https://doi.org/ 10.33472/AFJBS.6.10.2024.142-151

African Journal of Biological Sciences

Research Paper Open Access

Comparing the Efficacy of Direct and Indirect Myofascial Release in Treatment of MechanicalLow Back Pain due to Hamstring Tightness in Professional adults: A Pilot Study

Richa Kashyap [1], Saleem A. Naqvi [2], Madhusudan Tiwari [3], CS Ram [4]

1. Physiotherapy, PhD Scholar, MGPC, Mahatma Gandhi University of Medical Sciences and Technology, Greater Noida., IND 2. Physiotherapy, Professor, HOD (Clinical Services) MGH, MGPC, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, IND 3. Physiotherapy, Principal, MGPC, Mahatma Gandhi University of Medical Sciences and Technology, Jaipur, IND 4. Physiotherapy, Director, I.T.S College of Physiotherapy, Moradnagar, Ghaziabad, IND

Corresponding author: Richa Kashyap , richa.kashyap.20@gmail.com

Article History
Volume 6,Issue 10, Feb 2024
Received:17 Feb 2024
Accepted : 01 Apr 2024
doi: 10.33472/AFJBS.6.10.2024.142-151

Abstract

Background:

Mechanical Low back pain (LBP) due to hamstring tightness is a common condition affecting millions of people worldwide. Hamstring tightness is a common finding in professional adults in the age group of 18-35 years which disturbs the spinal curvature and alters the lumbo-pelvic rhythm becoming a cause
of mechanical back pain.Their sitting job profile and sedentary lifestyle being a contributory factor towards it. There is growing use of soft tissue manipulations techniques like myofascial release (MFR) among clinicians to treat hamstring tightness. Recent advances in myofascial release show that it can be administered in two ways, directly on the affected area and indirectly to some remote area. Thus, this study aimed to compare the efficacy of Direct and Indirect myofascial release in managing mechanical LBP due to hamstring tightness among professional adults.

Method:

This is a single blinded , pilot study involving 30 professional adults aged 18-35 years with mild to moderate LBP. Participants were divided into Direct and Indirect MFR groups .Direct MFR was given to the Hamstring muscle area and Indirect MFR to the suboccipital area. Both the techniques were applied for 3 weeks and the outcome measures included Visual Analogue Scale (VAS) for Pain, Range of motion (ROM) of knee extension for mobility and Lower Extremity Functional Scale (LEFS) score for function. Statistical analysis compared the baseline day 1 pretest data with post-test 21st day data.

Results:

The data analysis was performed using SPSS 26 software. The data of VAS and ROM was normally distributed so paired t-test was performed to compare the pre test and post test VAS and ROM scores of both groups. Wilcoxon signed-rank test was used to compare the intragroup differences of LEFS scores as the data was not normal. Unpaired t test was used to compare the difference in VAS and ROM score in between the groups.The Mann-Whitney U test was used to compare the inter-group differences in LEFS scores in Group A and Group B. Total percentage improvement in VAS score after 3 weeks in Group A was 59
% and in Group B was 45%. Total improvement in ROM in Group A was 8.05%, and in Group B it was 4.8%and total improvement in functional for Group A was 12.78%, and in Group B was 11.8%.

Conclusion:

The study suggests that both techniques Direct and Indirect MFR are effective in treating mechanical back pain due to hamstring tightness. However, Direct MFR is a more effective approach in reducing pain, improving range and function in professional adults.

Keywords:Manual therapy, remote MFR, myofascial release technique, hamstring tightness, mechanical low back pain.

Introduction

The most common pain complaint reported is back discomfort. In 2020, there were over half a billion cases of low back pain (LBP) worldwide, making it the largest cause of years lived with disability (YLD) internationally. Globally, 619 million persons reported having low back pain in 2020 and by 2050, that number is expected to rise to 843 million [1]. There is a growing incidence of LBP cases in young adults with males involved most commonly in the age group 21-40 years affecting 38.6 % population. Females were involved mostly in the age 30-40 years affecting 38.1 % of population [2]. M.E. Lachman, in Handbook of Midlife development, 2002 stated that adulthood can be divided into three categories, young (18-39), middle (40-54) and late (55-60) [3]. It is also seen that young adults being more enthusiastic towards building their career work very sincerely without taking breaks and suffer from back discomfort. Thus, It
is the most frequent cause of doctor visit affecting both men and women equally. A meta-analysis on the Indian population was conducted and concluded that the prevalence of LBP was 48% in a year 2022 [4].

