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The effect of myofascial release in hamstring versus iliotibial band tightness in knee osteoarthritis patients having functional disability - A comparative study

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Abstract

Background: Knee osteoarthritis is common degenerative joint disease brought on by wear and tear and progressive loss of articular cartilage. Hamstring muscles have tendency to shorten and tighten in knee osteoarthritis. Decrease in hamstring flexibility in patient with OA causes functional limitation. Therestrictions in fascia are responsible for myofascial trigger point formation which increases the tension in the IT band which results in spot tenderness, muscle and fascial tightness.MFR is a soft tissue mobilization technique. By MFR there is a change in the viscosity of the ground substance to a more fluid state which eliminates the fascia's excessive pressure on the pain sensitive structure and restores proper alignment and therefore is used here with conventional treatment.

Introduction: Osteoarthritis of knee has a severe impact on the muscles surrounding the knee joint causing pain, tightness, functional disability. The effects of MFR in tight hamstrings and tight iliotibial bands in knee OA patients have been studied previously and the findings of these studies indicated that MFR combined with conventional treatment is effective in reducing functional disability in knee OA patients. However, it is not yet known which muscle group out of these two has a significant reduction in functional disability in knee OA patients. We can therefore determine which muscle group improves more in lowering functional impairment in knee OA patients by comparing the effects of MFR in these two muscle groups. Also, when the patient has both types of tightness, we can concentrate more on the muscle region that responds most to MFR therapy.

Objective: To assess the effect of MFR for hamstring and iliotibial band on pain, flexibility, and functional disability in knee OA patients.

Methodology: The study includes 42 patients aged between 40-60 years with knee OA having hamstring and iliotibial band tightness with 21 patients in each group and their preintervention assessment was taken. Group A received MFR for hamstring tightness and Group B

received MFR for iliotibial band tightness and conventional treatment will be same for both the groups. The intervention was conducted for four weeks and after that post intervention assessment was done.

Result: Group A and Group B demonstrated significant improvement in pain, flexibility, and functional disability ($p < 0.0001$). Whereas, no significant difference was seen when intergroup comparison was done ($p > 0.05$).

Conclusion: The study concludes that there is no statistically significant difference in the effects of MFR in hamstring tightness vs MFR in IT band tightness in knee osteoarthritis patients but both are almost equally effective in reducing pain, tightness, and functional disability in knee osteoarthritis patients.

Keywords: Functional disability, Hamstrings tightness, Iliotibial band tightness, Knee Osteoarthritis, Myofascial release, Pain.

Introduction

Knee osteoarthritis is recognized as the most common degenerative disease, and it is the leading cause of disability and pain in adults. Knee osteoarthritis is mostly thought to be caused by joint injury, heredity, obesity, and aging. Knee osteoarthritis is degenerative joint disease of the knee and is due to constant wear and tear process in the joint and gradual loss of articular cartilage.[1]

Osteoarthritis (OA) is the most common form of arthritis affecting middle-aged and older people worldwide. Osteoarthritis (OA) is a complex condition that arises from a combination of factors, including trauma, mechanical forces, inflammation, biochemical reactions, and metabolic disruptions. Knee osteoarthritis is a complicated disease whose pathophysiology includes the contribution of biomechanical and metabolic factors that change the tissue's subchondral bone homeostasis and articular cartilage, as well as which determine which processes are more likely to be harmful than beneficial. The articular surface's lining will grow a tiny bony structure called a "spur". Osteoarthritis of the knee manifests physically as bony enlargement, crepitus, reduced range of motion, joint line tenderness, and pain during passive range of motion.[2]

