THE EFFECTIVENESS OF DIRECT VERSUS REMOTE TECHNIQUES ON HAMSTRING FLEXIBILITY, STAR EXCURSION BALANCE TEST REACH DISTANCE VERTICAL JUMP HEIGHT IN SUBJECTS WITH SHORT HAMSTRINGS – A RANDOMIZED CONTROLLED TRIAL

by

RICHA SHIVHARE

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in partial fulfillment

of the requirements for the degree of

MASTER OF PHYSIOTHERAPY (MPT)

In

SPORTS PHYSIOTHERAPY

Under the guidance of

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Bhubaneswar, Odisha 2023

DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation/thesis entitled "**The Effectiveness of direct versus remote technique on hamstring flexibility, star excursion balance test, reach distance, vertical jump height in subject with short hamstrings -A The randomized controlled trial"** is a bonafide and genuine research work carried out

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Dr. Chinmaya Kumar Patra (PT)

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My parents, my family, and my friends have always supported me morally and mentally.

And above all, I can't ignore the blessings of LORD JAGANNATH in completing this dissertation on time.

Date: Signature

Place : Odisha Name: Richa Shivhare

LIST OF ABBREVIATIONS

1. **ABSMARI –** Abhinav Bindra Sports Medicine and Research Institute
2. **MSEBT –** Modified Star Excursion Balance test
3. **MCID-** Minimal Clinically Important Differences
4. **SPSS –** Statistical package for social science
5. **BMI –** Body Mass Index
6. **CON –** Control group
7. **SD-** Standard Deviation
8. **VJ –** Vertical jump
9. **AKET –** Active knee extension test
10. **SRT –** Sit and reach test
11. **SMI –** Suboccipital Muscle inhibition technique
12. **MFR –** myofascial release
13. **RMFR** -Remote Myofascial release

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ABSTRACT

THE EFFECTIVENESS OF DIRECT VERSUS REMOTE TECHNIQUES ON HAMSTRING FLEXIBILITY, STAR EXCURSION BALANCE TEST , REACH DISTANCE, VERTICAL JUMP HEIGHT IN SUBJECTS WITH SHORT HAMSTRINGS: RANDOMIZED TRIAL

Background- The hamstrings play a major role in body posture. Shortening of tightness of the hamstrings affects postural alignment and results in possible musculoskeletal pain. The hamstrings is major muscles that control the movement of the hip and knee joints and control the alignment of the pelvis and spine. So they play an important role in postural alignment where the shortening of the hamstrings could result in a posterior pelvic tilt and hypolordosis of the lumbar spine. The changes in body posture resulting from hamstring shortening could result in lower back and lower limb pain including hip, knee or ankle joint pain.

Methods: Sixty collegiate Students aged between 18-25 years of aged subjects

were randomly assigned to a direct MFR (n=20), Remote MFR(n=20), and control(n=20) group for 3 weeks. Direct MFR consisted of 4 minutes and SMI consisted of 2 minutes. Hamstring flexibility, Balance, and jump performance were asses before and after the intervention using the Active knee extension test modified star excursion balance test, Sit and Reach test, and vertical jump test respectively.

Results – The results within the group show that hamstring flexibility, balance, and jump performance significantly ($p<0.05$) improved in both Group A and Group B. The between-group analysis revealed that the direct group showed a significant improvement in flexibility, balance, and jump performance than the Control group

Conclusion - This study concluded that Direct MFR has more effect than the Remote and Control group

Key Word- Active knee extension test, Direct MFR, Remote MFR, Modified Star Excursion Balance test, sit and reach test, Vertical jump

INTRODUCTION

The hamstrings comprise three large muscles, namely semi-tendinous, semi-membranous, and biceps femoris which originate from the inferior-medial impression on the upper part of the Ischial tuberosity and get inserted on the upperparts of the posterior surface of tibia. They are located in the posterior compartment of the thigh and act on the hip and knee joint. Hence, they are extensors of the hip and flexors of the knee. Muscle tightness is caused by a decrease in the ability of the muscle to deform, resulting in a decrease in the range of motion at the joint on which it acts(1) In muscles that are prone to shortness due to their flexor nature such as the hamstring muscle, shortness of muscle develops without any specific pathological cause and is only due to the continuous movement of the muscle in its full range of motion. Shortening of this muscle directly affects knee function and indirectly affects hip and ankle joint function(2)

Hamstring tightness, often defined as a lack of ROM with a concomitant feeling of restriction in the posterior thigh, has been documented across all age groups as a potential cause of the dysfunctional or restricted movement of the hip of motion.(3)

Hamstring tightness is caused by extended or prolonged sitting at work places and educational institutions, inadequate physical activity, genetic predisposition, previous injury to hamstring . Morden sedentary life style is one of the main reasons for postural abnormality. Most of the work place and educational setups have prolonged sitting hours which can easily hampered flexibility of soft tissues, especially in muscle which has multiple attachments.(4)

Hamstring tightness is one of the factors that affect dynamic balance because it loses the ability to deform while being stretched. This inability results in reduced hip

flexion, altered hip extension, and a posterior tilt of the pelvis, which leads to decreased lumbar lordosis and back pain.(5)

Available intervention for shortened harmstrings are foam roller, self myofascial release, soft tissue mobilization techniques, static, ballistic and proprioceptive neuromuscular facilitation stretching techniques, muscle energy technique, Mulligan bent leg raise techniques, eccentric training etc. (6)

There are several tests employed to assess hamstring flexibility, like sit and reach test (SRT), chair SRT, back saver SRT, active knee extension (AKE) test, passive knee extension test etc. We have chosen to measure hamstring flexibility by Active knee extension test and sit and reach test, Reach direction was assessed by using mSEBt, Jump performance was measured using Vertical Jump Height test(3)

It is important to study hamstring flexibility in students who have long sedentary hours of studying along with lack of physical activities to create awareness about lack of normal flexibility and preventing complications. Therefore present study measured the hamstring muscle flexibility in college students. This study may give light on student's educational sitting arrangement setups and value and need of co-curricular physical activities in routine day to day life.((4)

The purpose of this study was to develop a new effective approach to improve hamstring flexibility. In this study Comparison was made between DMFR vs Remote MFR by using AKET ,SRT,mSEBTand Vertical Jump Test.

Need of the Study

Hamstring tightness also affects performance as participants with greater flexibility demonstrated more power, speed, and agility than participants with lesser hamstring flexibility. There is a high incidence of injuries at the end of competitions, and it has been related to the alterations of the neuromuscular system and the limited ability to dynamically stabilize the lower extremities.

According to what we know, very little study has been done on the impact of direct versus remote technique on hamstring flexibility. Subjects with short hamstrings were tested on SEBT reach distance and vertical leap height. We therefore want to know if there was any correlation between the participants' reach distance, their ability to stabilize during sport-specific tests like the jump, and their hamstring tightness.

AIM OF THE STUDY

To investigate the effects of direct vs remote MFR techniques on hamstring flexibility, reach direction, reach distance and vertical jump height in a subject with a short hamstring.