Any sort of back pain that results from inappropriate stress and strain being applied to the muscles of the pelvic girdle and vertebral column is referred as mechanical back pain. Adaptive shortening of two jointmuscle like hamstring is seen very commonly due prolong hours of sitting and sedentary lifestyle.
Professional adults who have sitting job profile of more than 6-8 hours and have inactive lifestyle are prone to such musculoskeletal discomfort [5]. Clinical findings reveal that hamstring tightness leads the hip and pelvis to rotate backward, causing flattening of the lumbar spine and hence changing the sagittal plane curvature. This also alters the lumbo-pelvic rhythm thus disturbing the bending biomechanics of spine hence becoming the cause of low back pain in most professional adults [6].
Various physical therapy techniques are used for treating shortening of hamstring muscle which is a cure for mechanical back pain. These techniques include proprioceptive neuromuscular facilitation (PNF), Static stretching, muscle energy technique (MET) and myofascial release (MFR) technique. The aim of this study is to test the efficacy of the Direct myofascial release versus Indirect myofascial release for reducing pain, improving range and function in professional adults suffering from mechanicalback pain due to Hamstring tightness. Researchers and clinicians can now directly target the underlying pathology and provide more comprehensive and successful care to patients with low back pain by having a better understanding of the possible benefits of myofascial release technique.

Materials And Methods

Study overview:

This is a pretest post-test type single blinded (participants were blinded), single center pilot study.

Ethical considerations:

The study commenced after obtaining the approval from Institutional Ethical committee (270/PI/16/01/2023). We recruited a convenience sample 30 subjects in the age group of 18-35 years suffering from mechanical low back pain who were referred to Department of Physiotherapy at Prakash hospital in Greater Noida. After screening and clinical examination eligible participants were invited to participate and were required to sign an institutionally approved informed consent form where each participant was briefed about the procedure, the potential risks involved, the benefits of the study and no financial burden was laid on any subject during the course of the study. The willingness to participate in the study was consensual.The subjects of the two treatment groups formed were treated at different timings of the day and they had no interaction with each other. Only the therapist administrating the technique to the subject was aware about the treatment approach used. This maintained the single Blinding of the participants.

Study Criteria:

The study included subjects of both genders in the age group of 18-35 years(justified in the Introduction that the problem exists mainly in that age group as supported by studies in reference). The subjects should have a sitting job profile for atleast 6-8 hours per day and the cause of low back pain was presence of hamstring tightness which was concluded by Positive Active Knee extension test [7].
The study excluded subjects with any history of trauma in the past one year as it lead to reduced activity of lower limb whichfurther led to muscle shortening. Any associated cause of back pain like prolapsed intervertebral disc (PIVD), spondylosis, or spondylolisthesis, any pathological condition around the spine (e.g., tuberculosis, osteomyelitis), any pre-diagnosed case of tumor, any inflammatory condition such as Ankylosing spondylitis or Rheumatoid arthritis were also excluded. Also, presence of anygeneral medical condition such as diabetes, hypertension, hyperthyroidism were excluded as these conditions lead to increased sensitivity to pain and finally, subjects who are a part of any fitness program such as yoga, aerobics or dance like zumba were excluded as the efficacy of the treatment technique could not be truely concluded

Randomization and Allocation of Participants

Participants who met the inclusion criteria and were screened for exclusion were assigned to one of the treatment groups in a 1:1 ratio. A random number table, generated by statistician was used to allocate participants to their respective groups. After that, an allocation plan was carefully recorded in a step-by-step manner and sealed in opaque envelopes. An impartial person unaffiliated with the study was in charge of opening the envelope during the allocation process to reveal the designated group. Participants were assigned to the Group A-Direct MFR group (n=15) or Group B-Indirect MFR group (n=15) based on an impartial process.