There are two types of knee osteoarthritis that is primary and secondary osteoarthritis. Primary osteoarthritis is articular degeneration that has no known underlying cause or reasons. Secondary osteoarthritis is caused by abnormal articular cartilage, such as an abnormal concentration of force throughout the joint, as a result of trauma or Rheumatoid arthritis (RA). Usually, osteoarthritis progresses over time and can eventually cause disability. Each person may experience the clinical signs at a different intensity. But over time, they usually get worse, happen more often, and become more incapacitating. Also, each person's rate of advancement differs. Common clinical signs include knee stiffness and swelling, discomfort after extended sitting or sleeping, pain that gradually gets worse, and pain that gets worse with time.[3]

Osteoarthritis patients frequently report pain when moving; this pain usually starts when the patient moves or starts to walk. The pain is often described as a dull ache.[4] In individuals with knee OA the joint has limited range of motion and tightness in the muscles due to pain, damaged articular cartilage, loss of extensibility of the capsule surrounding the joint and muscles acting over the joint.[5]

Flexibility is the ability of a particular single joint or series of pain free range of motion (ROM). Flexibility is associated with the extensibility of musculotendinous components that crosses a joint, based on its ability to relax, deform, and yield to a stretch force. Therefore, muscle flexibility is an essential component of

musculoskeletal health.[6] Hamstring muscles have tendency to shorten and tighten in knee osteoarthritis. Decrease in hamstring flexibility in patient with OA causes functional limitation.[7]Hamstring flexibility can be improved by PNF and dynamic stretching.[8]

The pathogenesis of knee osteoarthritis involves chondrocyte cells malfunctioning within the cartilage, which may have an impact on the hamstring muscles flexibility. The degree of flexibility of the hamstrings and quadriceps muscle groups provides for a smooth and precise ambulatory pattern in the knee joint. As a result, the individual is predisposed to injuries and musculoskeletal dysfunction due to insufficient flexibility. As a result, there is a strong link between knee OA and poor hamstring flexibility.[9]

The degenerative changes associated with knee osteoarthritis include loss of cartilage in the medial compartment, narrowing of the joint, and collapse of the tibial plateau. These changes cause increased adduction movement and varus deformity, which in turn affects the relationship between the lateral epicondyle and the iliotibial band. Additionally, there may be an inflammation of the lower part of the IT band due to increased friction at the knee joint. These fascial restrictions cause the formation of myofascial trigger points, which in turn raises thetension in the IT band and causes spot tenderness as well as tightness in the muscles and fascia and due to which knee osteoarthritis patients mostly experience lateral knee pain. [10,11]

Myofascial release, or MFR, is a popular manual therapy technique that impacts the myofascial complex using precisely guided low load, long duration mechanical forces with the goals of restoring optimal length, reducing pain, and improving function. In order to perform MFR, restricted fascial layers are typically subjected to slow, continuous pressure (120–300 s), either directly (direct MFR technique) or indirectly (indirect MFR technique). The direct MFR technique applies pressure with a few kilograms of force to contact the restricted fascia, apply tension, or stretch the fascia. Practitioners use their knuckles, elbows, or other tools to slowly sink into the fascia. A gentle stretch follows along the path of least resistance in indirect MFR until free movement is attained. The hands have a tendency to follow the direction of fascial restrictions, hold the stretch, and let the fascia loosen on its own. A few grams of force are applied.[12]

Myofascial release technique (MFR) is a soft tissue mobilization technique. It is a manual technique and is defined as “the facilitation of mechanical, neural and psycho physiological adaptive potential as interfaced via the myofascial system”. Through myofascial release, the ground substance viscosity is changed to a more fluid state, relieving the fascia excessive pressure on the pain sensitive structures and allowing for the restoration of proper alignment.[14] In order to relieve pain and regain mobility, myofascial release is a kind of effective hands-on interactive technique that applies continuous pressure, stretching and compression to the body’s restricted fascia (connective tissue).[1]

Among the various techniques that work with the fascial tissue’s structures, myofascial release technique was thought to have the ability to reduce pain, increase flexibility, lessen disability, and ultimately improve daily living function.[13] The proprioception of knee joint improves after myofascial release. It has also been demonstrated that myofascial release can extend range of motion (ROM) without compromising muscle function or output.[14]