OBJECTIVES OF THE STUDY

To investigate the effects of direct vs remote MFR techniques on hamstring flexibility, reach direction, reach distance and vertical jump height in a subject with a short hamstring by using AKET,SRT,mSEBT,VJ

HYPOTHESIS

NULL HYPOTHESIS

- There is no significant effect of direct myofascial release technique to improve hamstring flexibility, Reach direction, distance reach, and vertical jump height.
- There is no significant effect of the Remote myofascial release technique to improve hamstring flexibility, Reach direction, distance reach, and vertical jump height.

ALTERNATIVE HYPOTHESIS

- There will be a significant effect of direct myofascial release technique to improve hamstring flexibility star excursion balance distance reach vertical jump height in subject with the short hamstring.

- There will be a significant effect of the Remote myofascial release technique to improve hamstring flexibility star excursion balance distance reach vertical jump height in subject with a short hamstring.

REVIEW OF LITERATURE

1.Paul Farius et al.(2021)in the international journal of environmental research & public health conducted a study on Does Self-Myofascial Release Causes a Remote Hamstring Stretching Effect Based on Myofascial Chains. They concluded that the superficial backline can be considered a functional structure, as the application of self-myofascial release on any of its component segments improved hamstring flexibility.

2. Keisuke Itotani et al.(2021) in the journal of healthcare conducted a study on the Myofascial Release of the Hamstrings Improves Physical Performance they concluded that MFR for hamstrings not only improves flexibility but also increases M-walking speed and physical performance of the SLJ. As MFR is safe and does not involve joint movement, it may be useful for maintaining and improving performance and flexibility during inactivity and for stretching before exercise.

3. Connor Burk et al.(2020) in the Journal of Sport Rehabilitation conducted a study on Can Myofascial Interventions Have a Remote Effect on ROM? A Systematic Review and Meta–Analysis was conducted on 8 randomized control trials which

concluded that Remote myofascial techniques may increase ROM at distant body segments, and there is preliminary evidence that these effects are comparable to local treatment interventions.

4. **Érika Quintana Aparicio et al(2009). Journal of Manipulative and Physiological Therapeutic** conducted a study on immediate effects of the suboccipital Muscle inhibition technique in subject with short hamstring syndrome they concluded that The SMI technique modifies the elasticity of the hamstring muscles as measured with the FFD test, the SLR test, and the PAT. The SMI technique modifies the PA of the right semimembranosus muscle but in contrast does not modify the PA of the semitendinosus muscle or biceps femoris.

5. Daniel Martínez-Lema et all(2020).journal of Bodywork & Movement Therapies conducted a study on the Immediate effects of a direct myofascial release technique on hip and cervical flexibility in inactive females with hamstring shortening a randomized controlled trial. they concluded that the protocol based on a single direct MFR intervention was no more effective than the placebo in improving flexibility both locally at the hamstring level and remotely at the level of the cervical extensor muscles. Future research should consider different MFR techniques on the immediate increase in muscle flexibility and the long-term effect of MFR, as well as consider different intervention groups.

6. Alberto Encarnación-Martínez et all(2023) journal sensors . conducted a study on the Effect of Hamstring Tightness and Fatigue on Dynamic Stability and Agility in Physically Active Young Men. They concluded, a reduction in the range of motion in HTG was observed, but no other effects were observed on performance and dynamic stability after a local fatigue protocol depending on hamstring extensibility.

7. Faris Alshammari et all (2019) South African Journal of Physiotherapy conducted a study on A novel approach to improve hamstring flexibility: A single-blinded randomized clinical trial. they concluded that Quadriceps muscle activation following passive stretching of the hamstrings appears to be superior to the PS and ND techniques in improving hamstring muscle flexibility.

8. Brittany L. Hansberger, DAT, AT et all (2019) The International Journal of Sports Physical Therapy | Conducted a study on Evaluating the relationship

between clinical assessments of apparent hamstring tightness: a correlational analysis they concluded that Active knee extension, one of the most common measures for apparent hamstring tightness have low correlations with the other assessments. Based on the findings of this study, it is possible that not all assessments of Apparent hamstring Tightness are measuring the same phenomena, with each involving different factors of perceived hamstring length.

9. Sung-Hak Cho et all (2014) Conducted a study on The comparison of the immediate effects of application of the suboccipital muscle inhibition and self-myofascial release techniques in the suboccipital region on short hamstring .they Concluded that Application of the SMI and SMFR to persons with short hamstrings resulted in immediate increases in the flexibility of the hamstring. However, we could see that the SMI technique was more effective.

10. Nishchal Ratna Shakya et all (2018) International Journal of Scientific andResearch Publications, Conducted a study on the Prevalence of Hamstring muscle tightness among undergraduate physiotherapy students of Nepal using Passive Knee Extension Angle Test they concluded that the present study shows a medium prevalence of hamstring muscle tightness among physiotherapy students of KUSMS and no association was found between low back pain and hamstring muscle tightness.

METHODOLOGY

- STUDY DESIGN – Randomized controlled trial
- STUDY POPULTION – Collegiate student
- SAMPLE SIZE – 60
- THE SAMPLE SIZE WAS CALCULATED BY USING THE FORMULA– $2K \times sd^2 / d^2$
- SAMPLING TECHNIQUE – Purposive Sampling (Non-random sampling)
- STUDY SETTING – ABSMARI, Bhubaneswar
- STUDY DURATION – 3 weeks
- **SELECTION CRITERIA**
    - **INCLUSION CRITERIA**

      1) Normal Healthy Individuals with Active knee Extension (popliteal angle) < 125^o.
      2) Both Genders i.e. males and females.
      3) Age group between 18-26 years with hamstring tightness.
      4) Those who were willing to participate.(7)

- **EXCLUSION CRITERIA :**

1) Individuals with neck pain, and neck trauma (Whiplash injury).
2) Individuals with a herniated disc, lumbar protrusion, low back pain, and showing neurological symptoms.
3) Individuals with recent fractures of the lower limb.
4) Individuals with cervical ligament instability or Migraine.
5) Inability to understand the informed Consent form.(8)

MATERIALS USED:

1) Sit and reach the box,
2) Plinth
3) Measuring tape
4) Universal Goniometer

OUTCOME MEASURES:

1.Modified Star Excursion Balance Test

2.Vertical jump

3.Active knee extension test

4.Sit and Reach test

PROCEDURE

The present study was reviewed and approved by the institutional Ethical Committee. A total of 60 samples were selected by using the purposive sampling method from where 60 subjects were selected based on inclusion criteria and exclusion criteria. these Study with some criteria like collegiate Student with short hamstring. The study Protocol was explained to all participants and their informed consent were obtained. Groups allocation was done by using Block Randomization.

20 subjects were placed in Group A (Experimental group)

20 subjects were placed in Group B (Experimental group)

20 subjects were placed in group C (Control group)

Baseline assessments were taken which include hamstring flexibility dynamic balance, and Jump performance. The assessment for hamstring flexibility using AKET AND SRT dynamic balance was taken using SEBT and jump performance was taken using the vertical jump test for vertical Jump.

