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Manual Therapy on Plantar Fascia Affects Superficial Back Line Flexibility: A Randomized Controlled Pilot Study

Neetu Rani Dhiman[1*], Vyom Gyanpuri[2] and Venkatesh Mishra[3]

[1]Department of Neurology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, UP, India
[2]Department of Anatomy, Institute of Medical Sciences, Banaras Hindu Universi-ty, Varanasi, UP, India
[3]Department of Physiotherapy, Babasaheb Bhimrao Ambedkar University, Lucknow, Varanasi, UP, India

Abstract

Background and aim: Myofascial Release (MFR) is a soft tissue mobilisation technique that has been widely researched and supported to increase muscular flexibility and joint range of motion along Superficial Back Line (SBL) structures. The purpose of the present study is to examine and compare the acute effects of MFR and post-isometric relaxation (PIR) applied on plantar fascia, on flexibility of superficial back line (hamstring muscle).

Design: This was a pilot single blind Randomized Control Trial (RCT).

Participants: Thirty young healthy students (24 boys and 6 girls; mean age 21.46 ± 0.97)

Methods: Inclusion and exclusion criteria were followed, and baseline measurements for the Toe Touch Test (TTT) and active Straight Leg Raise Test (SLRT) were obtained. Subjects were then randomly assigned to the MFR group and the PIR group. The MFR group received the technique on plantar surface of the feet by applying a gentle and sustained pressure into the myofascial connective tissue. The PIR group received the technique on plantar flexors by placing them in stretched position, performing isometric contraction followed by relaxation and lengthening. Both interventions will be performed for 10 minutes. Afterwards, the toe touch test and straight leg raise test were re-assessed.

Results: Before and after intervention SLRT (both right and left) and TTT difference (within group differences) is statistically significant ($p<0.05$) in both MFR and PIR group. Between group comparison also shows significant difference in both groups with $p<0.05$. The MFR group showed a significant difference in the SLR test and Toe Touch test compared to the PIR group ($p<0.05$).

Conclusion: The results of the current study showed that MFR on the planter fascia was immediately effective for improving flexibility of the SBL for the hamstring muscle.

Trial registration: CTRI/2021/08/035518

Keywords: Plantar fascia • Myofascial release • Superficial back line • Flexibility

Introduction

Flexibility is characterized as the capacity of the muscles to get stretched to a point where range of motion of those joint finishes. This is an integral part of the normal human body system [1].

For all motions, a change in versatility is important to avoid irregular weight distribution damaging the orthopedic system [2,3]. Flexibility is one of the major and important factors which harm the muscles, ligaments, tendons, bones and other soft tissue structures that form musculoskeletal system [4,5]. In recent times, due to increased echnology, and digital advancement in every field,

***Address to Correspondence:** Neetu Rani Dhiman, Department of Neurology, Institute of Medical Sciences, Banaras Hindu University, Varanasi, UP, India, Tel: 201096388681; E-mail: gyanpurineetu@gmail.com*

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there is development in sedentary lifestyle in students. They are spending large time in sitting. This particular habit of sitting for long hours has given them obesity and stiff posture leading to decreased flexibility [6,7]. Poor flexibility and stiff lower limb muscles leads to low back pain and injuries to the lower limbs [8-12]. So, having good hamstring flexibility is necessary for the prevention as well as management of various musculoskeletal disorders [13,14].

Superficial Back Line (SBL) is one of the myofascial meridians, as reported by Myers', which transmits the tension formed in fascia linked from plantar fascia to epicranial fascia [15]. The ham-string muscles are connected to the sacrotuberous ligament, thoracolumbar fascia, the erector spine, the iliocostalis, the epicranial aponeurosis and frontal muscle, by the superficial back line moving from the plantar fascia and short toe flexors (lumbricals, flexor accessories and flexor digitorum braves) [16]. There are studies that identified the effect of various myofascial therapies applied on sub-occipital region [17], hamstrings [18], and the plantar region of the feet [19] to increase hamstring flexibility. Hence, this has been already proved that hamstring muscle flexibility could improve indirectly even without directly acted upon when any part of fascia connecting SBL is treated.

