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**Research Article**

# A Comparative Study of Mulligans Bent Leg Raise versus Muscle Energy Technique in Asymptomatic Individuals with Hamstring Tightness

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**Abstract:** Tightness of hamstring muscle is closely linked with movement dysfunction at the lumbar spine, pelvis and lower limbs coupled with low back pain. In the present study, purposively selected 50 collegiate students having asymptomatic hamstring tightness aged 18-26 years from Guru Nanak Dev University, Amritsar, participated in two intervention groups, i.e. Mulligans bent leg raise (BLR) and muscle energy technique (MET). To evaluate the hamstring flexibility, active knee extension test, finger to floor test and sit and reach test of both right and left legs of all the subjects were measured at baseline and after 4$^{th}$ week of intervention. The results indicated significant improvement ($p<0.001$) in hamstring flexibility in asymptomatic students after the intervention using both Mulligans BLR and MET. After the 4$^{th}$ week intervention, when comparisons were made between these two groups, significant difference ($p<0.05$) was found only in active knee extension test of right leg. It could be concluded that both Mulligans BLR and MET were effective in improving the hamstring muscle flexibility in individuals with asymptomatic hamstring muscle tightness. However, MET showed significantly more improvement after 4 weeks of intervention on hamstring flexibility in terms of active knee extension test of right leg as compared to Mulligans BLR technique.

**Keywords:** asymptomatic individuals with hamstring tightness, Mulligans bent leg raise, muscle energy technique.



## INTRODUCTION

Tightness of a muscle is considered to be a limiting factor for the optimal performance which includes daily activities of an individual (Sambandam *et al.*, 2011). The term muscle tightness refers to the adaptive shortening of the contractile and the non-contractile elements of the muscle (Hertling and Kessler, 2006). Hamstring muscle is the most common group of muscle to get involved due to overuse stress placed on it (Baker *et al.*, 2013). Hamstring muscle is a postural muscle and is bi-articular, having tendency to shorten even under normal circumstances. Since it is a superficial two-joint muscle, it tends to get very light which further leads to muscle imbalance giving rise to a number of postural problems. The prevalence and incidence of hamstring tightness in normal individuals in day to day life is high owing to lack of regular exercise and limited activity (Hopper *et al.*, 2005).

Inability to achieve more than 160 degrees of knee extension with hip at 90 degrees of flexion is considered to contribute to hamstring tightness (Waseem *et al.*, 2009). Worrel *et al.*, (1992) stated that lack of hamstring flexibility was the single most important characteristics of hamstring injuries in athletes (Baker *et al.*, 2013). In fact, hamstring tightness leads to high risk of recurrent injury, decreases the performance of athletes, leads to post-exercise soreness and decreases coordination among athletes ((Hopper *et al.*, 2005). The prolonged sitting hours required in most of the jobs and educational setups are said to affect the flexibility of the soft tissues, especially the two joint muscles like hamstring (Yeole *et al.*, 2017).

Many stretching procedures have been used to improve hamstring flexibility, which include static stretching, and dynamic stretching such as ballistic stretching and the pre-contraction stretching which is a technique of PNF. Muscle energy technique (MET) is a manual therapy technique which is being used by many physical therapists targeting the tissues primarily and can also be termed as the active muscular relaxation technique (Waseem *et al.*, 2009; Yeole *et al.*, 2017, Ahmed and Abdelkarim, 2013; Sailor *et al.*, 2018; Kage *et al.*, 2017).

Mulligans bent leg raise is a painless technique and can be applied to any patient who has limitation in straight leg rising along with pain and can also be tried in patients who are having gross bilateral limitation of straight leg raise. BLR technique consists of gentle isometric stretching of hamstring in specific

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and particular direction in progressively increased angles of hip flexion (Tai *et al.,* 2017; Phadnis and Bhave, 2018; Sambandam *et al.,* 2011). Literature related to efficacy of MET and Mulligan BLR in patients with hamstring tightness was available only from the study of Chauhan and Nouman (2019). More information is required in this direction to validate the data. Thus the present study was planned to compare the effectiveness of Mulligans BLR and MET in improving the flexibility of hamstring muscle in collegiate population of Amritsar, Punjab.