The experimental group took intervention for a total of 4 minutes, the experimental group took intervention for 2 minutes and Control group took intervention for 10 sec Group A performed only Direct MFR; Group B performed Remote MFR Group C Active stretching Subjects took intervention 4 days per 3 weeks. At the end of 3 weeks, post-intervention data were assessed For both groups data were analyzed. The difference between pre-intervention and post Intervention within the group was assessed using paired t-test and differences between groups were analyzed by one-way ANOVA followed by post hoc TURKEY test.

ACTIVE KNEE EXTENSION TEST

Hamstring muscle flexibility was measured through the degree of limitation in the knee extension range of motion (ROM). A double-arm universal goniometer (UG) was used to measure the knee extension ROM. The UG is a valid and highly reliable tool for measuring knee joint ROM. The inter-tester reliability of the UG is 0.977–0.982 and the intratester reliability is 0.972–0.985. The pre-and post-intervention measures for each participant were taken by the same physiotherapist. Participants were placed supine, holding their hip joint at 90° flexion. Following that, the participants were asked to extend their knee actively to their maximum ability while keeping the hip joint blocked at 90° flexion. Knee extension ROM was measured at this point to determine the level of hamstring flexibility. The hamstrings were considered to have limited flexibility if the ROM limitation was 20° or more.(9)

- **SIT AND REACH TEST**
  The SR test has shown adequate reliability (ICC>0.9) . Standard Baseline® box (30.5 cm high) was used. This device permitted a scoring range from 0 to

50 cm. The subject sat on the floor without shoes with both legs together and knees fully extended so that the heels and soles of the feet were supported against the box. They then extended their arms forward, placing one hand on top of the other. Keeping their eyes straight ahead, with their palms down they extended their hands forward, pushing the marker along the measuring scale as far as possible in a smooth, controlled motion. The evaluator verified that the knees were not bent and that the feet remained in contact with the box throughout the tests.(10)

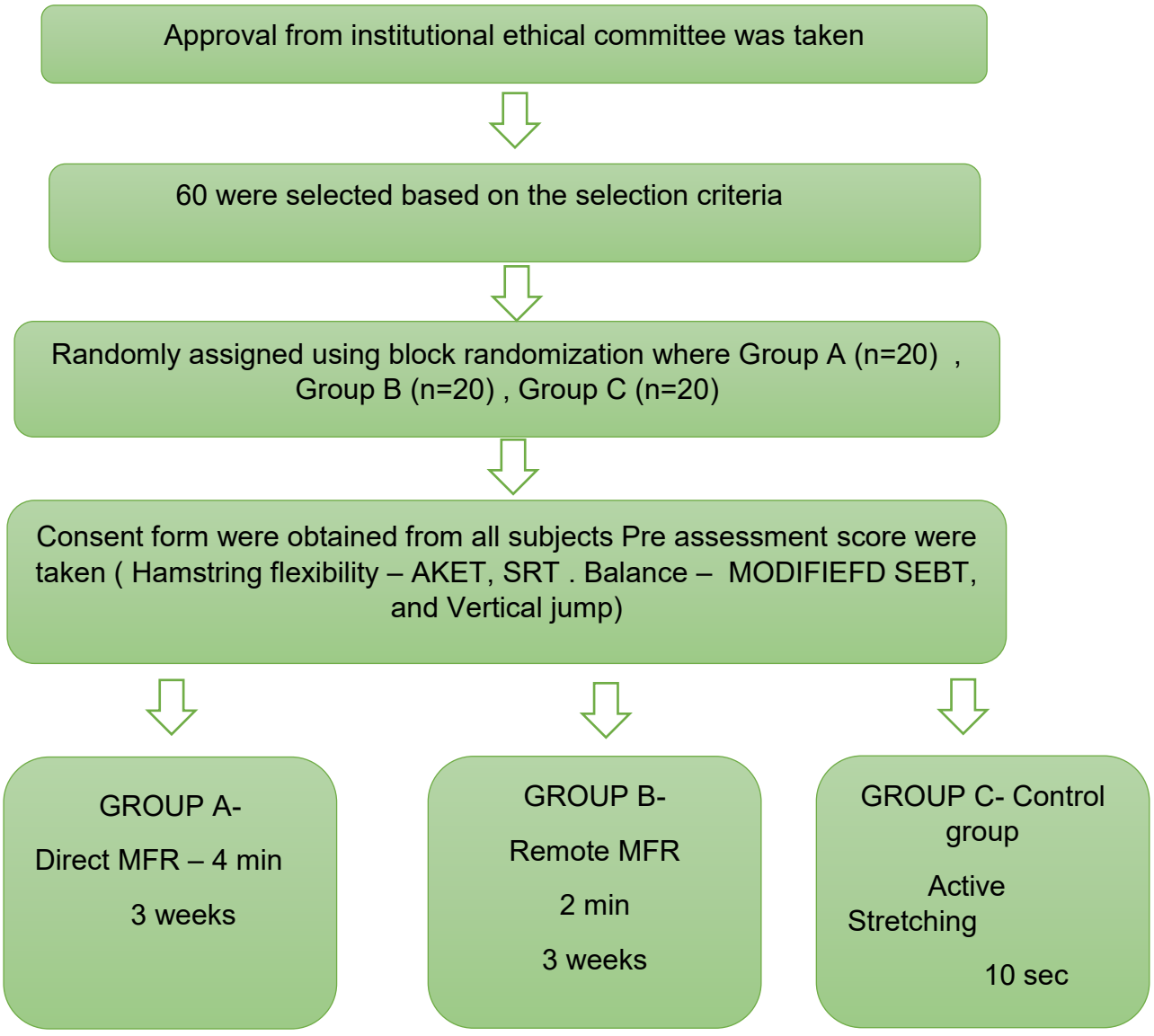
- **MODIFIED STAR EXCURSION BALANCE TEST**

Modified Star Excursion Balance Test (mSEBT) and Dynamic Postural Stability Index (DPSI) were used to evaluate dynamic postural stability in reach and landing

tasks, respectively. According to Gribble et al., mSEBT evaluates the reach in anterior, posterolateral, and posteromedial directions. Intratester reliability (ICC) ranged from 0.85 to 0.89, whereas intertester reliability was nearly perfect, ranging from 0.97 to 1.00 . Before the assessment, four familiarization attempts in each direction were performed. Then, three randomized attempts in each direction were recorded . The average reach in anterior, posterolateral, and posteromedial directions and the sum of the three were saved.(5)

- **VERTICAL JUMP**

the players were made to stand on the side of a wall and reached up with the hand closest to the wall with their feet flat on the ground. The point of the fingertips was marked which is called standing reach (m1). The player was asked to put color powder on their fingertips to mark the wall at the height of their jump. The players were then asked to stand away from the wall and instructed to jump vertically as high as possible in an attempt to touch the wall at the highest point of the jump (m2). The difference in distance between the standing reach height and the jump height was calculated. The best of three attempts scored of vertical jump was recorded.(11)


