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Original Research Article

Comparing Effectiveness of Suboccipital Muscle Energy Technique Alone, Passive Hamstring Stretching Technique Alone and Combination of both for Improving Hamstring Muscle Flexibility in Healthy Collegiate Subjects

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ABSTRACT

Objective: To compare the effectiveness of sub occipital muscle energy technique alone, passive hamstring stretching technique alone and combination of both the techniques for improving Hamstring flexibility in collegiate subjects.
Methodology: 60 healthy collegiate subjects were randomly assigned into 3 groups (1, 2 &3), (N=20 in each group). Treatment in all the 3 groups was given for 5 consecutive days regularly. The effect was recorded immediately post intervention taken as first reading(one day), second reading was taken on 5th day post intervention and third reading was taken on the 15th day of follow up assessment with active knee extension test (AKET)
Results: All the groups 1, 2 and 3 showed change with the significant difference of p=0.025, p=0.001, p=0.001 after the immediate i.e., one day, five days and fifteenth day (i.e., follow up assessment) proving that intervention given to all three groups were independently efficient in improving post AKET scores and hamstring flexibility. In Between group analyses, subjects of group 3 showed significantly better results than group 1 and 2. During within group analysis group 1, 2 and 3 showed significant difference of p=0.000 after the immediate i.e., one day, five days of treatment and after the fifteenth day of follow up assessment.
Conclusion: These all three techniques are very simple and safe and could be use to improve hamstring flexibility. But Combination of both the techniques was much more effective in comparison of two techniques alone.

Keywords: Hamstring flexibility, Passive hamstring stretching technique, Sub occipital muscle energy technique, Active knee extension test

INTRODUCTION

Flexibility has been defined as the ability of a muscle to lengthen allows one joint or more than one joint in a series to move through a range of motion. [1] Flexibility is an important component of physical conditioning program used as an adjunct to muscle strength and endurance

training. Flexibility allows the tissue to accommodate more easily to stress, to dissipate shock impact and improve efficiency and effectiveness of movement that helps in minimizing or preventing injury. [2] A reduction in muscular flexibility not only reduces functional level but also causes damage to the musculoskeletal system due to overuse. Such damage mainly occur in multi- joint muscles which have large functional excursion and high percentage of fast twitch muscle fibers, and the hamstring muscle has been reported to be one such multi-joint muscle which is most frequently damaged in the human body. [3] Hamstring muscle has tendency to shorten even under normal circumstances and tends to become very tight leading to muscle imbalance, which can give rise to number of problems and leave us open to muscle injury. [4] Inadequate hamstring flexibility can cause low back pain, alter the lumbar pelvic rhythm, posterior pelvic tilting, reduce lumbar lordosis, decrease lumbar and thoracic flexion, may increase chances of lower extremity injuries, hamstring strains, patellofemoral pain and also affects the posture and gait. [5] To improve hamstring flexibility number of different treatment have been utilized and practiced including soft tissue mobilization technique, [6] different Stretching techniques [7-9] like static, ballistic and proprioceptive neuromuscular facilitation, Muscle energy technique, [10] Mulligan techniques [11] and Eccentric training etc. [12] Since Few studies [13,14] have explored the role of sub occipital stretching technique in improving hip flexion range of motion but still there is a lack of evidence about the use of sub occipital muscle energy technique for improving flexibility of hamstring muscles. Also many of the researches suggested [8,9] that static stretching is significantly effective in improving hamstring flexibility. Therefore, this study was aimed to determine the effectiveness of Sub occipital muscle energy technique alone, Passive Hamstring Stretching technique alone and the combination of both techniques for improving muscle flexibility in collegiate subjects.