Myofascial Release Technique (MFRT) is known as a broader term for a range of heterogeneity of physical and manual physiotherapy techniques in which force is applied to the soft tissue structures like muscle and fascia [20]. MFRT requires a physical approach of less magnitude and prolonged stretch to the muscles and fascia that never include stimulating one region for more than 2 minutes [21]. MFRT aims to maintain tissue flexibility to structures like fascia that has gone through modifications in its mechanical properties, for example, loss of ordinary flexibility and consistency [22]. Muscle Energy Technique (MET) is a technique in which muscle is actively used through isometric contractions for relaxation via reciprocal inhibition, and lengthening [23]. Post isometric relaxation (PIR) is part of MET only, performed by first stretching the muscle, then contracting the muscle isometrically against minimal resistance and finally relaxation. PIR is an effective technique for improving muscle flexibility [24,25].

No study has been conducted till now to compare the effects of MFR and PIR techniques when applied on plantar fascia and short toe flexors, for improving superficial back line flexibility (ham-strings muscle flexibility) in asymptomatic young students. This study aims at determining the effectiveness of myofascial release technique against post-isometric relaxation technique on hamstring flexibility.

Materials and Methods

Participants

Thirty healthy students from the Banaras Hindu University (BHU), Varanasi, UP, India took part in the study. Participants were invited directly by explaining the work to them and taking their in-formed consent in written. Students of both sexes were included if they had short hamstring length diagnosed with the help of Toe Touch Test (TTT). Participants were excluded if they were below 18, hyper mobile (Brighton score>4), involved in regular flexibility program, any diagnosed soft tissue or bony injuries in spine or lower limb within two months of participation, fibromyalgia and contraindicated to any kind of manual therapy by physician.

Trial registration: Registered in Indian Clinical Trial Registry with no. CTRI/2021/08/035518 dated 01.08.2021.

Study design

This was a pilot single blind Randomized Control Trial (RCT). Participants were randomly divided in two groups by card method. Subjects blindly chose one of two cards that mentioned each intervention program on them, from a bowl. Each group had 15 participants in total.

Procedure

First of all, pre-intervention Toe Touch Test (TTT) and active Straight Leg Raise Test (SLRT) measurements were taken. After assignment into groups, subjects were called at the outpatient department of physiotherapy in trauma center, BHU where whole study procedure conducted, and were given complete verbal instructions so that they understand the procedure of intervention well.

The study aimed to know the difference in the level of improvement achieved by both interventions in terms of hamstring muscle flexibility. The study consisted of a single MFR session (group A) and a single PIR session (group B) and pre-post intervention outcome measure assessment (Figure 1).

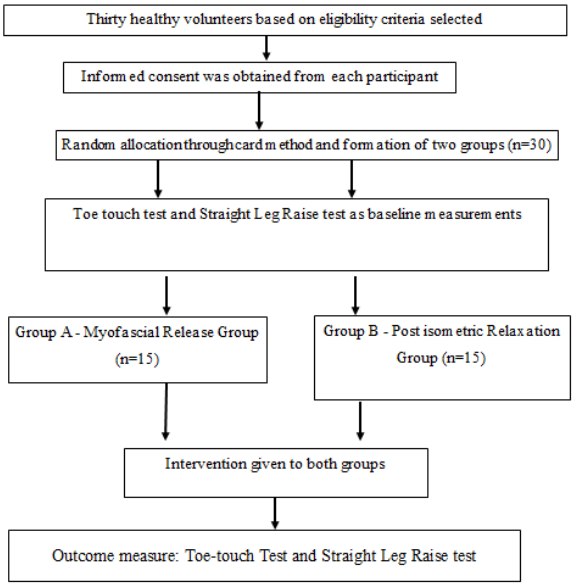

Figure 1. Flow diagram of the procedure.

Interventions

Subjects in group A were given the MFR technique on the plantar fascia of both feet in prone position.

In group B, Post-isometric relaxation technique was given to the plantar fascia/short toe flexor muscles of both sides. This is one of the muscle energy technique used for relaxation and deformation of tissues. Muscle PIR consisted of three phases: stretching the muscle, contracting the muscle isometrically and then relaxing the muscle.

The treatment session lasted for 10 minutes for both groups.

After that, post intervention measurements (TTT and SLRT) were taken from each group.

Outcome measures

Flexibility of hamstring muscle, which is a Superficial Back line structure, was calculated by using Toe Touch Test (TTT) (Figure 2) and active Straight Leg Raise Test (SLRT) (Figure 3) at baseline and post intervention. In Toe touch test, subject stands straight barefoot, with feet closer, and toes pointing forward.

Figure 2. Toe touch test performed by the student.