Knee osteoarthritis is a common condition among India's middle and elderly populations, but people between the

ages of 51 and 60 are at a higher risk than those over 60. [15]

Osteoarthritis of the knee has a severe impact on the muscles surrounding the knee joint causing pain, tightness, functional disability. Myofascial release technique can lessen the functional impairment of knee osteoarthritis patients.[4]

The effects of MFR in tight hamstrings and tight iliotibial bands in knee OA patients have been studied previously [1, 10,11,13], and the findings of these studies indicated that MFR combined with conventional treatment is effective in reducing functional disability in knee OA patients. However, it is not yet known which muscle group out of these two has a significant reduction in functional disability in knee OA patients. We can therefore determine which muscle group improves more in lowering functional impairment in knee OA patients by comparing the effects of MFR in these two muscle groups. Also, if the patient has both types of tightness, we can concentrate more on the muscle region that responds most to MFR therapy.

The objective of the study is to compare the effects of MFR in hamstring tightness vs MFR in iliotibial band tightness. To assess the effect of MFR for hamstring muscle on pain, flexibility, and functional disability in knee OA patients.

To assess the effect of MFR for IT band on pain, flexibility, and functional disability in knee OA patients.

Materials And Methods

The type of study was a comparative study. The study took place in Dr. APJ Abdul Kalam College of physiotherapy, Pravara Institute of Medical Sciences, Loni from 15 April 2023 until 31 January 2024 after the ethical approval from the institute. Participants were selected based on inclusion and exclusion criteria which is mentioned below. The software tool used to calculate the sample size was Openepi. 78 participants were screened for the eligibility criteria out of which 42 participants were selected for the study and further were randomized into 2 groups that is Group A (MFR for hamstring + Conventional treatment for knee OA) and Group B GROUP B – (MFR for iliotibial band + Conventional treatment for knee OA) , conventional treatment is same for both the groups by simple random sampling method. The study was single blinded study. Informed consent was obtained from the participants prior to the study. Pre-intervention assessment of all the participants. Following that, both groups underwent a 4-week (3-day-per-week) intervention, and a post-intervention assessment was conducted once the intervention was finished. The data was then collected and analyzed.

Selection Criteria

Inclusion Criteria

1) Age group: 40 – 60years old
2) Both male and female population
3) Radiographic evidence of knee OA (Grade 2 and 3)
4) Tightness of both the groups (hamstring and iliotibial band)- Active knee extension test (ATKT) and Ober's test
5) Unilateral knee OA
6) Written consent from patients

Exclusion Criteria

1) Recent fracture
2) Circulatory pathologies- such as DVT, Varicose veins
3) Any skin sensitivity issue
4) Past history of knee surgery

Outcome Measures

Outcome measures used for this study are as follows:

