performed.



Image: 5 Sit and Reach test Image: 6 Stretching of Hamstring

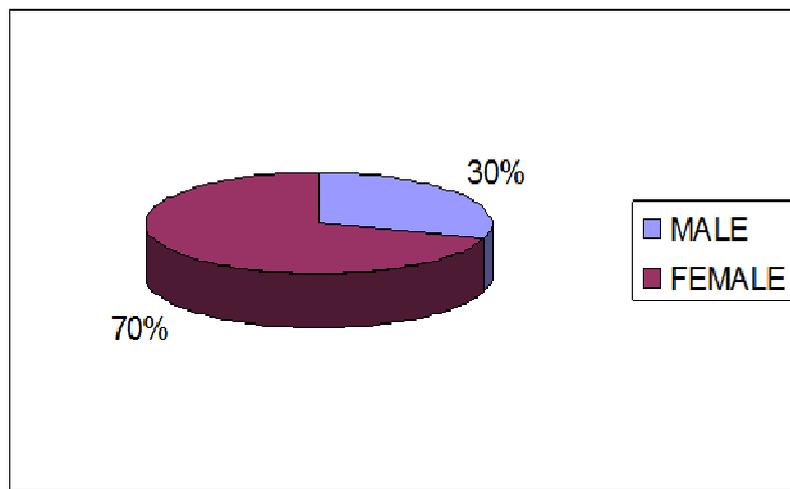
Result

In this study 60 subjects (minimum age was 18 & maximum age was 25) suffering from hamstring tightness were included out of which 18 were male and 42 were female.

Demographic Profile

I. Gender Distribution

There was 30 participants in each group taken after matching the criteria's taken. Total 60 participants are taken from which 42 are Females and 18 are Males are divided randomly in both group of exercise.



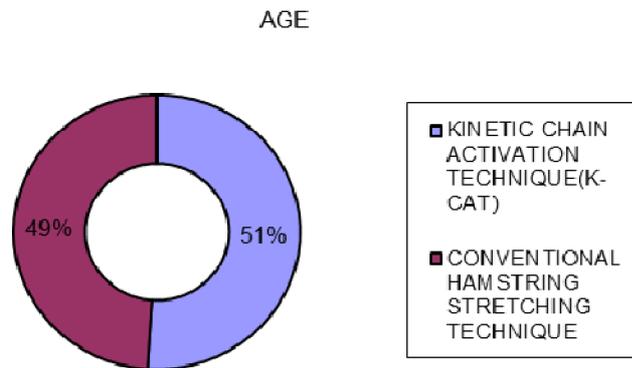
Graph: 1.1 Gender Distribution

II. Age Distribution

The mean age of K-CAT group participants is years 21.60 ±2.12 and the mean age of Hamstring Stretching group participants is years 20.90 ± 2.15.

MEASURES (exercise)	MEAN	STANDARD DEVIATION
GROUP A (K-CAT)	21.60	2.12
GROUP B (Hamstring Stretching)	20.90	2.15

Table: 1 Mean and SD of Age Distribution of K-CAT and Hamstring Stretching group.



Graph:1.2 Age Distribution

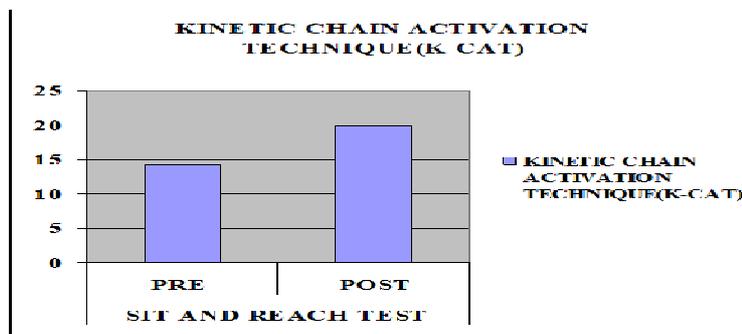
Clinical Parameters

The participants in both group shows significant result in increasing hamstring flexibility but K-cat shows more significant result than hamstring stretching in Sit and Reach Test.