Figure 3. Active Straight leg raise test performed by the student.

Then, the subject bends down to the floor as low as possible while keeping the knees, arms, and fingers in full extension. If the tip of the middle finger could not reach the floor and had a distance of 5 cm or more, the test was considered positive and subject was confirmed for having short hamstrings. The distance from the tip of the middle finger and the floor was measured in centimeters with a measuring tape/ruler. Best of two trials was recorded. The Intra Class Correlation Coefficient (ICC) of the test was 0.99 [26]. Its validity and reliability has also been demonstrated in several other studies [27-29].

SLRT was performed with the subject in supine position. The subject retained the complete extension of the knee and the neutral position of the ankle. Complete ankle dorsiflexion was prevented to prevent the feeling of hamstring stiffness and pain from calf muscle stretch or pain (gastrocnemius and soleus), which would signify the limits of the SLR test. The subject then actively raised his lower limb until he felt some pain or rigidity in the region of the thigh, knee, or swing into posterior pelvic tilt (observed by movement of the anterior superior iliac spine). SLRT range was measured using goniometer [30-32]

Data analysis

The findings were analyzed using version 16.0.0. of SPSS. The descriptive statistics were carried out with regard to the general subject characteristics. The paired t-test was conducted to evaluate the changes in SLRT and TTT outcomes before and after intervention. The independent t-test was carried out to compare the SLRT and TTT findings between the MFR and PIR groups. The statistical significance was kept to be $\alpha=0.05$.

Results

The general attributes of the subjects (30) are shown in Table 1. The descriptive statistics for the pre post SLRT and TTT of both groups along with between group comparisons is shown in Table 2.

Feature	MR group (n=15)	PIR group (n=15)
Sex (male/female)	12/3	12/3
Height (cms)	171.88 ± 8.81	170.78 ± 8.43
Weight (Kg)	60.74 ± 4.66	59 ± 4.49
Age (Y)	21.4 ± 1.18	21.5 ± 0.74

Table 1. General attributes (N=30).

Variable	MFR group (n=15)	PIR group (n=15)	t (p)
Left sided SLRT			
Pre-test	40.3333 ± 10.43118	42.3333 ± 8.63272	8.33 ± 3.62
Post-test	48.6667 ± 10.93267	47.3333 ± 7.98809	5.00 ± 2.67
t (p)	-8.92 (0.00)	-7.246 (0.00)	2.87 (0.008)
Change value	8.3334 ± 0.50149	5 ± -0.64463	
Right sided SLRT			
Pre-test	40 ± 9.81981	41.6667 ± 8.38082	8.33 ± 2.44
Post-test	48.3333 ± 9.57427	45.3333 ± 9.72234	3.67 ± 2.97
t (p)	-13.23 (0.00)	-4.785 (0.00)	4.704 (0.000)
Change value	8.3333 ± -0.24554	3.6666 ± 1.34152	
TTT			
Pre-test	20.3667 ± 4.73387	20.0667 ± 6.15243	4.57 ± 0.86
Post-test	15.8 ± 4.49524	16.7333 ± 5.94579	3.33 ± 0.72
t (p)	20.49 (0.00)	17.838 (0.00)	4.24 (0.000)
Change value	4.5667 ± 0.23863	3.3334 ± 0.20664	

Values as mean ± SD. SLRT: Straight Leg Raise Test, TTT: Toe Touch Test, MR: Myofascial Release, PIR: Post Isometric Relaxation

Table 2. Within and between group comparison for SLRT and TTT (N=30).

Before and after intervention SLRT (both right and left) and TTT difference (within group differences) is statistically significant ($p<0.05$) in both MFR and PIR group. This shows that both techniques are useful in improving hamstring muscle flexibility individually and in turn superficial back line flexibility. Between group comparison also shows significant difference in both groups with $p<0.05$. The MFR group subjects improved more than PIR group subjects as the percentage change value are also high for right sided SLRT, left sided SLRT and TTT, to be 56.00, 40.00 and 27.01 respectively.

Discussion

This study was done to compare the effectiveness of MFR and PIR technique on superficial back line flexibility (Hip flexion and knee extension range) through hamstring muscle flexibility using SLRT and TTT. The results of the present study demonstrated that both techniques can improve hamstring flexibility. When MFR and PIR techniques compared, the difference in the mean of pre-post treatment for both SLRT and TTT, was statistically significant. The MFR technique when applied at the plantar fascia is superior to PIR in improving superficial back line flexibility.