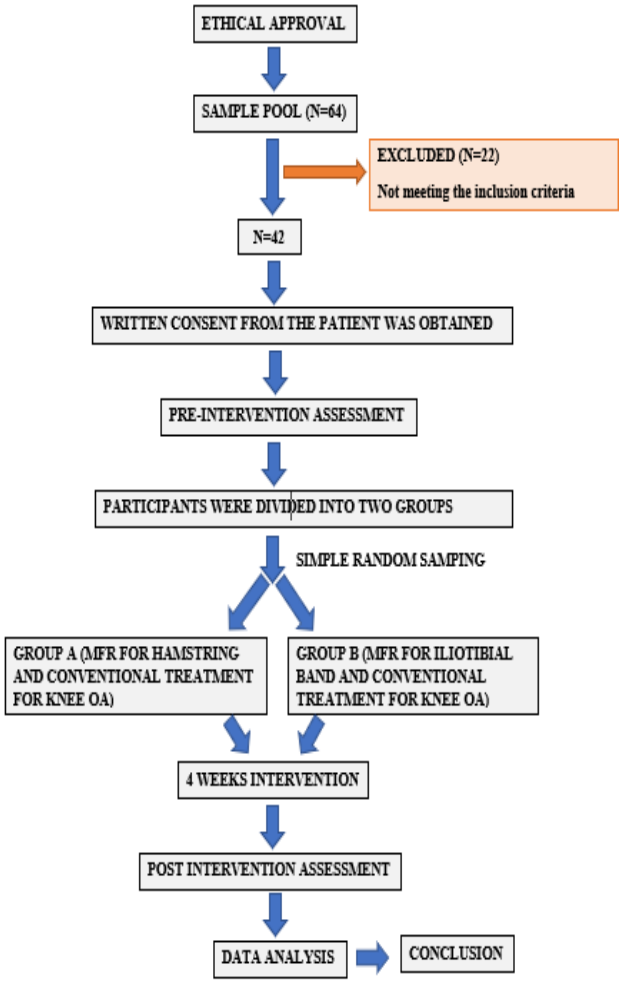
1. Visual analog scale (VAS): Visual analog scale (VAS) is a highly reliable tool for measurement of

pain. It is composed of a 10-centimeter line that reads "no pain" on the left extremity and "unbearable pain" on the right. The participants will be asked to indicate their level of pain by marking the line.[16]

2. Western Ontario and McMaster osteoarthritis index (WOMAC): A common self-administered health status measure, the Western Ontario and Macmaster Universities (WOMAC) Osteoarthritis Index evaluates function, stiffness, and pain in patients with osteoarthritis (OA) of the hip or knee. Three distinct dimensions are measured by the WOMAC: function (17 questions), stiffness (2 questions), and pain (5 questions). The WOMAC is graded on a best-to-worst scale, with lower subscale scores representing less pain, stiffness, or improved physical function. [17,18]

3. Knee range of motion (ROM): Range of motion is a common outcome measure used in clinical trials to evaluate the effectiveness of physiotherapy interventions for knee osteoarthritis patients. It is often combined with other measures. Range of motion measured with a goniometer in patients with knee osteoarthritis has very good reliability. Measuring knee range of motions in patients with knee osteoarthritis is reliable and generally valid.[19]

Procedure



Intervention

Group A – (MFR for hamstring + Conventional treatment for knee OA)

1. Patient position: Prone lying
2. Hamstring area was exposed
3. Light stroking using hand over hamstring muscle from proximal to distal of the hamstring (2-3 minutes)
4. Compression of the posterior thigh (2-3 minutes)
5. Cross hand release technique for hamstring-120seconds, 5 repetition/session

Myofascial release is given with ulnar border from proximal to distal direction with light gentle pressure over the hamstring muscle until the slack in the skin is loosened. [13,20]

Figure 1: Myofascial release for hamstring

Group B – (MFR for iliotibial band + Conventional treatment for knee OA)

1. Patient position- side lying on unaffected side with hip and knee 30 degree flexed
2. Technique- soft fist or elbow used to engage the fasciae at the greater trochanter. Then sustain gentle pressure in inferior direction at the line with the fibers of IT band from femur towards the knee. This pressure then should be held for 90 seconds followed by 60 seconds of rest period and repeated for 5 minutes.

Neuromuscular technique (longitudinal stroke)- the thumb is placed over the taut band and longitudinalstrokes are applied slowly with moderate pressure; this technique is applied for 3 minutes.[10,11,20]

Figure 2: Myofascial release for iliotibial band

Conventional treatment common for both the groups-

1. Thermal therapy for 10 minutes using hot pack- for pain relief
2. Cryotherapy- to reduce swelling (if present)
3. Ultrasound
4. Static quads- 10 reps, 10 second hold
5. Static hams- 10 reps, 10 second hold
6. Static abductors- 10 reps, 10 second hold
7. Static adductors- 10 reps, 10 second hold
8. Active knee flexion- 10 reps, 10 second hold
9. Straight leg raises- 10 reps, 10 second hold
10. Lateral straight leg raises- 10 second hold [1,10,11,20]

Results And Discussions

Results

In this study statistical analysis was done using GraphPad InStat. A paired t test was done to compare inter group differences in the outcome measures in the result obtained between Group A and Group B and unpaired t test was done to compare intra group differences.