# MATERIALS AND METHODS

**Participants**

The present study encompassed purposively selected 50 collegiate population (36 females and 14 males) having asymptomatic hamstring tightness aged 18-26 years from Guru Nanak Dev University, Amritsar. The subjects were then randomly allocated into two groups for intervention. Group-A consisted of 25 subjects (all females) who received Mulligans BLR technique for 4 weeks (alternate days) and Group-B comprised of 25 subjects (11 females and 14 males) who were treated with muscle energy technique for 4 weeks (alternate days). The Age of the subjects was estimated from their date of birth obtained from their respective classes. A written consent was obtained from the subjects. The study was approved by the Institutional Ethical Committee (IEC).

**Mulligan BLR (Intervention Group-A)**

Subject was asked to lie in supine position with the knee flexed to $90^0$ placing it on the therapist's shoulder, the popliteal fossa being rested on the therapist's shoulder. The subject was then asked to push therapist away with the flexed leg and then relaxed voluntarily. At this point, the therapist pushed the subjects bent knee up as far as possible in the direction of the subjects shoulder on the same side thereby increasing the subjects hip flexion range provided there was no pain. Subject was then asked to hold each of the hamstring isometric contraction for about 6 seconds with 3 repetitions which was performed in a pain-free range. A longitudinal traction force was added along the long axis of the femur with this technique.

**Muscle Energy Technique (Intervention Group - B)**

Subject was placed in supine lying position. Therapist then passively flexed the subject's hip until the end feel was felt. From this position, the subject's lower leg was placed onto the therapists shoulder. The subject was asked to apply pressure over the shoulder of the therapist for 7-10 seconds. After the contraction of the hamstring and during the relaxation period, the therapist passively took the leg further into flexion with 30 seconds hold time. The subject's leg was then lowered on to the treatment table for a short resting period of approximately 10 seconds and the procedure was then repeated with the frequency of 2 repetitions.

**Anthropometric Variables**

Three anthropometric variables namely height, weight and BMI were measured from all the subjects using the techniques provided by Lohmann *et al.,* (1988) and were measured in triplicate with the median value used as the criterion. Stadiometer (Holtain Ltd. Crymych, Dyfed, UK) was used for measuring standing height. Subjects were weighed in minimal light-weight clothing, bare foot, using standard weighing machine (Model DS-410, Seiko, Tokyo, Japan) to the nearest 0.1 kg. Body mass index (BMI) was calculated from height and weight as follows: BMI=weight (kg) / height$^2$ ($m^2$).

**Measurement of Hamstring Tightness**

The demographic data like age, gender contact number and address was collected followed by the measurement of the hamstring tightness.

**Active Knee Extension Test (AKET)**

The test measured the angle of the knee flexion with the help of a goniometer after the active knee extension with the hip stabilized at 90 degrees flexion. The angle of knee flexion represented the hamstring tightness. Each subject was positioned in supine position on the examination table. The lower limb which was not been examined was stabilized across the thigh with a strap. Another strap was used to stabilize the pelvis by placing the strap over the antero-superior iliac spine. A line was drawn between the fibular head and the lateral malleolus. The angle of knee flexion of the subject was recorded from the goniometer in degrees.

**Finger to Floor Test (FTF)**

The Finger to Floor Test was performed with the subject standing barefoot. The subject was asked to reach the floor with their finger-tips. The distance between the subject's long finger and the floor was measured using a standard measuring tape in centimetres.

**Sit and Reach Test (SAR)**

The test involved the subjects sitting on the floor with legs stretched out straight ahead. Footwear was removed and the soles of the feet were placed against the wall. Both the knees were locked and pressed flat on the floor. With the palm facing downward, the subject reached forward along the measuring line as far as he/she could ensuring that the hands remain at the same level. The subject was asked to hold the end position for at least 2 seconds while the distance was being measured using the measuring tape in centimetres.

**Statistical Analysis**

Data was analysed using SPSS (Statistical Package for Social Science) version 20.0. Independent t-test was applied for all the variables between the patients treated with Mulligans BLR and MET and for

within group comparisons. A 5% level of probability was used to indicate statistical significance.

## RESULTS

Table 1 showed the descriptive statistics of selected anthropometric variables in patients with hamstring tightness treated with Mulligans BLR and MET techniques. The patients treated with muscle energy technique have higher mean values in height (165.52 cm), weight (64.12 kg) and BMI (23.55 kg/m$^2$) than the patients treated with Mulligans BLR technique (159.28 cm, 53.25 kg and 20.34 kg/m$^2$ respectively). However, statistically significant differences ($p<0.018 – 0.001$) were found in height (t=3.046), weight (t=4.478) and BMI (t=2.459).