Superficial back line is one of the six myofascial chains that join individual muscles into functional complexities. There are studies that support the evidence that there is transmission of force from proximal to distal anatomical structures via myofascial pathways [33-36]. Plantar fascial is one of the structures that forms SBL and is very important for transferring mechanical tension within the foot. It is first of many links in myofascial entire chain [37]. This is one factor that favours the result of our study that there is lengthening of hamstring muscle on applying manual techniques over plantar fascia. There is always positive effect of any manual approach in improving flexibility, when given along superficial back line structures irrespective of the location of treatment [38-41]. Myofascial release technique has come out to be one of the most researched manipulative techniques for many disorders like muscular tightness, arterial stiffness, muscle soreness, fascial adhesions and so on which makes it most commonly used therapy among sports as well as general people. Its effect has also been established for improving superficial back line flexibility (hamstring flexibility) when applied over local as well as remote areas of SBL [42-46]. Effect of Muscle energy technique is also established on hamstring muscle flexibility. Although previous

studies have reported that a variety of therapies are available to improve superficial back line flexibility but PIR is not being explored much in this reference. Also, there is no evidence for superiority of any one technique over another. This research was performed to explore the disparity between the effects of the MFR and PIR techniques in asymptomatic subjects with short hamstrings.

Considering the SLRT and TTT, the results showed a significant difference pre-post intervention in both groups, and it was established that the difference is more in MFR group than PIR group. The fact that both techniques may improve hamstring flexibility could be because the superficial back line was relaxed by plantar flexor relaxation [47]. Evidence points to the movement of forces across pathways of intramuscular connective tissue and inter muscular connective tissue. Previous researches conducted for the same objective to examine the functional significance of SBL, have reported similar results. Plantar fascia which is a small link in the entire SBL, plays crucial role in regulating the tension of the entire system as there is integrity of all the structures of SBL. In the targeted areas, there may be improved blood supply, which tends to improve muscle endurance [48]. This increase in circulation leads to temperature raise and can shift to a more fluid-like state. This change in condition allows fibrous adhesions between the various layers of the fascia to be broken apart and restores the extensibility of the soft tissue [49].

MFR has been compared to other soft tissue manipulative techniques like deep tissue massage, static and dynamic stretching, proprioceptive neuromuscular facilitation technique, and contract-relax technique in various studies. Data and results of all studies found MFR more beneficial than other techniques. There is strong evidence supporting the efficacy of MFR, when given in remote areas, in improving superficial back line flexibility. Hence, the results of current study are supported by the results of these studies. These findings indicate that treatments should be extended not only to the body part, but also to other areas of the body, taking into account the continuity of the myofascial meridian, in order to improve flexibility. Although PIR has been found effective in improving ankle and knee range of motion in two separate studies, and also in our study as well but when considering the difference between the two, MFR and PIR, MFR is significantly superior to PIR. As this is very certain and also described above that lack of flexibility in hamstring muscle can cause many musculoskeletal injuries in lower extremities and low back pain, hence these techniques can be used to improve hamstring flexibility immediately after application.

Conclusion

This RCT pilot study was exploratory in nature with respect to the efficacy of MFR and PIR in one region of the 'anatomy train' that is superficial back line and its global effects on proximal flexibility. This research presented evidence for the immediate efficacy of MFR and PIR on the SBL and indicates that through these treatments, asymptomatic young adults may have an immediate improvement in hamstring flexibility. However, MFR is found to be more effective than PIR. These preceding results should be interpreted cautiously and future research with a larger asymptomatic sample in the same field should be incorporated. The exact mechanisms behind the success of myofascial therapies should continue to be the subject of more research recommendations.

Declarations

Ethics approval and consent to participate: Ethical consent for present trial was taken from the Institutional Ethical Board Committee of Institute of Medical Sciences, Banaras Hindu University, Varanasi, UP with number-dean/2019/EC/1296 dated 07.05.2019. Consent to participate was taken from each subject. The authors certify that they have obtained all appropriate patient consent forms. In the form the patient (s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patient (s) understand that his/her/their name (s) and initials will not be published and due efforts will be made to conceal his/her/their identity, but anonymity cannot be guaranteed.

Consent for publication

Approved and taken from each author.

Competing interests

None

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None

Authors' contributions

Each author contributed equally. All authors read and approved the final version of the manuscript.

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