Study Procedure:

Baseline measures for outcome measures included pain measurement through Visual Analogue Scale (VAS) score, Mobility measurement through Range of Motion (ROM) measurement of Knee extension range by Goniometer [8] and Function measurement by Lower Extremity Function Scale (LEFS) score [9].
Group A was given hot packs for 15 minutes in the lower back region and then the myofascial release technique directly on hamstring muscle [8-10]. The cross-hand technique (Figure *1*) was used for the samegroup, where the hands anchored the tissue and pressure was applied to take the tissue slack initially and then maintain a slow steady stretch in the longitudinal direction. The technique was applied for 3 minutes per set with a rest period of 1 minute in three sets. The total time of application of technique was 15 minutes, and this was then followed by application of cold pack for 10-15 on hamsting muscle [11]. The whole process was repeated 3 times a week [12].

FIGURE 1: Cross-hand technique for Direct Myofascial release on Hamstring

Group B was given hot pack for 15 minutes in the lower back region first, and then Indirect myofascial release [13-15] technique was used in suboccipital region (Figure *2*) followed by cold pack application to the same region. The VAS score, ROM of knee extension, and LEFS score, readings were recorded again on 21st day after the intervention.

FIGURE 2: Indirect Myofascial release

Assessment.

Baseline measures for outcome measures included pain measurement through Visual Analogue Scale (VAS) score, Mobility measurement through Range of Motion (ROM) measurement of Knee extension range by Goniometer [16] and Function measurement by Lower Extremity Function Scale (LEFS) score [17].

The VAS score, ROM of knee extension, and LEFS score, readings were again recorded on 21st day after the intervention of both the techniques in each group.

The primary investigator who performed the technique also collected the data. The consolidated standard of reporting the trials (CONSORT) flow chart, presented in Figure *3*, provides a visual representation of participant enrollment and progression throughout the study, showing their inclusion, allocation, follow-upand analysis.