Approval from institutional ethical committee was taken
60 were selected based on the selection criteria
Randomly assigned using block randomization where Group A (n=20) , Group B (n=20) , Group C (n=20)
Consent form were obtained from all subjects Pre assessment score were taken (Hamstring flexibility – AKET, SRT . Balance – MODIFIEFD SEBT, and Vertical jump)
GROUP A-
Direct MFR – 4 min
3 weeks
GROUP B-
Remote MFR
2 min
3 weeks
GROUP C- Control group
Active Stretching
10 sec

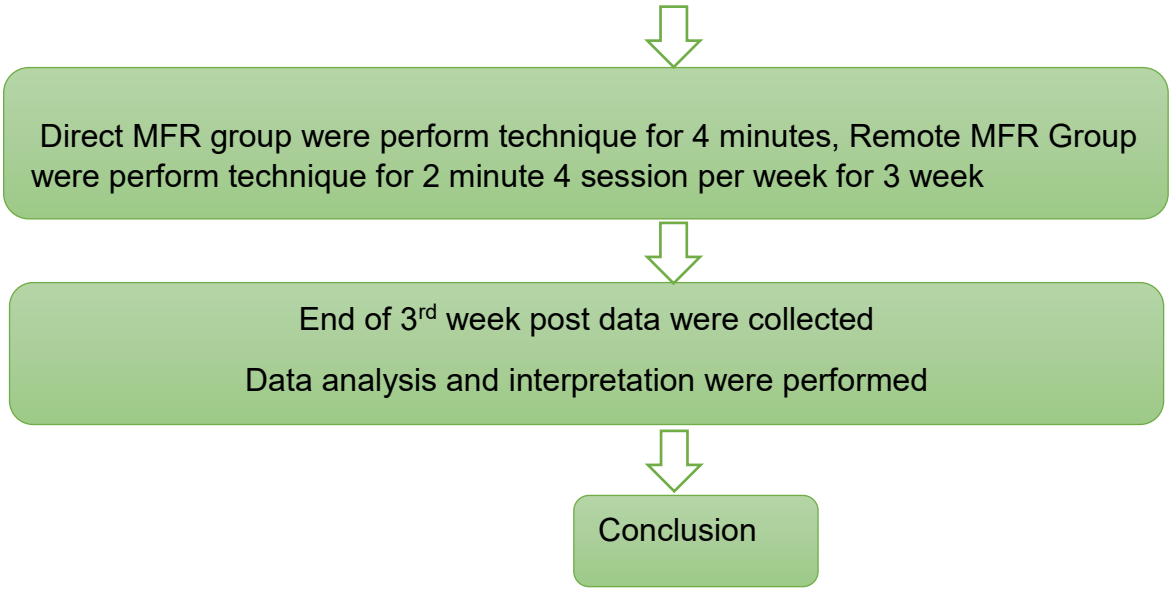


Fig Flow chart of study procedure

INTERVENTION

GROUP A- Direct myofascial Release

- Subjects were positioned prone on a clinical stretcher, while wearing shorts.
- The physiotherapist was placed on one side of the stretcher and used the forearm-elbow segment to perform a friction technique on the posterior region of both thighs, making a longitudinal movement to the muscle fibers from proximal to distal.
- The elbow was flexed at 90° to facilitate the transmission of force to the subject with as little muscular effort as possible. The wrist and hand were in a relaxed position .
- The technique was applied for 90 seconds with a frequency of 1 friction/second for each limb.

GROUP B- Suboccipital Muscle Inhibition technique

- The SMI technique was used as the intervention technique.

- With the patient in the supine position and the eyes closed, the therapist sat behind the subject's head and placed the palms of her hands beneath it, resting the pads of her fingers on the projection of the posterior arch of the atlas.
- The pressure was exerted upward and toward the therapist. The pressure was maintained for 2 minutes until tissue relaxation had been achieved.

GROUP C- Active stretching 10 sec

GROUP	INTERVENTION	TREATMENT PROTOCOL
GROUP A	**Direct MFR**	**Direct MFR**
GROUP B	**SUBOCCIPITAL MUSCLE INHIBITION**	**SUBOCCIPITAL MUSCLE INHIBITION**
GROUP C	**CONTROL**	**Active Stretching**

TABLE 5.1 -TREATMENT PROTOCOL

SAMPLE SIZE ESTIMATION

Sample size calculation was done by using the formula for experimental studies (outcome – balance)

$$n=2k\ SD^2 / d^2$$

where

n= Number of samples

k= Power

SD=Standard Deviation

d = MCID Value

K =10.5

SD= 5.14

d (MCID value)=5.5

$n= 2k * SD^2/d^2$

$2x10.5 x (5.14)^2/(5.5)^2$

=21x0.87=18.27

=20 per group (3 groups are there so total of 60 subject)

STATISTICAL ANALYSIS

Data was analyzed using the statistical package **SPSS 22.0** (SPSS Inc, Chicago,IL), and the level of significance was set at **p<0.05 Descriptive statistics** was performed to assess the Median and IQ of specific groups. The normality of the data was assessed using the **Kolmogorov-Smirnov test which showed BMI AND SEBT R LEG are normally distributed others are not normally distributed. Interferentialstatistics** to find out the difference between groups was done using the **Willcoxon sign X test for not normally distributed variables and paired t-test for the normally distributed outcome,** and analysis between three groups was done using **Kruskal Wallis ANOVA for not normally distributed sample and one-way ANOVA with TUKEY post hoc for normally distributed outcomes** to find out the difference between any two groups.