This study's outcome measures included the visual analogue scale (VAS), the Western Ontario and McMaster osteoarthritis index (WOMAC), and knee range of motion (ROM) (flexion and extension).

The study included participants between the ages of 40 and 60 who had grade 2 and 3 knee osteoarthritis (according to Kellgren-Lawrence grading scale).

The study included participants aged 40 to 60 who had knee osteoarthritis grade 2 or 3 according to the Kellgren and Lawrence grading scale. The study's findings revealed that of the 42 knee OA participants, group A (n=21) included 4 males and 17 females, while group B (n=21) included 7 males and 14 females. Furthermore, the mean age range for group A was 49.71 years, while group B was 53.05.

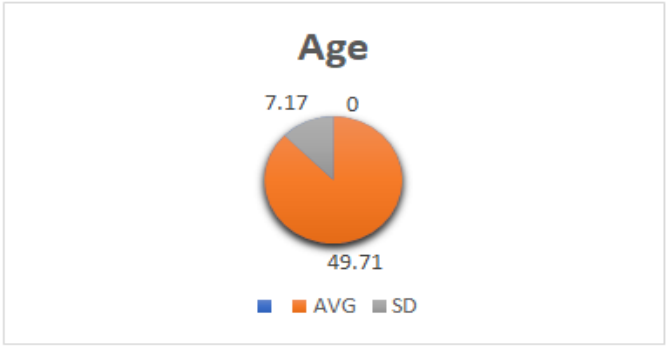


Figure 3: This shows the age distribution of participants in group A.

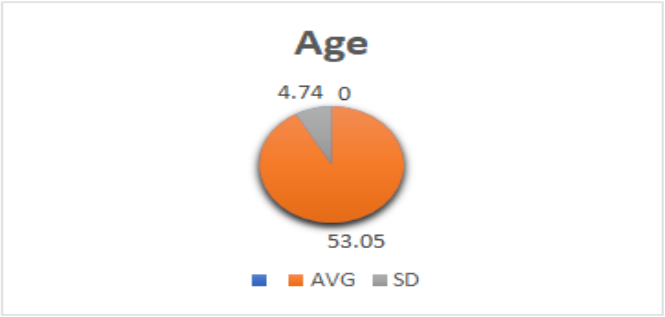


Figure 4: This shows the age distribution of participants in group B

Table 1: Comparison of pre and post intervention scores of VAS, WOMAC, Knee flexion and Knee extension in group A

	GROUP A				
PARAMETERS	MEAN AND STANDARD DEVIATION (PRE -INTERVENTION)	MEAN AND STANDARD DEVIATION (POST- INTERVENTION)	T TEST	P VALUE	SIGNIFICANCE
VAS	7.19±1.08	4.43±1.52	16.263	<0.0001	SIGNIFICANT
WOMAC	59.62±7.96	50.86±7.36	14.294	<0.0001	SIGNIFICANT
KNEE FLEXION	119.90±6.28	129.24±5.57	14.391	<0.0001	SIGNIFICANT
KNEE EXTENSION	19.52±7	2.43±4.63	15.024	<0.0001	SIGNIFICANT

Table 2: Comparison of pre and post intervention scores of VAS, WOMAC, Knee flexion and Knee extension in group B