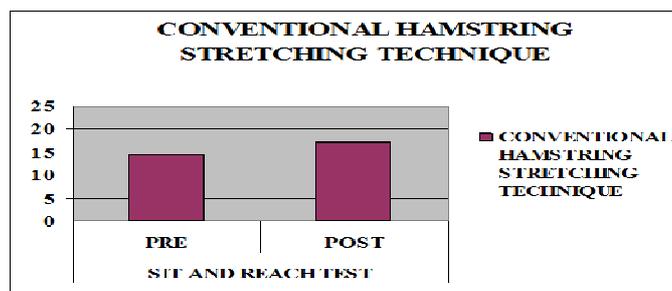
Sit and Reach Test Pre And Post Difference(Mean And Sd)

MEASURES	SRT AND REACH TEST (Mean±SD)		DIFFERENCE (Mean±SD)	TVALUE	PVALUE
	PRE	POST			
GROUP A (K-CAT)	13.79 ± 5.34	19.89 ± 4.57	6.1 ± 3.24	10.32	<0.01
GROUP B (HAMSTRING STRETCHING)	14.48 ± 3.08	17.27 ± 3.03	2.76 ± 0.55	26.84	<0.01

Table: 2 Comparison of within and between Groups for Sit and Reach Test.



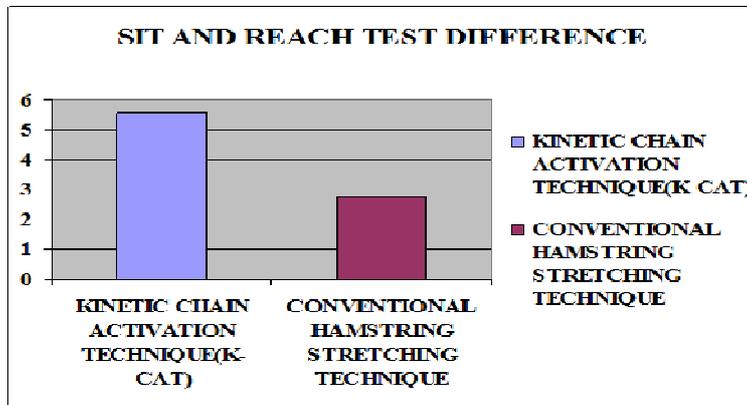
Graph 1.3: Group A SRT Pre And Post Mean DF



Graph 1.4: Group B SRT Pre and Post Mean DF



Above graphs shows within group pre-post data comparisons. Paired t- test was used and p value is <0.05. So statically proven that within group treatment was effective. There was a significant difference between K-CAT pre-post exercise and hamstring stretching pre-post exercise for improving hamstring flexibility in college students with hamstring tightness.



Graph 1.5: Comparison OfSRT DF Between The Group A (K-Cat) andGroup B(Hamstring Stretching)

Above graph shows that there is more improvement in sit and reach test in group A(K-CAT group) rather than group B(Hamstring Stretching group).

Discussion

There is limited evidence of Hamstring fascia activation through Kinetic chain activation technique (K-CAT) and Conventional Hamstring Stretching technique on hamstring flexibility in college students. There is less evidence which compare the immediate effect of K-CAT and Conventional Hamstring stretching on hamstring flexibility. So, this study was conducted to evaluate and compare the immediate effect of K-CAT and hamstring stretching on hamstring flexibility in college students. In this study, 60 subjects were randomly divided in 2 groups. 30 subjects received K-CAT and 30 subjects received Conventional hamstring stretching technique. Both techniques were given for only 1 day to see the immediate effect.