TABLE 6.1 Median Age Analysis

	MEDIAN	IQ
DMR	23	5.75
SMI	23.5	5.5
CON	22	6

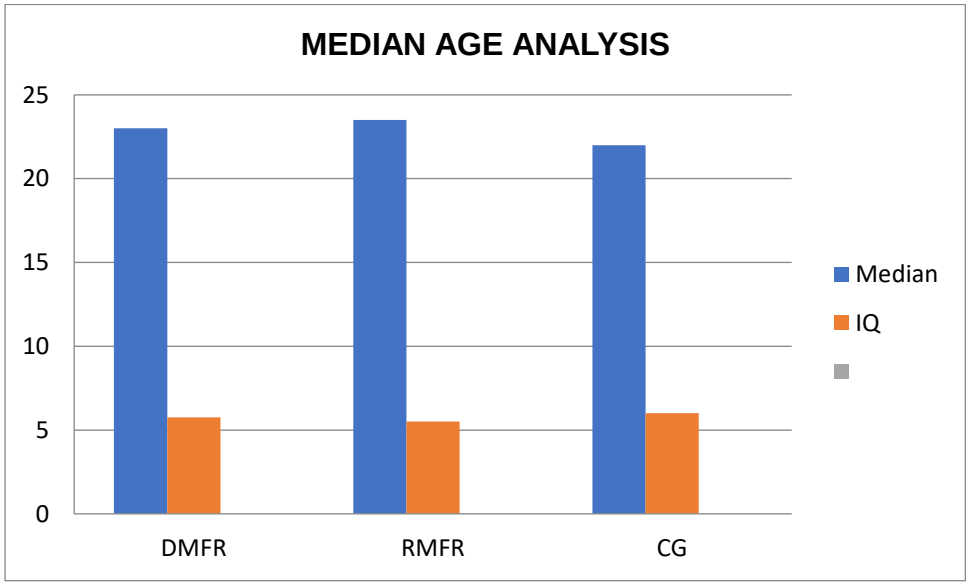


FIG 1.1Graphical presentation of median age

TABLE 6.2 MEAN BMI Analysis

	MEAN	SD
Direct MFR	24.95	4.32
SMI	23.81	4.59
CON	24.38	3.76

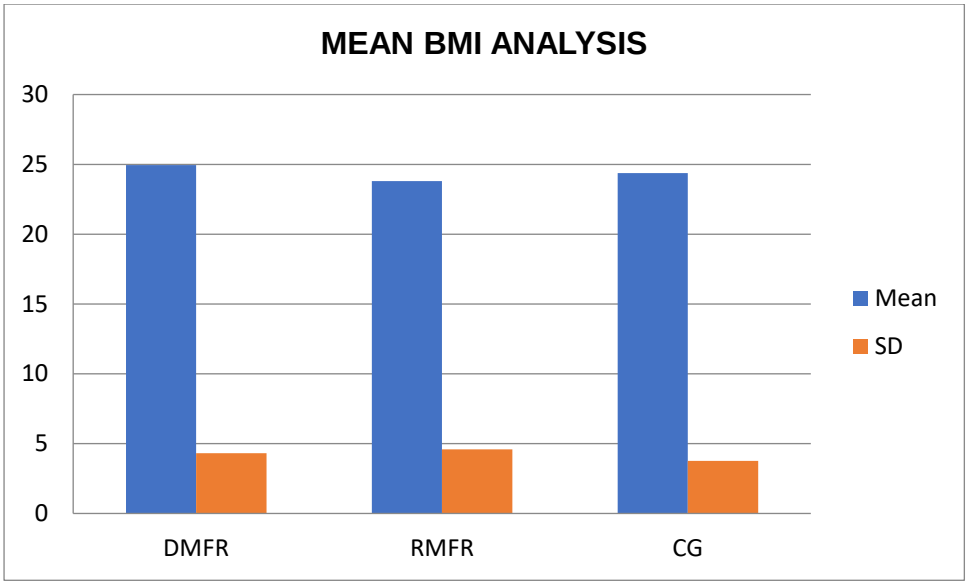


FIG1.2 Graphical presentation of Mean BMI

TABLE – 6.3 MODIFIED SEBT LEFT LEG WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE
Direct MFR	81.5	85	.000	3.5
SMI	74	75.5	.000	1.5
CON	78.5	78	.059	0.5

Modified SEBT test of left leg analysis with Wilcoxson sign test indicates statistically significant difference within the group in Direct MFR group ($p < 0.05$), SMI group ($p<0.05$), CON group ($p<0.05$). The difference in median value was reported was as follows direct MFR>Remote MFR>Control Group.

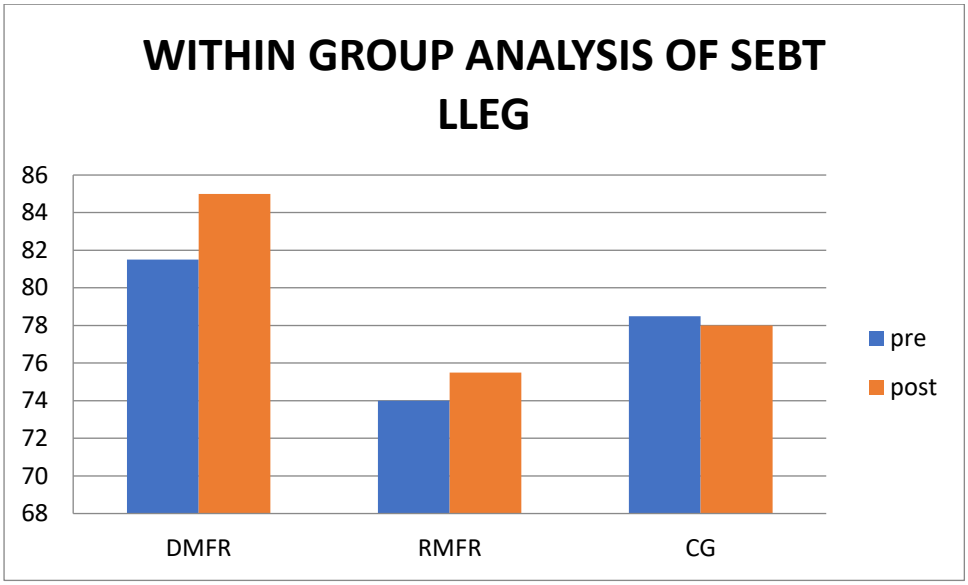


FIG 1.3 Graphical presentation of within group analysis Of SEBT L LEG

TABLE – 6.4 MODIFIED SEBT OF RIGHT LEG WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE
Direct MFR	**80**	**86.20**	**.000**	**6.2**
SMI	**78.8**	**79.9**	**.000**	**1.1**
CON	**79.3**	**79.5**	**0.056**	**0.2**

MSEBT test of right leg analysis with Pair t test indicates statistically significant difference within the group in Direct MFR group ($p < 0.05$), Remote MFR group ($p<0.05$), CON group ($p<0.05$). The difference in median value was reported was as follows Direct MFR>Remote MFR>Control MFR

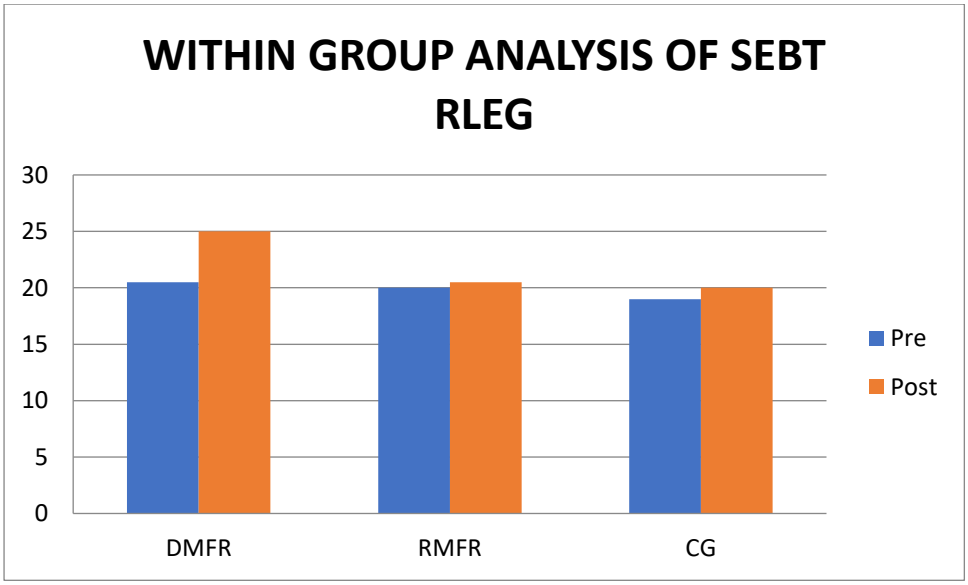


FIG –1.4 Graphical presentation of within group analysis of SEBT R LEG

TABLE-6.5 SIT AND REACH TEST WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE

Direct MFR	**20.5**	**25**	**0.000**	**5.5**
SMI	**20**	**20.5**	**0.000**	**0.5**
CON	**19**	**20**	**0.020**	**1**

SRT with willcoxson sign indicates statistically significant difference within the group in Direct MFR group ($p < 0.05$), Remote MFR group ($p<0.05$), CON group ($p<0.05$). The difference in median value was reported was as follows,Direct MFR >Control>Remote MFR

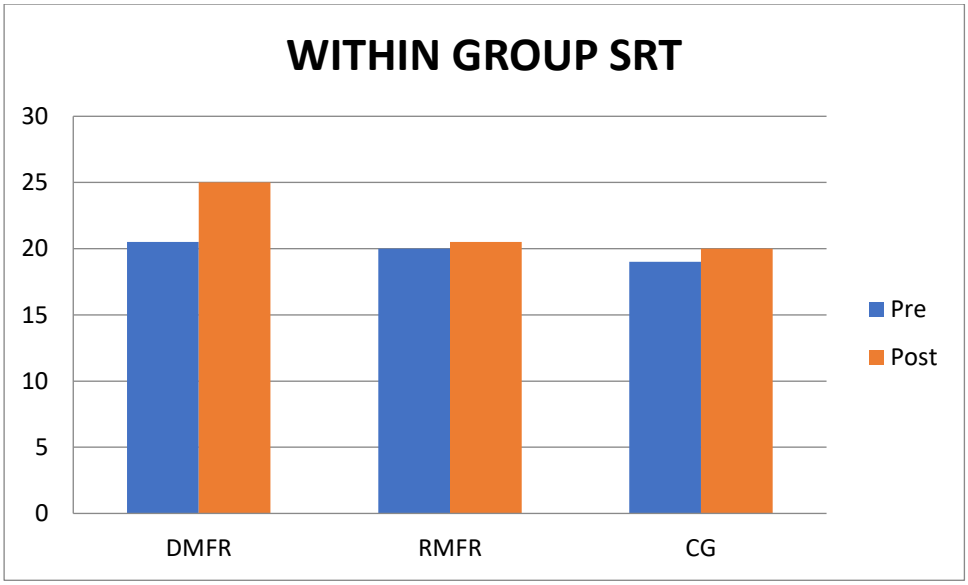


FIG1.5 Graphical presentation of within group analysis of SRT

TABLE 6.6 AKET OF LEFT LEG WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE
Direct MFR	**30**	**35.5**	**0.000**	**5.5**

SMI	**25**	**30**	**0.000**	**5**
CON	**30**	**32.5**	**0.157**	**2.5**

AKET of left leg with willcoxson sign indicates statistically significant difference within the group in Direct MFR group (p <0.05), Remote MFR group (p<0.05), CON group (p<0.05). The difference in median value was reported was as follows,direct > Remote >Control

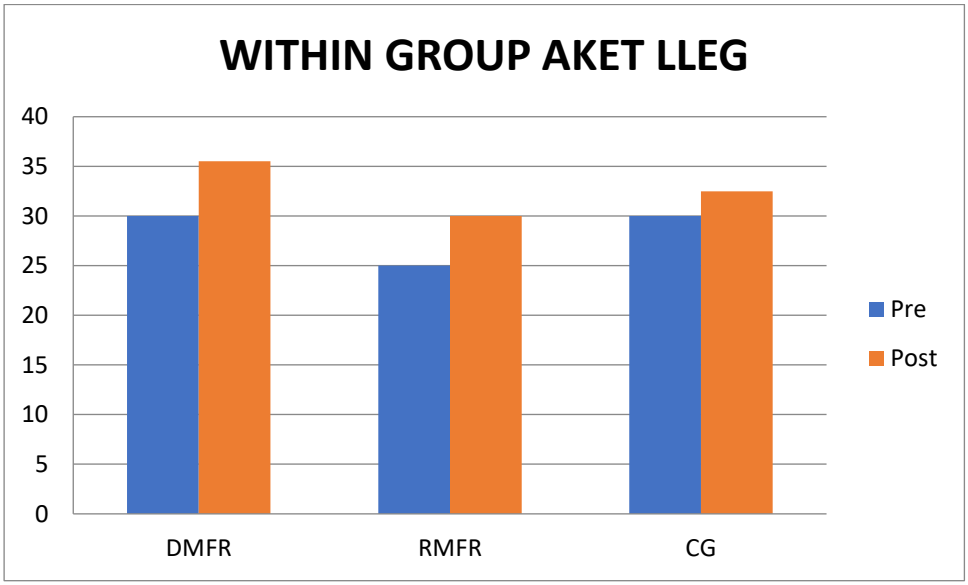


FIG1.6 Graphical presentation of within group analysis of AKET L LEG

TABLE 6.7 AKET OF RIGHT LEG WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE
Direct MFR	**35**	**40**	**0.00**	**5**

SMI	**30**	**35**	**0.00**	**5**
CON	**30**	**30**	**0.317**	**0**

AKET of Right leg analysis with willcoxson sign indicates statistically significant difference within the group in Direct MFR group ($p < 0.05$), Remote MFR group ($p<0.05$), CON group ($p<0.05$). The difference in mean value was reported was as follows Direct MFR= Remote MFR >control

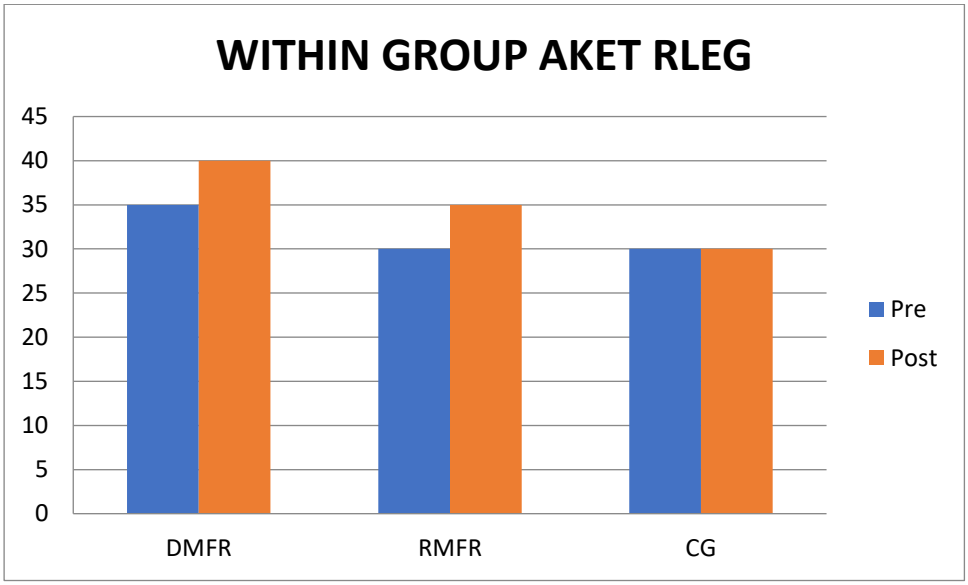


FIG -1.7 Graphical presentation of within group analysis of AKET R LEG

TABLE-6.8 VERTICAL JUMP WITHIN GROUP ANALYSIS

	PRE	POST	P VALUE	MEAN DIFFERENCE

Direct MFR	**25.5**	**30**	**0.001**	**5.5**
SMI	**27**	**29**	**0.001**	**2**
CON	**34.5**	**35.5**	**0.001**	**1**