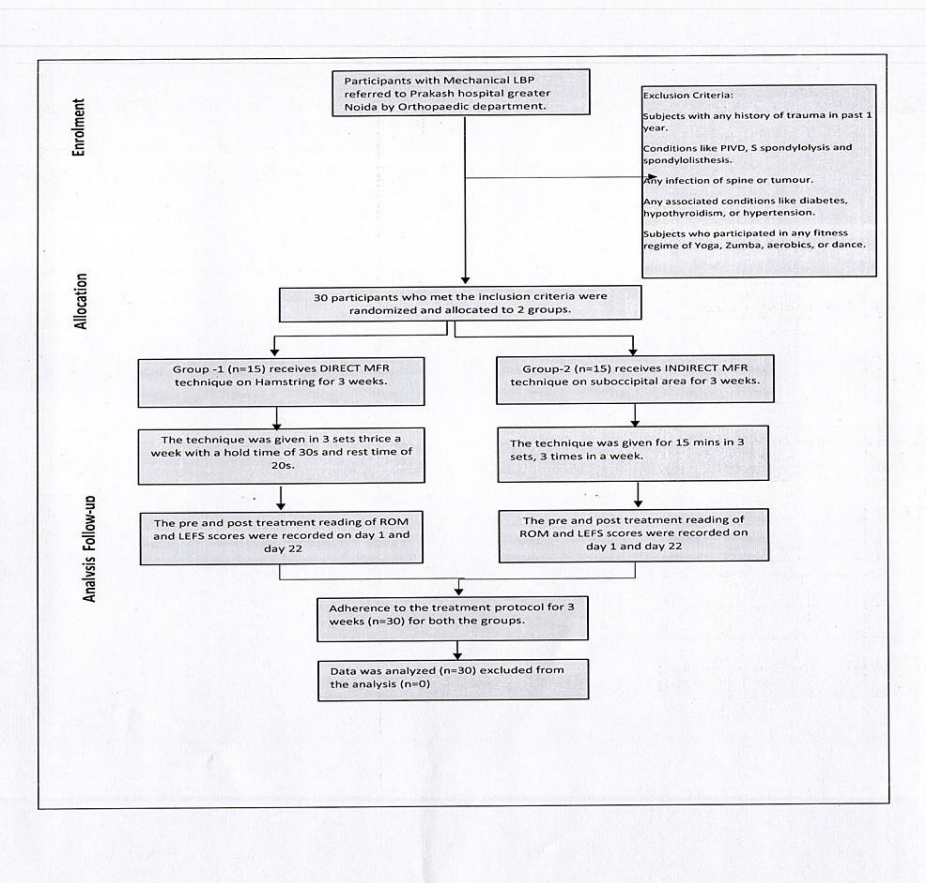

FIGURE 3: CONSORT Flow Chart

CONSORT- Consolidated Standard Of Reporting Trials

MFR- Myofascial Release

Outcome measures:

In the complete study the outcome measures included pain measurement through Visual Analogue Scale (VAS) score, mobility measurement through Range of Motion (ROM) measurement of knee extension by Goniometer and function measurement by Lower Extremity Function Scale (LEFS) score.

Sample size Calculation

L.M. Conelly in 2008 suggested that sample size of Pilot study should be 10 percent of the larger working population [18]. So if the larger population for experimental study is 300, 30 should be the sample size of Pilot study.

Statistical Analysis:

The data analysis was performed using SPSS 26 software by a biostatistician who was blinded to the treatment group assignments. Mean differences at a 95%confidence interval was reported to convey the data. The normality of the data was tested by Kolmogorov-Smirnov test and Shapiro Wilk test and based on the distribution of sample a parametric paired t-test was performed to compare the pretest and post-test VAS and ROM scores of both groups as the data was normally distributed. Non parametric Wilcoxon sign rank test was used to compare the intra-group differences of LEFS scores as the data was not normal. TheUnpaired t test was used to compare the inter-group differences for VAS and ROM scores and Man Whitney U test was used to compare the LEFS scores between Group A and Group B.

Results

As shown in the table *1*, the Groups were matched after the allocation process before starting either technique and assured that there was no significant statistical difference between age and gender distribution along with Goniometer readings of Active Knee Extension-AKE test performed on both the extremities and Lower Extremity Functional Scale score.

Variables	Group-A (DIRECT MFR)	Group-B (INDIRECT MFR)	p value
Mean Age	27.85 ± 5.7	27.45 ± 5.78	0.42
Male	8 (53.3%)	9 (60%)	0.3
Female	7 (46.7%)	6 (40%)	0.316
Mean Rt AKE ROM	140.8 ± 5.4	138.75 ± 4.8	0.30
Mean Lt AKE ROM	138.6 ± 4.6	139 ± 5.2	0.003
Mean LEFS score	65.98 ± 6.3	66.19 ± 4.5	0.003

TABLE 1: The mean and standard deviations of demographics (age, gender,Rt AKE ROM,Lt AKE ROM, LEFS score)

AKE ROM- Active Knee Extension Range of Motion

Interpretation of Visual Analogue Scale (VAS) Score

There were 13 females and 17 males included in the study. Matching of the groups for mean age, gender distribution, mean left AKE score, mean Right leg AKE score and mean LEFS score was done before starting the treatment.

VAS	PRE (Mean and SD)	POST (Mean and SD)	t	p
GROUP A (Direct MFR)	5.000 ± .756	2.066 ± 1.791	8.513	0.000
GROUP B (Indirect MFR)	7.333 ± 1.799	3.800 ± 2.274	9.390	0.000

TABLE 2: Within group variation in Mean and Standard deviation in Pretest and Post-test VAS score

VAS- Visual Analogue Scale.

MFR- Myofascial release

SD- Standard deviation

The mean VAS Scores of both groups are presented in Table *2*. Pretest score on day 1 and Post-intervention Scores on 21st day to monitor improvement at the end of sessions showed a significant difference in the pretest and post test values of both the groups (t = 8.513and 9.39) and p values less than 0.05 demonstrating that both techniques Direct MFR and Indirect MFR are effective in treating hamstring tightness and providing pain relief for low back pain.