MATERIALS AND METHODS

60 healthy collegiate subjects who met the inclusion criteria were randomly assigned into 3 groups (1, 2 &3), (N=20 in each group). The inclusion criteria were: Age between 18-25 years, [1,12] Both males and females, hamstring tightness should be in dominant lower limb [5,15] Asymptomatic healthy subjects with no pathology in spine and lower quadrant [15],inability to achieve greater than 160° of knee extension with hip at 90° of flexion. [1,14] The exclusion criteria were: Any history of surgery related to low back, knee & hip, Any Limb length discrepancy,[5] Iliopsoas muscle tightness [16], Body mass index (BMI) of more than 30 kg/m [1,15], and subjects who were involved in any kind of exercise program and sports activity apart from our protocol. A duly signed informed consent was taken from all the subjects.

Study Design: pre & post test experimental group design, convenience sampling

Equipments & Measuring Tools: Plinth, Cross bar, a double arm plastic universal Goniometer with full scale protractor, 12 inch plastic ruler for adding extension to Goniometer arm, [17] Straps, Markers and Stopwatch.

Outcome Measure: Active Knee Extension Test (AKET): A cross bar which is made of metal was used to measure the Popliteal angle. The cross bar has two horizontal bar (one bar above to maintain proper position of hip and thigh and second bar below on the plinth to maintain stability of the cross bar apparatus) and two vertical bars on either side. AKET was used instead of passive knee extension test, straight leg

raise and sit and reach test as AKET was more reliable. [18]

Procedure:

Physical Examination: All subjects were Pre assessed for hamstring tightness using AKET in supine position with both lower extremities extended. Both anterior superior iliac spines were positioned by aligning them with the vertical bars of the apparatus. Dominant lower limb was assessed and the other lower limb was strapped so that subject was not able to do the compensatory movement (Fig.1). Following Landmarks used to measure hip and knee range of motion were Greater trochanter, Lateral condyle of femur and Lateral malleolus, marked by the marker. After that, subject was asked to flex the hip until the thigh touch the horizontal bar by maintaining hip at 90^0 of flexion with knee flexion. Again, while maintaining the contact between the thigh and the horizontal bar, the subject was asked again to extend the knee as much as possible while keeping their foot in relaxed and hold position for about 5 seconds. A standard universal goniometer was placed over the previously marked joint axis, and the goniometer arms were aligned along the femur and fibula to take the readings. Three repetitions for the same were performed and an average of three was taken as the final reading of Popliteal angle in all the subjects.

Protocol for Group I: Passive Hamstring Stretching Technique: In supine position. Subject was asked to endure as much stretching force as possible without pain, when the knee was passively and gradually extended in the Active Knee Extension Test position. After 15 seconds of continuous stretching readjustment of the stretching force was done when subject's reported that maximum stretch tolerance was decreased considerably. This readjustment was performed to maintain the maximum stretching force during most of the static stretch period, which lasted for 30 seconds. This technique was repeated 3 times with 10 seconds rest intervals between each stretch. This technique was repeated three times with 45 seconds hold period in each set and 10 seconds rest interval between each stretch.

Protocol for Group2: Sub occipital Muscle Energy Technique (SMET): SMET have two techniques in which Post Isometric Relaxation technique (PIRT) was applied for this group. In supine position therapist was standing towards the head side of the subject. Therapist placed his one hand on the occiput and other on the C2 spinous process and the Barrier of restriction of sub occipital muscle was identified. Therapist placed his anterior aspect of shoulder on the subject's forehead and was instructed to inhale and perform the isometric contraction of sub occipital muscle by saying tip your chin upwards against the resistance, applied by the therapist shoulder. Force applied by the subject against therapist resistance was not greater than 30% - 40%. The above contraction was held for 10seconds followed by exhalation phase including 5 seconds rest period was given. Again subject was asked to inhale which was followed by exhalation and along with the exhalation phase stretching of sub occipital muscle was done by the therapist. It was held for 30 seconds. The muscle was again taken into the new barrier and same above process was repeated 3 times with 10 seconds contraction followed by 30 seconds hold and with a 10 seconds rest period between each set.