This study compares the immediate effects of K-CAT and hamstring stretching technique in increasing hamstring flexibility of subjects with bilateral hamstring tightness. In paired t- test comparison of the pre-test and the post-test values of the Sit and Reach test showed that there was a significant improvement in K-CAT group and Conventional Hamstring Stretching technique group, which demonstrate that both techniques are effective individually improving hamstring flexibility of hamstrings in college students. When comparing the mean difference of the both groups by using unpaired t- test, the results showed that there was significant difference between the effect of group A and B in improving hamstring flexibility. K-CAT group showed more significant improvement in Sit and Reach test. which suggest that K-CAT is more beneficial than Conventional Hamstring stretching.

In this study, college students are included. Deepak B. Anap (2018) studied on prevalence and severity of hamstring tightness among college students. He included 50 participants with hamstring tightness and it measured by AKE test. Analysis showed higher prevalence of hamstring tightness among college student of age group 18-25 years.²⁷

Aaron Sciascia and Robin Cromwell gave a kinetic chain rehabilitation framework in which they stated that Impairment of one or more kinetic chain links can create dysfunctional biomechanical output leading to pain and/or injury.²⁹Fascia is virtually inseparable from all structures in the body and acts to create continuity amongst tissues to enhance function and support.²⁸ Fascia undergoes tension and ultimately reduces the overall functioning of the body movements. Thus, there is a need to create detention in these compensated fascia to overcome the symptoms caused by them. By performed K-CAT, we had detensioning the hamstring which lead to reduction in tightness of hamstring. Margaret Rood’s gave facilitating technique in which sensory stimuli is used to facilitate the motor responses.³⁵ They used sensory inputs like proprioceptive tapping technique for facilitation of muscles. When the therapist taps a part of the body to create a small amount of lengthening (stretch) in a muscle. This activates stretch receptors in the muscle spindle, of which the cell bodies are in the dorsal root ganglia, and an afferent impulse is conducted via these Ia afferent neurons to the spinal cord where they directly synapse on an alpha motor neuron. This activated motor neuron transmits the efferent impulse back to the muscle leading to contraction.³⁶ From this technique, facilitatory tapping technique used in Kinetic Chain Activation Technique (K-CAT) to improve hamstring flexibility.



Glady Samuel Raj stated that Repeated contraction technique can be used for lengthening and strengthening of muscles. So, in K-CAT repeated knee flexion and extension was done for detensioning of hamstring fascia.

Medeiros DM, et al (2016) Influence of static stretching on hamstring flexibility in healthy young adults: Systematic review and meta-analysis. They have compared static stretching to control group, and evaluated range of motion (ROM). Nineteen studies were included out of 813 articles identified. In all tests, the results favored static stretching compared to control group: passive straight leg raise, passive straight leg raise, passive knee extension test. In conclusion, static stretching was effective in increasing hamstring flexibility in healthy young adults.³⁷

Bohannon(1984),Kirsch (1995) and Magnusson (1996) studied and demonstrate the transient effects of stretch from viscous deformation; a well-documented characteristic of soft tissues. These effects are not lasting and dissipate soon after the removal of the stretch.³⁸ That's why group B showed less improvement compare to group A

Results also suggested that a longer period of intervention may produce further gains in muscle flexibility, which can be study in future.

Conclusion

This study shows significant difference in immediate effect of Kinetic Chain Activation Technique (K-CAT) and Conventional Hamstring Stretching Technique to improve hamstring flexibility in college students. There was improvement in hamstring flexibility among college students in both the groups but there was significant improvement in K-CAT by Sit and Reach test.

Summary

The study compares the efficacy of Kinetic Chain Activation Technique (K-CAT) versus Conventional Hamstring Stretching Technique in college students having hamstring tightness. 60 students were randomly allocated in 2 groups. Each subject evaluated by therapist before and after treatment, group A was received K-CAT and group B received Conventional Hamstring Stretching Technique. Hamstring flexibility measured by Sit and Reach test and it was measured before and immediately after the treatment. Both treatments were significantly effective in improve hamstring flexibility in college students with hamstring tightness, but there is more significant effect in group A.