**Table 1:** Descriptive statistics of selected anthropometric variables in patients treated with Mulligans BLR and muscle energy techniques with hamstring tightness

| Variables | Patients treated with Mulligans BLR | | Patients treated with MET | | t-value | p-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| Age (years) | 21.76 | 22.33 | 21.20 | 2.24 | 0.867 | 0.390 |
| Height (cm) | 159.28 | 7.76 | 165.52 | 6.67 | 3.046 | **<0.004** |
| Weight (kg) | 53.24 | 6.69 | 64.12 | 10.14 | 4.478 | **<0.001** |
| BMI (kg/m$^2$) | 20.34 | 4.89 | 23.55 | 4.31 | 2.459 | **<0.018** |

BLR= bent leg raise, MET= muscle energy technique.

**Table 2: Descriptive statistics of AKET, FTF and SAR in the pre-intervention values of the patients treated with Mulligans BLR at baseline versus at the end of 4$^{th}$ week**

| Variables | Patients treated with Mulligans BLR pre-intervention (baseline) | | Patients treated with Mulligans BLR post-intervention (end of 4$^{th}$ week) | | t-value | p-value | % Increment/ Decrement |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| AKET(rt) (degree) | 29.44 | 5.85 | 38.56 | 4.38 | 6.238 | **<0.001** | 30.97 |
| AKET(lt) (degree) | 35.80 | 4.71 | 42.68 | 3.66 | 5.769 | **<0.001** | 19.21 |
| FTF(rt) (cm) | 15.72 | 6.30 | 5.64 | 4.26 | 6.625 | **<0.001** | 64.12 |
| FTF(lt) (cm) | 17.28 | 6.80 | 6.36 | 4.56 | 6.665 | **<0.001** | 63.19 |
| SAR(rt) (cm) | 13.64 | 6.81 | 6.04 | 4.50 | 4.653 | **<0.001** | 55.71 |
| SAR(lt) (cm) | 14.96 | 7.12 | 6.76 | 4.86 | 4.756 | **<0.001** | 54.81 |

AKET-rt= active knee extension of right leg, AKET-lt= active knee extension of left leg, FTF-rt= finger to floor test of right leg, FTF-lt= finger to floor test of left leg, SAR-rt= sit and reach test of right leg, SAR-lt= sit and reach test of left leg.

The descriptive statistics of AKET, FTF and SAR in the pre-intervention values of the patients treated with Mulligans BLR at baseline versus at the end of 4$^{th}$ week were shown in Table 2. The patients treated with Mulligans BLR showed higher mean values in pre-intervention at baseline in FTF-rt (15.72 cm), FTF-lt (17.28 cm), SAR-rt (13.64 cm), SAR-lt (14.96 cm) and lesser mean values in AKET-rt ($29.44^0$) and AKET-lt ($35.80^0$) than the values in post-intervention at the end of 4$^{th}$ week (5.64 cm, 6.36 cm, 6.04 cm, 6.76 cm, $38.56^0$ and $42.68^0$ respectively). However, statistically significant differences ($p<0.001$) were found in all the variables i.e. AKET-rt (t=6.238), AKET-lt (t=5.769), FTF-rt (t=6.625), FTF-lt (t=6.665), SAR-rt (t=4.653) and SAR-lt (t=4.756) between them.

**Table 3:** Descriptive statistics of AKET, FTF and SAR in the pre-intervention values of the patients treated with MET at baseline versus end of 4$^{th}$ week

| Variables | Patients treated with MET pre-intervention (baseline) | | Patients treated with MET post-intervention (end of 4$^{th}$ week) | | t-value | p-value | % Increment/ Decrement |
|---|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | | |
| AKET(rt) (degree) | 31.04 | 6.30 | 40.96 | 4.32 | 6.490 | **<0.001** | 31.95 |
| AKET(lt) (degree) | 35.36 | 4.92 | 43.52 | 3.75 | 6.590 | **<0.001** | 23.07 |
| FTF(rt) (cm) | 16.00 | 9.38 | 5.72 | 4.22 | 4.999 | **<0.001** | 64.25 |
| FTF(lt) (cm) | 17.36 | 9.69 | 6.36 | 4.49 | 5.148 | **<0.001** | 63.36 |
| SAR(rt) (cm) | 15.20 | 8.75 | 7.04 | 4.69 | 4.108 | **<0.001** | 53.68 |
| SAR(lt) (cm) | 16.32 | 9.03 | 7.72 | 4.93 | 4.179 | **<0.001** | 52.69 |