Protocol for Group 3: Combination of both Techniques (Passive Hamstring Stretching Technique & Sub occipital Muscle Energy Technique): First passive hamstring technique was applied with the same above process which was followed by Post Isometric Relaxation technique of SMET. Repetitions were same for both the techniques mentioned above.

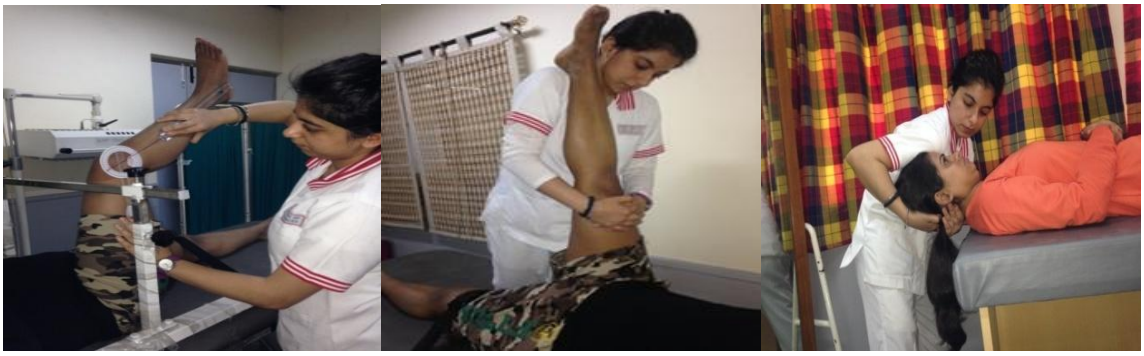


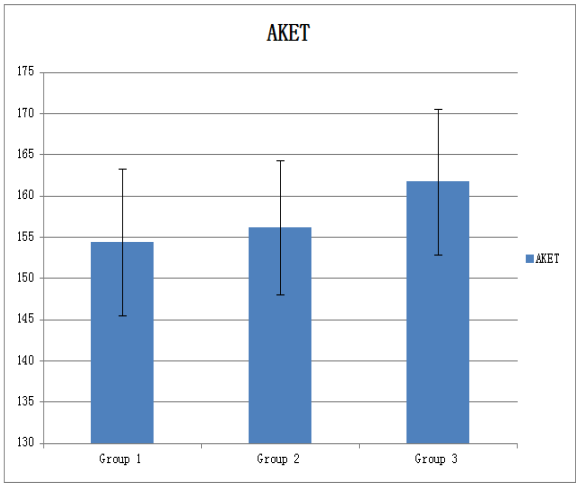
Fig 1 – AKET. Fig 2 – Passive Hamstring Stretching Technique. Fig 3 – SMET.

Treatment in all the 3 groups was given for 5 consecutive days regularly. The effect was recorded immediately post intervention taken as first reading, second reading was taken on 5th day post intervention and third reading was taken on the 15th day of follow up assessment with AKET

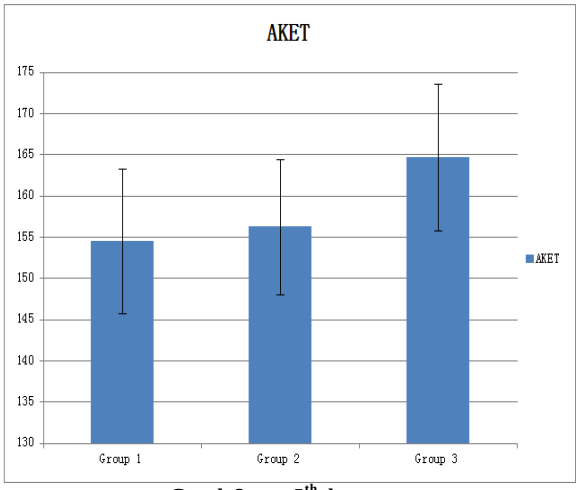
Statistical Methods: Statistically One-way ANOVA test was used to examine the Pre and Post difference between all the three groups. Paired sample t-test was used to examine difference between PRE-AKET, Post-AKET 1 (First reading), Post-AKET 2 (Second reading) and Post-AKET 3 (Third Reading) within the three groups. Mean and Standard deviation of all the groups were calculated. The observed differences were tested at 95% level of significance ($p \leq 0.05$)