VAS	GROUP A (Direct MFR)	GROUP B (Indirect MFR)	t	
PRETEST VAS SCORE	5.000 ± .756	7.333 ± 1.799	-4.0	
POST-TEST VAS SCORE	2.066 ± 1.791	3.800 ± 2.274	-2.319	

TABLE 3: BETWEEN GROUP COMPARISON OF VAS SCORES

VAS- Visual analogue scale

MFR- Myofascial release.

The table *3* shows the results of between group analysis in which unpaired T test was done to compare the efficacy of treatment of both the techniques show a significant difference in improvement between the groups (t value= -4.63 and -2.319) and p value than 0.05 suggesting that Direct MFR is better than Indirect MFR in treating hamstring tightness causing mechanical back pain.

Interpretation of Range of Motion (ROM) Scores

	Pretest ROM score day 1 (Mean and SD)	Post-test ROM score day 21 (Mean and SD)		
Group A (Direct MFR)	140.133 ± 7.059	152.400 ± 5.234		
Group B (Indirect MFR)	139.800 ± 5.387	146.866 ± 5.249		

TABLE 4: Within group comparison of Mean and Standard deviation of pretest and post-test values.

ROM- Range of motion

MFR- Myofascial release

SD- Standard deviation

Table *4* shows Within-group analysis of ROM scores of baseline value of ROM on day 1 (140.133±7.059)and post-intervention score on the 21st day (152.40 ± 5.23) respectively for Group A gave statistically
significant p values of less than 0.001. A comparison of baseline values of Group B (139.80 ± 5.38) with post- intervention on the 21st day (146.86 ± 5.24) respectively gave statistically significant p values of less than
0.001. It suggests that both the techniques are effective in improving the range of motion and thus treatinghamstring tightness causing low back pain.

	GROUP A (Direct MFR)	GROUP B (Indirect MFR)		
PRETEST ROM SCORE	140.133 ± 7.059	139.800 ± 5.387		
POST-TEST ROM SCORE	152.400 ± 5.234	146.866 ± 5.249		

TABLE 5: Comparison of ROM scores between the groups.

ROM- Range of Motion

MFR- Myofascial release

Table *5* shows Between group analysis of Range of motion scores performed by using unpaired t test. This compares the efficacy of the two treatment approaches and concludes that significant difference exists with t values = 0.145 and 2.891 respectively and p value less than 0.01 suggesting Direct MFR is better than Indirect MFR in treating hamstring tightness causing mechanical low back pain.

Interpretation of Lower Extremity Functional Scale (LEFS) Scores

	Pretest LEFS score Day 1 (Mean and SD)	Post-test LEFS score Day 21 (Mean and SD)		
Group A (Direct MFR)	68.533 ± 3.502	78.666 ± 1.397		
Group B (Indirect MFR)	67.733 ± 3.594	76.800 ± 2.512		

TABLE 6: Within group Pretest and Post-test analysis of LEFS score.

LEFS- Lower extremity functional score.

MFR- Myofascial release

SD- Standard deviation.

Within-group analysis done by Wilcoxon sign rank test for LEFS scores shows a comparison of baseline values of LEFS score with post-interventions on 21st day for Group A gave statistically significant p value of less than 0.001 and an overall Improvement of 12.78% .A comparison of baseline values of LEFS scores of Group B with post-interventions on the 21st day respectively gave statistically significant p value of less than 0.001 with an overall improvement of 11.8% as shown in Table *6*. The results suggest that both the techniques are almost equally effective in improving function and treating hamstring tightness causing mechanical low back pain.

	GROUP A (Direct MFR)	GROUP B (Indirect MFR)		
PRETEST DAY 1 LEFS SCORE	68.533 ± 3.502	67.733 ± 3.594		
POST-TEST DAY 21ST LEFS SCORE	78.666 ± 1.397	76.800 ± 2.512		

TABLE 7: Comparison of LEFS scores of both the techniques.

LEFS- Lower extremity functional score

MFR- Myofascial release

Table *7* shows between group analysis performed by Man Whitney U test showed difference with z value - 0.521, -2.138 for two groups respectively and p value less than 0.01. This suggests that Direct MFR is a better than Indirect MFR to improve function and treat hamstring tightness leading to mechanical back pain.