Vertical jump with Willcoxson sign indicates statistically significant difference within the group in direct MFRT group($p < 0.05$), Remote MFR group ($p<0.05$), CON group ($p<0.05$). The difference in median value was reported was as follows,Direct MFR >Remote >CON

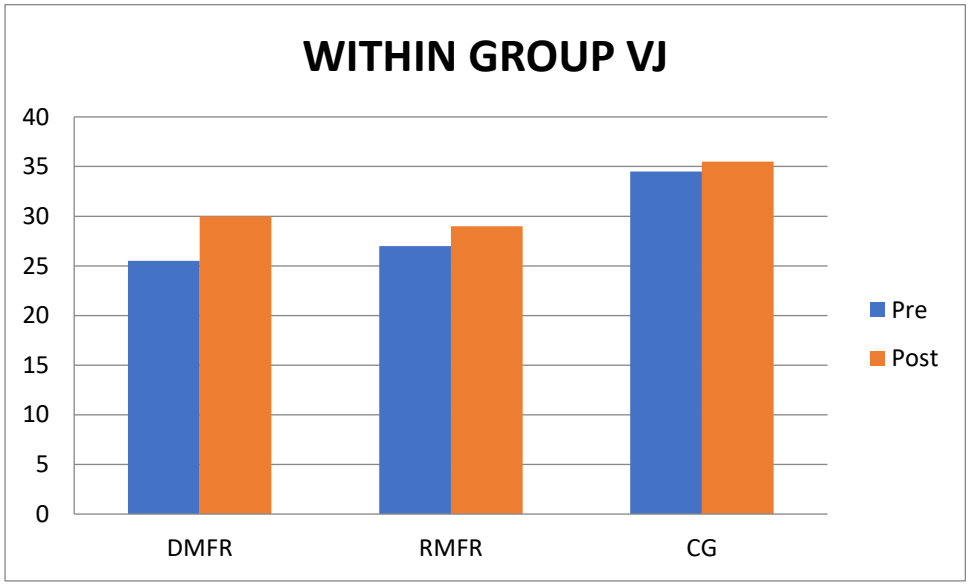


FIG 1.8 Graphical presentation of within group analysis of Vertical jump test

TABLE6.9 Between Group Analysis summary

OUTCOME	GROUPS	MEAN DIFFERENCE	P VALUE

MODIFIED SEBTL	Direct MFR vs Remote MFR	3.60	.000
	Direct MFR vs CON	6.81	.000
	Remote MFR vs CON	3.21	0.001
MODIFIED SEBTR	Direct MFR vs Remote MFR	5.58	0.008
	Direct MFR vs CON	5.005	0.008
	Remote MFR vs CON	5.005	0.000
SRT	Direct MFR vs Remote MFR	4.33	0.000
	Direct MFR vs CON	6.77	0.000
	Remote MFR Vs CON	2.44	0.015
AKET L	Direct MFR vs Remote MFR	1.75	0.79
	Direct MFR vs CON	6.19	0.000
	Remote MFR Vs CON	4.43	0.000
AKET R	Direct MFR vs Remote MFR	2.94	0.003
	Direct MFR vs CON	6.62	0.000
	Remote MFR Vs CON	3.68	0.000
VERTICAL JUMP	Direct MFR vs Remote MFR	4.61	0.00
	Direct MFR vs	6.19	0.00

	CON		
	Remote MFR Vs CON	1.58	0.114

analysis between three groups was done using **Krushalwallis ANOVA for not normally distributed sample and one way anova with TUKEY post hoc for normally distributed outcomes** to find out difference between any two groups.statistically significant difference between Direct MFR vs Remote MFR, vs CON group ($p<0.05$) and statistically significant difference between vs CON ($p>0.05$) on SEBT test left and right , SRT, AKET Left and right and Vertical jump.

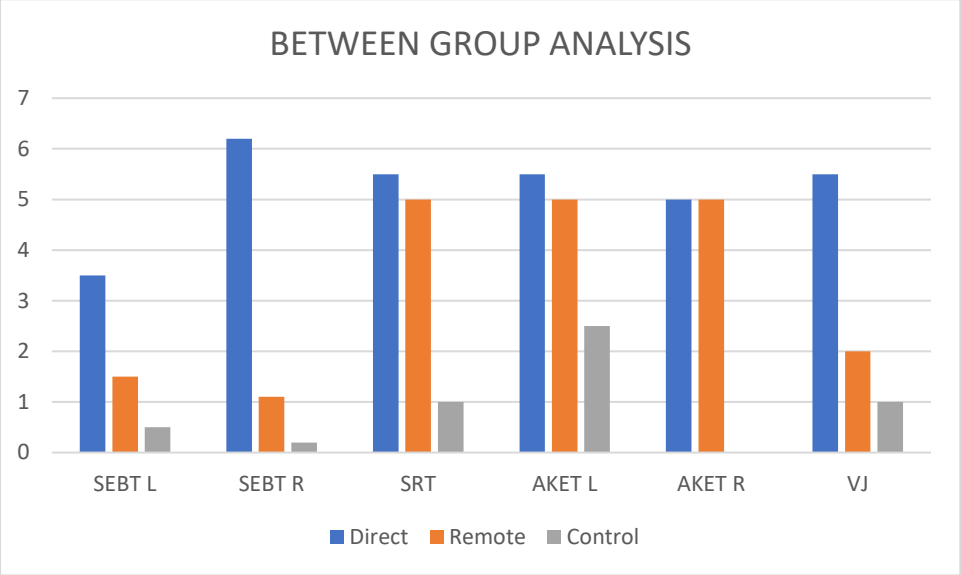


FIG -1.9 Graphical presentation of Between group mean difference analysis of outcome measures

DISCUSSION

The purpose of this study was to compare the effects of direct and remote MFR techniques on collegiate athletes' short hamstrings' flexibility, reach direction, and vertical jump height.

We had predicted that direct MFR would perform better in this trial than remote MFR. The star excursion balancing test was used to assess reach direction, while the vertical jump height test, active knee extension test, and SRT were utilized to assess jump performance and hamstring flexibility.