Table 3 showed the descriptive statistics of AKET, FTF and SAR in the pre-intervention values of the patients treated with MET at baseline versus end of 4th week. The patients treated with MET showed higher mean values of pre-intervention at baseline in FTF-rt (16.00 cm), FTF-lt (17.36 cm), SAR-rt (15.20 cm), SAR-lt (16.32 cm) and lesser mean values in AKET-rt ($31.04^0$) and AKET-lt ($35.36^0$) than the values of pre-intervention at the end of 4th week (5.72 cm, 6.36 cm, 7.04 cm, 7.72 cm, $40.96^0$ and $43.52^0$ respectively). However, statistically significant differences ($p<0.001$) were found in all the variables i.e AKET-rt (t=6.490), AKET-lt (t=6.590), FTF-rt (t=4.999), FTF-lt (t=5.148), SAR-rt (t=4.108) and SAR-lt (t=4.179) between them.

The descriptive statistics of AKET, FTF and SAR in patients with Mulligans and MET before the intervention (Baseline) were shown in Table 4. Patients treated with muscle energy technique have higher mean values in AKET-rt ($31.04^0$), FTF-rt (16 cm), SAR-rt (15.20 cm) and SAR-lt (16.32 cm) than the patients treated with Mulligans technique ($29.44^0$, 15.72 cm, 13.64 cm and 14.96 cm respectively). However, no significant differences ($p>0.05$) were found in any of the variables.

Table 5 showed the descriptive statistics of the comparison of Mulligans BLR and MET with respect to AKET, FTF and SAR in patients treated at the end of 4thweek (post-intervention). Patients treated with MET have higher mean values in AKET-rt ($40.96^0$), AKET-lt ($43.52^0$), SAR-rt (7.04 cm) and SAR-lt (7.72 cm) than the patients treated with Mulligans BLR ($38.56^0$, $42.68^0$, 6.04 cm and 6.76 cm respectively). However, significant difference ($p<0.05$) was found only in AKET-rt (t=1.950) between the patients treated with Mulligans BLR and MET.

**Table 4:** Descriptive statistics of comparison of AKET, FTF and SAR in patients treated with Mulligans BLR and MET during pre-intervention (Baseline)

| Variables | Patients treated with Mulligans BLR pre-intervention (Baseline) | | Patients treated with MET pre-intervention (Baseline) | | t-value | p-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| AKET(rt) (degree) | 29.44 | 5.85 | 31.04 | 6.30 | 0.390 | 0.357 |
| AKET(lt) (degree) | 35.80 | 4.71 | 35.36 | 4.92 | 0.323 | 0.748 |
| FTF(rt) (cm) | 15.72 | 6.30 | 16.00 | 9.38 | 0.124 | 0.902 |
| FTF(lt) (cm) | 17.28 | 6.80 | 17.36 | 9.69 | 0.034 | 0.973 |
| SAR(rt) (cm) | 13.64 | 6.81 | 15.20 | 8.75 | 0.703 | 0.485 |
| SAR(lt) (cm) | 14.96 | 7.12 | 16.32 | 9.03 | 0.591 | 0.577 |

**Table 5:** Descriptive statistics of AKET, FTF and SAR in patients treated with Mulligans BLR and MET at the end of 4thweek (post-intervention)

| Variables | Patients treated with Mulligans BLR post-intervention (4th week) | | Patients treated with MET post-intervention (4th week) | | t-value | p-value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| AKET(rt) (degree) | 38.56 | 4.38 | 40.96 | 4.32 | 1.950 | **<0.050** |
| AKET(lt) (degree) | 42.68 | 3.66 | 43.52 | 3.75 | 0.801 | 0.427 |
| FTF(rt) (cm) | 5.64 | 4.26 | 5.72 | 4.22 | 0.067 | 0.947 |
| FTF(lt) (cm) | 6.36 | 4.56 | 6.36 | 4.49 | 0.001 | 1.000 |
| SAR(rt) (cm) | 6.04 | 4.50 | 7.04 | 4.69 | 0.769 | 0.446 |
| SAR(lt) (cm) | 6.76 | 4.86 | 7.72 | 4.93 | 0.694 | 0.491 |