Discussion

The goal of this study was to assess the impact of myofascial release on professional adults suffering from mechanical back pain caused by tight hamstrings.The study is a significant addition to the existing knowledge regarding the array of treatment approaches available to address the problem,shedding light on potentially more efficient intervention for this widespread condition.

One of the intriguing aspects of our study is the direct comparison of the two techniques fills the gap in literature as there has been limited research directly comparing the two techniques. Our study provides valuable insights into designing an appropriate treatment plan for such patients.The rationale behind superior outcome observed in direct myofascial release technique in improving Pain, ROM and functional outcome is that hamstring muscle serves as the biomechanical link between femur,pelvis and vertebral column. Direct MFR technique corrects the biomechanical derrangement that occurs due to hamstring tightness thuus curing the problem.

M.S. Ajimsha et al. conducted a systematic review of randomized control trials and concluded that the effectiveness of MFR was mixed in both quality and results. Most of the results were encouraging, particularly the recently published articles. MFR is emerging as a technique that has tremendous potential in improving pain management and the functional limitations associated with mechanical back discomfort and hamstring tightness [19] as mentioned in the above study.

Binsu Daniel et al. conducted a study on 80 nursing professionals in the age group of 20-40 years old who suffer from chronic back pain. The subjects were randomly divided into two groups: an MFR group and a specific back exercises group. The results of the study concluded there is greater improvement in McGillPain Questionnaire and Quebec back pain disability scale scores in the MFR group after 26 sessions of treatment throughout a period of eight weeks; thus concluding that MFR technique is better than back exercises in treating back pain [20] similar to this research.

Bent Harper et al. conducted a study on 102 participants with low back pain. The subjects were divided into two groups: Fascial manipulation and standard physical therapy. It was concluded that the Fascial manipulation group offered better improvement in pain management measured by Numerical Pain rating scale and functional disability using Oswestry disability index than the standard physical therapy group [21].

According to Barnes who was the prime educator of MFR technique said that MFR helped to restore the fascia's original length by lengthening, softening, and making it more malleable. As a result, increasing joint ROM and flexibility supports the current study. The glide of fascial tissue is increased as the viscosity of the ground substance changes from a more solid to a gel state. Specifically, the pressures generated by MFR will cause heat, improve blood flow to the impacted areas, cause metabolic waste to be drained from the body via lymphatic drainage, and realign fascial planes.

Joshi DG et al in 2018 did a research on and concluded that Indirect MFR to Suboccipital or Plantar region gave better results in treating hamstring flexibility than static stretching. In a randomized control trial on 8%subjects, the treatment was given for seven sessions over ten days and the variables measured were Sit-To- Reach test, thus manifesting the efficacy of Indirect MFR technique [22]. This explains the selection of Indirect MFR as one of the ideal therapeutic techniques that were used in the above study.

Limitations

The limitations of our investigation must be acknowledged. No follow-up was included to evaluate the treatment's long-term efficacy. The age range of participants in our single-blind study, which was limited to those between the ages of 18 and 35 must be taken into account as it may have an impact on how broadly applicable the findings are to other age groups. Furthermore, non-examination of variables such as BMI, food habits, and socioeconomic status in the study is a concern. The observed results may be impacted by these omissions, which have the potential to introduce confounding errors. In order to overcome these constraints, future studies must include a participant selection approach that is more inclusive, a broad age group, and a follow-up strategy.