	GROUP B				
PARAMETERS	MEAN AND STANDARD DEVIATION (PRE- INTERVENTION)	MEAN AND STANDARD DEVIATION (POST- INTERVENTION)	T TEST	P VALUE	SIGNIFICANCE
VAS	7.33±0.91	4.38±1.07	18.283	<0.0001	SIGNIFICANT
WOMAC	63.05±7.57	53.95±7.75	13.901	<0.0001	SIGNIFICANT
KNEE FLEXION	117.76±7.06	128.67±4.03	11.848	<0.0001	SIGNIFICANT
KNEE EXTENSION	19.76±7.73	2.1±4.62	16.181	<0.0001	SIGNIFICANT

Table 3: Comparison between group A and group B scores

	BETWEEN GROUP COMPARISON				
PARAMETERS	MEAN AND STANDARD DEVIATION (GROUP A)	MEAN AND STANDARD DEVIATION (GROUP B)	T TEST	P VALUE	SIGNIFICANCE
VAS	4.43±1.52	4.38±1.07	0.1327	0.90	NOT SIGNIFICANT
WOMAC	50.86±7.36	53.95±7.75	1.343	0.19	NOT SIGNIFICANT
KNEE FLEXION	129.24±5.57	128.67±4.03	0.3811	0.71	NOT SIGNIFICANT
KNEE EXTENSION	2.43±4.63	2.1±4.62	0.2334	0.82	NOT SIGNIFICANT

In group A (n=21): The post-intervention evaluation of the VAS ($p<0.0001$) shows a significant difference from the pre-intervention assessment. Pre-intervention (m = 7.19) and post-intervention (m = 4.43) are the group's mean VAS values. Following the intervention, the patients VAS pain scores decreased.

The post-intervention evaluation of WOMAC($p<0.0001$) score showed significant difference from the pre-intervention assessment. Pre- intervention (m=59.62) and post-intervention (m=50.86) are the group's mean WOMAC score values. Following the intervention, patients WOMAC score was reduced.

The post-intervention evaluation of knee flexion ($p<0.0001$) range also showed significant difference compared to pre-intervention evaluation. Pre-intervention (m=119.90) and post-intervention (m=129.24) are the group's mean knee flexion ranges. After the intervention there was improvement in the knee flexion range of motion in these patients.

The post-intervention evaluation of knee extension ($p<0.0001$) range also showed significant difference compared to pre-intervention evaluation. Pre-intervention (m=19.52) and post-intervention (m=2.43) are the group's mean knee extension ranges. After the intervention there was improvement in the knee extension range of motion in these patients.

The p value within group showed a statistically significant difference between the pre and post intervention analysis of group A.

In group B (n=21): The post-intervention evaluation of the VAS ($p<0.0001$) shows a significant difference from the pre-intervention assessment. Pre-intervention (m = 7.33) and post-intervention (m = 4.38) are the group's mean VAS values. Following the intervention, the patients VAS pain scores decreased.

The post-intervention evaluation of WOMAC ($p<0.0001$) score showed a significant difference from the pre-intervention assessment. Pre-intervention (m=63.05) and post-intervention (m=53.95) are the group's mean

WOMAC score values. Following the intervention, patients WOMAC score was reduced.

The post-intervention evaluation of knee flexion ($p<0.0001$) range also showed a significant difference compared to pre-intervention evaluation. Pre-intervention (m=117.76) and post-intervention (m=128.67) are the group's mean knee flexion ranges. After the intervention there was improvement in the knee flexion range of motion in these patients.

The post-intervention evaluation of knee extension ($p<0.0001$) range also showed significant difference compared to pre-intervention evaluation. Pre-intervention (m=19.76) and post-intervention (m=2.1) are the group's mean knee extension ranges. After the intervention there was improvement in the knee extension range of motion in these patients.

The p value within group showed a statistically significant difference between the pre and post intervention analysis of group B.

In inter-group analysis of group A and group B, the post-intervention p- values are VAS (p=0.90), WOMAC (p=0.19), Knee flexion (p=0.71) and Knee extension (p=0.82).