RESULT

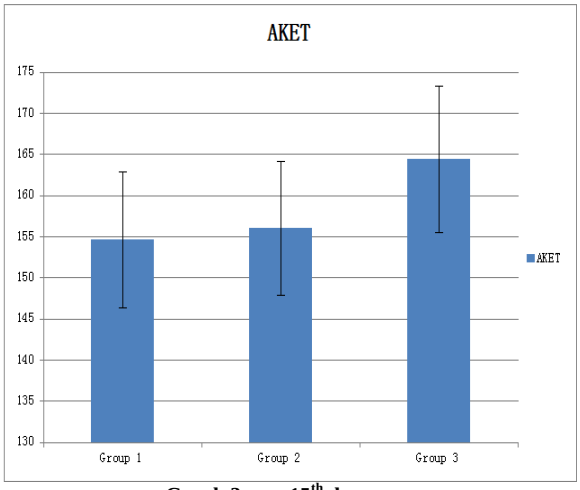
In this study 60 subjects participated with a mean age of 21.55±2.3 in group 1 (M, n=5; F, n=15) and 22.45± 2.13 in Group 2 (M, n=5; F, n=15) and with a mean age of 22.15± 2.08 in group 3 (M, n=5; F, n=15) ranging from 18 to 25 years. All the groups 1, 2 and 3 showed change with the significant difference of p=0.025, p=0.001,p=0.001 after the immediate i.e., one day (Graph1), five days (Graph 2) and fifteenth day (i.e., follow up assessment Graph 3) proving that intervention given to all three groups were independently efficient in improving post AKET scores and hamstring flexibility. Between group analyses, when all the three groups were compared to each other, subjects of group 1 and 3 showed significantly better results than subjects of group 2. Meanwhile, subjects of group 3 showed significantly better results than group 1.



Graph 1 Immediate effect (1day)



Graph 2 post 5th day score



Graph 3 post 15th day score

During within group analysis group 1, 2 and 3 showed significant difference of p=0.000 after the immediate i.e., one day, five days of treatment and after the fifteenth day of follow up assessment which proves that all these treatment when given individually may improve hamstring flexibility. (table1)

Table 1: within group analysis of pre and post scores

AKET scores	Group 1	Group 2	Group 3
Pre-AKET	144.40± 8.79	151.08± 8.05	149.58± 8.80
Post-AKET (immediate one day)	154.36± 8.89	156.10± 8.12	161.68± 8.88
Post-AKET (fifth day)	154.52± 8.78	156.23± 8.20	164.62± 8.92
Post-AKET 3 (fifteenth day, follow up assessment)	154.62± 8.30	155.99± 8.10	164.39± 8.94
Average difference in degree	10.08^0	4.75^0	13.98^0

DISCUSSION

The purpose of this study was to compare the effectiveness of passive hamstring stretching technique alone, sub occipital muscle energy technique alone and combination of both the techniques in order to improve the flexibility of hamstring muscle in healthy collegiate subjects. The fact that there are different types of treatment for improving hamstring flexibility, some of the treatment has multiple categories, is a evidence that no single treatment has been yet able to demonstrate its definitive dominance. For example, Passive Hamstring stretching technique and use of sub occipital energy techniques are one of the promising treatment options, but there is still no consensus upon which one is most effective and could be utilized for improving flexibility. This situation becomes very difficult for the therapists, patients and doctors to make decisions regarding which treatment is the most suitable for improving hamstring flexibility.