Conclusions

In conclusion,the results of the study suggest that Direct MFR on hamstring is better than Indirect MFR on suboccipital muscle in treating mechanical back pain due to hamstring tightness in professional
adults. Clinicians should consider incorporating this technique for pain reduction, improved muscle flexibility, and enhanced functional ability. Further research is warranted to work on the limitations such as long-term effectiveness on various age groups considering all variables. Thus, our study helps us to determine the most effective treatment procedure in manual therapy which helps in treatment of mechanical back pain due to hamstring tightness.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. Institutional Ethical committee, Prakash Institute issued approval 270/PI/16/01/2023. Human subjects: Consent was obtained or waived by all participants in this study. The Institutional Ethical Committee at Prakash Institute issued approval to Richa Kashyap, Dept. of Physiotherapy, Prakash Institute of Physiotherapy Rehabilitation & Allied Medical Sciences (run by Gautam Budh Health Care Foundation), Plot No-9A, Pocket-P2, Omega-1, Builders Area, Greater Noida-201308; Ph.: 0120-4279261, 9810532534; Fax: 01204279260. Under guidance of Dr. Salim Akhtar Nagvi, professor and HOD clinical services, MGUMST, Jaipur; e-mail: prakashinstitute@gmail.com, directorprakash05@gmail.com; website: www.prakashinstitute.edu.in. Dear Richa Kashyap, Dept. of Physiotherapy, MGUMST, Jaipur, Rajasthan. Subject: Controlled intervention to compare the efficacy of direct and remote MFR in treatment of mechanical low back pain due to hamstring tightness in professional young adults. Your letter of permission to conduct the above-mentioned study was reviewed and discussed in the meeting of the Institutional Ethical Committee held on l6 January 2023. The
following members were present in the meeting: Professor K.V.S. Chaudhary, Principal, Nursing Department; Professor Priyanka Sukrawal, Vice-Principal, Nursing Department; Professor Neelam Chaudhary, Nursing Department; Associate Professor Prerna Bhandari, Nursing Department; Professor Priyadarshani Bhat, Department of Physiotherapy; Assistant Professor Pooja Sharma, Department of Physiotherapy; Assistant Professor Garima Pant, Nursing Department; Assistant Professor Sarika Verma, Nursing Department. Thecommittee approves the above-mentioned study. The committee fee of IEC was exempted. It is hereby certified that the investigator or their representative was not present in the decision-making procedure or discussion. The ethics committee expects to be informed about the following: The progress of the study andthe completion of the study. In case of any deviation, default, or any unlawful activity, your study will be discontinued under intimation to INC, IAP, DCGI-New Delhi Principal, Prakash Institute of Physiotherapy, Rehabilitation and Allied Medical Sciences. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any
organizations that might have an interest in the submitted work. **Other relationships:** All authors havedeclared that there are no other relationships or activities that could appear to have influenced the submitted work.

Acknowledgements

We are grateful to the chairman and Director of the Prakash Institute and Hospital for providing us with the permission to conduct this research in their institution, and we are also thankful to the subjects who participated in the study without any hesitation. We would like to thank the medical and research staff for their support and assistance throughout the study.