## DISCUSSION

The outcome measures considered for the study were Active knee extension test (AKET), Sit and reach test (SAR) and Finger and finger test (FTF). High reliability of AKET was reported by Gajdosik and Lusin (1983) followed by Worrel *et al.,* (1992). Hamid *et al.,* (2013) and Norris and Mathews (2006) also proved AKET to be effective in assessing the hamstring tightness. Lopez-Minarro *et al.,* (2009) conducted a study to compare the sit and reach test and back saver sit and reach test in university students proving higher validity of sit and reach test Jackson and Baker (1986) conducted a study to find out the relationship of the sit and reach test to criterion measures of hamstring and back flexibility in young females and concluded that sit and reach test have a moderate relationship with passive hamstring flexibility. Perret *et al.,* (2001) conducted a study to check the validity, reliability and responsiveness of the finger to floor test and concluded as having excellent results when used in clinical practice with great responsiveness. Ayala *et al.,* (2011)

carried out a study on the absolute reliability of 5 clinical tests for assessing hamstring flexibility in professional futsal players that indicated higher reliability for sit and reach test (SRT), Toe touch test (TT) and Back saver sit and reach test (BSSRT) compared to passive straight leg raise test (PSLR) and modifies sit and reach test (MSRT).

In the present study, the mean values of the pre-intervention AKET, FTF and SAR test of both right and left legs at baseline was compared between the patients treated with Mulligans BLR and MET and the differences were non-significant, hence the baseline was comparable (Table 4).

When the comparisons of mean values of the post-intervention AKET, FTF and SAR at the end of 4$^{th}$ week were compared between the patients treated with Mulligans BLR and MET and the differences were statistically significant ($p<0.05$) only in AKET-rt (Table 5). Chauhan and Nouman (2019) studied the comparative effect of Mulligans BLR and MET in asymptomatic healthy individuals for duration of 3 weeks which concluded that MET was more effective than Mulligans BLR. The present study supported the finding of them.

When comparisons were made between the mean values of AKET, FTF and SAR at baseline and after 4$^{th}$ week of intervention in patients treated with Mulligans BLR and MET, both the techniques showed significant improvement in the reduction of hamstring tightness (Table 2 and 3), highlighting the latter technique slightly superior. The findings of the present study supported the findings made by Ahmed and Abdelkarim (2013), when they reported that MET was highly effective than static stretching alone to treat hamstring tightness post burn contracture. An increase in hamstring muscle flexibility after MET occurred due to biomechanical or the neurophysiological changes or due to increase in the tolerance to the stretching (Waseem *et al.,* 2009; Ahmed and Abdelkarim, 2013; Yeole *et al.,* 2017).

The effects observed in the muscles of the patients treated with Mulligans BLR focused on the theory that BLR technique triggers the neurophysiological responses influencing the muscle stretch tolerance explaining the above results as the neurophysiological response might help the shortened muscles to tolerate the stretch and thus produce an immediate effect on the hamstring muscle flexibility after the treatment (Sambandam *et al.,* 2011; Tai *et al.,* 2017; Phadnis and Bhave, 2018). Whereas the effects observed in the shortened muscles of the patients treated with MET is due to autogenic inhibition which occurs when the GTO is activated which is located between the muscle belly and the tendon during the isometric contraction of the muscle and responds by inhibiting this contraction and contracting the opposite group of muscles (antagonist muscle group) (Kage *et al.,* 2017; Sailor *et al.,* 2018). When the GTO inhibits the (agonist) muscle contraction and allows the contraction of the antagonist muscle, the muscle can be stretched further and easier which is the same effect seen in the study thus improving its flexibility.

# CONCLUSION

The present study proved that both Mulligans BLR and muscle energy technique (MET) are effective in improving the hamstring muscle flexibility in individuals with asymptomatic hamstring muscle tightness. Thus both the techniques can be used in clinical practice for improving the flexibility of the hamstring muscle. However, muscle energy technique showed significantly more improvement after 4 weeks of intervention on hamstring flexibility in terms of active knee extension test of right leg.

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**CONFLICT OF INTEREST**

Nil.

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