The results showed that there was no statistically significant difference in the control group for the right and left legs, but there was a statistically significant difference in the direct MFR and the remote MFR groups for the L and R Leg reach directions. For the between-group study of reach direction for the right and left legs, the direct MFR group performed considerably better than the remote MFR group (p 0.05).

The outcome showed that all three groups (Pre & Post) for SRT had statistically significant within group differences.A comparison of the two groups revealed that both the direct and remote MFRs improved more than the control group. However, the direct MFR group improved more than the remote MFR group (p.<0.05).

According to the study, there were statistically significant pre- and post-test differences in the direct MFR and remote MFR groups for AKET, but not in the control group.AKET for the left leg between-group analysis revealed that the direct MFR group was not significantly different from the remote MFR.Direct MFR, however, performed better for the right leg than the group using remote MFR.

There were statistically significant within-group differences (pre & post) for vertical jump height in all groups. Both the direct MFR group and the distant MFR group improved more than the control group, according to a between-groups comparison. When comparing direct to remote, we discovered that direct performed much better than distant for all outcome measures. The direct MFR group is better than Remote MFR group therefore the alternate hypothesis was accepted and null hypothesis was rejected.

The research done by Keisuke Itotani et al. is in line with the improvement of harmstring flexibility by DMFR. Where they found that MFR for hamstrings influences not only the improvement in flexibility but also the improvement in physical performance, they came to the conclusion that MFR of the hamstrings improves physical performance. direct The elastocollagenous complex (integrated collagen and elastin fibers) and the consistency of the ground substance are both impacted by myofascial release. The elastocollagenous complex's tissues are released from stress through increased soft tissue elasticity. The metabolic rate increases as the density and viscosity of the matrix (ground substance) decreases, leading to an improved metabolism and state of health. Fascia that has been compressed, tightened, and twisted can exacerbate and maintain musculoskeletal problems.

Another reason for the increase in how much we can move might be because of the pressure MFR puts on the tissues. This pressure could affect the way our body's sensors feel things, possibly making them less sensitive. This might help reduce discomfort and make it easier to stretch without feeling as much resistance .(12)

Vertical jump

Our study showed significant improvement in vertical jump height in direct mfr group Hamstring muscles are essential for jumping because they help with knee flexion and hip extension during the explosive movement of jumping. A study by Gleim GW et al. showed that In participants with normal hamstring flexibility, the muscle-tendon unit can work optimally, allowing for effective energy storage and release during the jump. However, when hamstring flexibility is reduced (severe or moderate), this could impact the muscle-tendon unit's ability to store and release energy efficiently. As a result, the vertical jump height might be lower because the muscles and tendons aren't working as effectively together.

Tight or restricted hamstrings are more susceptible to strains and injuries during explosive movements like jumping. By releasing tension the risk of muscle strains and related injuries may be reduced.(13)

Reach distance Our study showed significant improvement in distance reach Similarly, Zagyapan et al showed in their study that hamstring shortness causes postural changes that affect balance. The positive correlation between hamstring

tightness and dynamic balance suggests that as hamstring tightness increases, the reach distance decreases. Muscle tightness is one of the most common motor system factors which affect the balance of an individual. In addition, myofascial includes a multitude of sensory nerves related to proprioceptive and mechanical receptors like Golgi receptors or Pacini receptors (Tozzi, 2012). Therefore, the pressure exerted during the myofascial release intervention may stimulate these mechanical receptors and improve the proprioceptive information integrated by the central nervous system to tune the activation level of the motor units Therefore increasing harmstring flexibility improves balance in mSEBT.(14)

Statistically significant improvement in hamstring flexibility, reach direction & jump performance was noted in subjects in Group B (REMOTE MFR).The possible explanation of suboccipital muscle inhibition technique for improving flexibility could be Myofascial chain connection and dural mechanism.The suboccipitals and hamstring musculature are included in the superficial back line. If any tensions arise in that myofascial chain, it will result in hamstring tightness. As, suboccipital muscle and hamstring muscles are included in superficial back line, addressing any of the structures in superficial back line may cause positive effect of entire line itself. Schleip, observed that if the tension of the suboccipital muscle decreases, the length of the hamstring muscles increases. Release of suboccipital muscle fascia allows tension reduction in the knee flexors (hamstring muscles). Schleip, observed that if the tension of the suboccipital muscle decreases, the length of the hamstring muscles increases.Release of suboccipital muscle fascia allows tension reduction in the knee flexors (hamstring muscles).(6)

Significant improvement in the Conventional group but less than in direct & Remote goup Winter et al. Reciprocal inhibition adjusts the contraction of agonist and antagonist muscles to facilitate various movements. The reason for this difference may be the posture of the active stretching group during the stretch. When holding the stretch position the excitatory spinal motor neurons overcome γ inhibitory neuron impulses. In this study, the final knee extension position was held for 10 seconds by subjects in the active stretching group. Consequently, there was a simultaneous contraction of agonist and antagonist muscles without antagonist suppression of the γ impulses. Therefore, the active stretching group did not experience antagonist muscle

relaxation, suggesting that there is a difference in the degree of stretch stimulation.(15)

CONCLUSION

This study has demonstrated that Direct MFR has more effective than Remote MFR and Conventional group is effective in improving hamstring flexibility and jump

performance and better flexibility in healthy younger and middle aged individuals. These results reinforce the importance of Direct as an effective intervention for improving flexibility and athletic performance in collegiate student. Moreover, our study highlights the potential benefits of incorporating manual therapy alongside stretching exercises. Coaches, trainers, and therapists can utilize these findings to design evidence-based flexibility training programs for their athletes, optimizing performance and reducing the risk of injuries.

LIMITATION

This study had few limitations. Smaller sample size, No follow-up was taken post intervention.

Hamstring flexibiilty is a key factor for young players so it could be done in sports players.

FUTURE RECOMMENDATION

Study could be done with large sample size.

Treatment can be given for longer duration with follow up.

CLINICAL IMPLICATION

Both the techniques are effective in improving hamstring flexibility in healthy collegiate subjects. So, sub occipital muscle inhibition technique can be used when the hamstring is injured or when there is severe pain and cannot directly work on hamstring.

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CONSENT FORM

Title of the study – The effectivness of direct versus remote technique on hamstring fklexibilty, star excursion balance test reach distance,vertical jump height in subject with short hamstring: randomized trail

I have been informed by richa shivhare that pursuing MPT (sports) and conducting the above-mentioned study under the guidance of Deepak kumar pradhan , Department of Physiotherapy, , ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE (ABSMARI), BHUBANESWAR.

I have explained to MR/MISS/MRS

the purpose of the research, and the procedure required in the language he/she could understand to the best of my ability.

(Investigator) (Date)

I confirm that Richa shivhare (investigator) has explained to me in a language I can understand, the purpose of the study and the procedure. Therefore, I agree to give my assent for participation as a subject in this study and I will be accountable for the decisions.

(Signature) (Date)

ASSESSMENT FORM

ASSESMENT FORM:

DEMOGRAPHIC DATA:

Name-

Age-

Gender-

Address-

Phone number-

Height –

Weight-

Date of examination-

- Pre test-
- Post test –

GROUP