References

1. Hoy D, Brooks P, Blyth F, et al.: The epidemiology of low back pain. Best Practice & Research Clinical Rheumatology. 2010, 24:769-781. 10.1016/j.berh.2010.10.002
2. P Ferran,B Federico: Prevalence of Low Back Pain and Its Effect on Health-Related Quality of Life in Adolescents. Archives of Pediatric Adolescence Medicine.. 2009, 163:65-71. 10.1001/archpediatrics.2008.512
3. ME Lachman: Handbook of Midlife Development . John Wiley and sons, Newyork; 2002.
4. Shetty, GM, Jain S, et al.: Prevalence of low back pain in India: A systematic review and meta-analysis .Work.. 2022, 73(2):429-452. 10.3233/WOR-205300
5. A Huma, M Pakiza, A Ramsha: Correlation of Hamstring Tightness with Balance and mobility in Young adults.. Pakistan Journal of Medical and Health Sciences. 2023, 17: 10.53350/pjmhs2023173295
6. G Penny, K Michele, A. Raya: Hamstring Muscles: An Overview of Anatomy, Biomechanics and Function, Injury Etiology, Treatment, and Prevention. Critical Reviews™ in Physical and Rehabilitation Medicine. 1997, 9:191-203. 10.1615/CritRevPhysRehabilMed.v9.i3-4.10
7. Shamsi M, Mirzaei M, Khabiri SS: Universal goniometer and electro-goniometer intra-examiner reliability in measuring the knee range of motion during active knee extension test in patients with chronic low back
pain with short hamstring muscle . BMC sports science Medicine and Rehabilitation. 2019, 11: 4:019-0226. 10.1186/s13102-019-0116-x
8. Gajdosik R, Lusin G: Hamstring muscle tightness. Reliability of an active-knee-extension test . Physio Therapy. 1983, 63(7):1085-1090. 10.1093/ptj/63.7.1085
9. Warren AJ, LaCross Z, Volberding JL, et al.: Acute outcomes of myofascial decompression (cupping therapy)compared to self-myofascial release on hamstring pathology after a single treatment. Int J sports physio therapy. 2020, 15(4):579-592.
10. Patel G, Bathia K, Kanase SB, et al.: Effectiveness of self myofascial release, static stretching and neural tissue mobilization on hamstring flexibility in athletes. Indian Journal of Public Health Research. 2019, 10 (6):0976-5506.
11. Tikhile PJ, Bele AW: A Protocol on Effect of Cryotherapy and Myofascial release Technique in Calf Muscle Spasticity of Spastic Diplegic Cerebral Palsy Children.. Indian Journal of Forensic Medicine & Toxicology.April-June 2021, 15:587-591. 10.37506/ijfmt.v15i2.14374
12. Patel K, Doshi H, Shah H: TO COMPARE THE EFFECTIVENESS OF MFR VERSUS STRETCHING OF POSTERIOR MUSCLES OF LOWER LIMB ALONG WITH ULTRASOUND THERAPY IN CASE OF PLANTAR FASCIITIS."- THE COMPARATIVE STUDY.. International Journal of Research and Analytical Reviews (IJRAR). 2019, June, 6:430-435.
13. Paolini, J. : Review of Myofascial Release as an Effective Massage Therapy Technique . International Journalof Athletic Therapy Today. 2009, 14:30-34. 10.1123/att.14.5.30
14. Tamartash H, Bahrpeyma F, Dizaji MM: The effect of remote myofascial release on chronic nonspecific lowback pain with hamstrings tightness. Journal of Sports and rehabilitation. 2023, 32(5):549-556. 10.1123/jsr.2022-0141
15. Dhingani M, Mody V: Short term effects of remote myofascial release versus Mulligan's bent leg raise on hamstring and lumbar spine flexibility in college going students: An experimental study. Indian Journal of Physiotherapy & Occupational therapy. 2022, 16(2):10.37506/ijpot.v16i2.18041
16. Ahmed AS, Padhy GK: Effectiveness of myofascial release in increasing hamstring flexibility . BIJSSHR. 2023,2:1-6. 10.54646/bijsshr.017
17. Liang, H.-W. M., Hou, W.-H. M., & Chang, K.-S. M. : Application of the Modified Lower Extremity Functional
Scale in Low Back Pain. Spine. 2013, 38(23):2043-2048. 10.1097/BRS.0b013e3182a826e8
18. L.M.Conelly: Pilot studies. Medsurg Nursing; Pitman . Dec 2008, 17:411-2..
19. Ajimsha MS, Al-Mudahka NR, Al-Madzhar JA: Effectiveness of myofascial release: Systematic review ofrandomized controlled trials. Journal of Bodywork and Movement Therapies. 2015, 19(1):102-112. 10.1016/j.jbmt.2014.06.001
20. Ajimsha MS, Daniel B, Chithra S: Effectiveness of myofascial release in the management of chronic low back pain in nursing professionals. Journal of Bodywork and Movement Therapies. 2014, 18(2):273-281. 10.1016/j.jbmt.2013.05.007
21. Harper B, Steinbeck L, Aron A: Fascial manipulation vs. standard physical therapy practice for low back pain diagnoses: A pragmatic study. Journal of Bodywork and Movement Therapies. 2019, 23(1):115-121. 10.1016/j.jbmt.2018.10.007
22. Joshi DG, Balthillaya G, Prabhu A: Effect of remote myofascial release on hamstring flexibility in asymptomatic individuals—A randomized clinical trial. Journal of Body work and Movement therapy. 2018,22(3):832-837. 10.1016/j.jbmt.2018.01.008