Since, all three groups showed remarkable improvement in post AKET scores at different days of duration. The result findings of this study revealed that when combination of both the techniques i.e., Passive hamstring stretching technique and PIRT which is a part of SMET when given to the subjects, their hamstring flexibility improved more in comparison to Passive hamstring stretching technique alone and SMET alone.

The successful effects of stretching exercises may lies in its physiology mechanism which have been attributed firstly to neurophysiologic mechanism in which inhibition of the muscles decreases the activity of the contractile component and result in an increased extensibility of the muscle and an increase in range of motion as well. Secondly to the Biomechanical mechanism that is based on viscoelastic property in which muscles like biologic tissues react viscoelastically to stretch. Elastic behavior refers to the property of a structure to elongate when a force is applied, and to return to its original length when the force is taken away. Meanwhile, viscous behavior refers to the property of a structure to elongate when a load is applied and elongation of a muscle is determined by the exerted force and force rate. Due to the above fact, this has been suggested that

during the passive hamstring stretching technique subjects shown significant improvement may due to the changes in viscoelastic property of the muscle. Likewise, a study done by Schleip and Aparicio et al [19] considered that if the tone of suboocipital muscles is decreased, the length of the hamstring muscles and the increase in the amplitude of hip flexion will be greater.

As there are four sub occipital muscles -Rectus capitis posterior minor, Rectus capitis posterior major, Obliques capitis superior and Obliques capitis inferior. Sub occipital muscles are the part of superficial back lines and these back lines are the ribbon of fascial and muscular continuity that begins with the plantar fascia and short toe flexors beneath the arches of the foot, wrapping around the heel to the soleus and gastrocnemius of the lower leg. It goes above and forms a link with hamstrings then with the subcutaneous ligaments around pelvis then with lumbosacral fasica, erector spinae and nichael ligament finally it attaches to the scalp fascia which links the occiput to the brow ridge. [20,21] Hence, there is a possible hypothesis that improvement in SMET may relate to its structures that relates with the hamstring muscle in following ways. First is Postural control, sub occipital play a role in postural control and will affect the coordinated movement of muscles down the chain. Second is the myofascial chains - Both the sub occipital and the hamstring musculature are included in the superficial back line. Addressing any of the structures in the superficial back line may have a positive effect of the entire line itself. [19] Most of the studies [13,14] suggested that there was an immediate effect of upper cervical manipulation technique in improving hip flexion range of motion. Another study [19] also reported the immediate effect of sub occipital inhibition technique in improving the flexibility of hamstrings as measured by active knee extension test in case of short hamstring syndrome. In our study findings group 3 showed more remarkable improvement as mechanisms behind both the techniques worked together for improving the flexibility of the hamstring muscle. Also we did the follow up assessment after 15 days of initial intervention of all the three groups. We found that majorly sustainability was reported in the subjects of group 3 which itself proved the efficacy of the combination of both the techniques were more than the Passive stretching technique alone and SMET technique alone.

In over all response, results were significant in all the three groups because it has been suggested in the study done by Youdas et al [15] that female has demonstrated greater flexibility than their male counterparts, hence this could be the another factor of improvement in the present study.

Clinical Implications:

1. All the techniques may be used in individuals with musculoskeletal disorders to improve hamstring flexibility
2. PIRT subpart of sub occipital muscle energy technique can be used in critical cases or population where direct stretch can't be given to the hamstring muscles.
3. Combination of both the techniques could be given to those individuals where higher range of hamstring flexibility is required in short period of time.

Limitation: Homogeneity was not maintained in the genders as in our study male subjects participation was less in comparison to female.

Future Scope: There is recommendation to see these techniques effects in follow up of more than 15 days with the patient pain scores and satisfaction. Also same

techniques could be implemented indifferent populations like elderly, athletes and individuals with low back pain.

CONCLUSION

These all three techniques are very simple and safe and could be use to improve hamstring flexibility. But Combination of both the techniques was much more effective in comparison of two techniques alone.

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