The inter-group analysis between group A and group B showed no significant differences ($p>0.05$) in VAS, WOMAC, Knee flexion and Knee extension range of motion.

Discussion

The objective of the study was to find the effect of MFR for hamstring and Iliotibial band on pain, flexibility and functional disability in knee osteoarthritis patients.

This study included outcome measures such as the visual analogue scale (VAS), the western ontario and mcmaster osteoarthritis index (WOMAC), and knee flexion and extension range of motion (ROM), which were assessed and analyzed in both groups prior to and following the intervention.

In group A (n=21), the treatment was myofascial release for hamstring and conventional physiotherapy for knee osteoarthritis. After giving the treatment there was a significant difference compared to the pre intervention analysis of VAS, WOMAC, Knee flexion and extension range of motion.

Prior to the intervention, the mean of VAS (pain) score was m=7.19, while after the intervention, it was m=4.43. The findings of this study indicate a notable reduction in pain levels among knee osteoarthritis patients who underwent myofascial release (MFR) for the hamstring. The pain was reliably measured using the Visual Analogue Scale (VAS), and the observed decrease in VAS score implies that MFR could be a useful intervention for pain relief in knee osteoarthritis. This is consistent with earlier research on MFR in hamstring tightness in knee OA published by Rahman SR et al and Preeti Phullava et al. [1, 13]

Prior to the intervention, the mean of WOMAC score was m=59.62, while after the intervention, it was m=50.86. The Western Ontario and McMaster Osteoarthritis Index (WOMAC) scores provide comprehensive insights into the functional status of knee osteoarthritis patients. The findings of the study demonstrate a significant improvement in WOMAC scores post-intervention, implying enhanced functional ability. MFR for the hamstring appears to have a positive impact on daily activities such as walking and stair climbing, indicating that it could be a valuable addition to rehabilitation strategies aimed at improving functional outcomes. This is consistent with the articles published by Rahman SR et al and Preeti Phullava et al. [1, 13]

Prior to the intervention, the mean of knee range of motions (ROM) was flexion (m=119.90) extension

(m=19.52), while after the intervention, it was flexion (m=129.24) extension (m=2.43). The knee range of motion significantly improves after the intervention. The findings of the study demonstrate a significant improvement in knee flexion and extension range of motions. This improvement in range of motion suggests that joint flexibility may be enhanced by using MFR to address fascial restrictions in the hamstring. Increased range of motion can have a beneficial impact on a patient's capacity to carry out daily tasks and engage in exercise programmes. This is in consistent with the articles published by Rahman SR et al and Preeti Phullava et al. [1, 13]

In group B (n=21), the treatment was myofascial release for iliotibial band and conventional physiotherapy for knee osteoarthritis. After giving the treatment there was a significant difference compared to the pre intervention analysis of VAS, WOMAC, Knee flexion and extension range of motion.

Prior to the intervention, the mean of VAS (pain) score was m=7.33, while after the intervention, it was m=4.38. The findings of this study indicate a notable reduction in pain levels among knee osteoarthritis patients who underwent myofascial release (MFR) for the iliotibial band. The pain was reliably measured using the Visual Analogue Scale (VAS), and the observed decrease in VAS score implies that MFR could be a useful intervention for pain relief in knee osteoarthritis. This is consistent with earlier research on MFR in iliotibial band tightness in knee OA published by Gomaa EF et al and Chavan SE et al. [10,11]

Prior to the intervention, the mean of WOMAC score was m=63.05, while after the intervention, it was m=53.95. The Western Ontario and McMaster Osteoarthritis Index (WOMAC) scores provide comprehensive insights into the functional status of knee osteoarthritis patients. The findings of the study demonstrate a significant improvement in WOMAC scores post-intervention, implying enhanced functional ability. MFR for the iliotibial band appears to have a positive impact on daily activities such as walking and stair climbing, indicating that it could be a valuable addition to rehabilitation strategies aimed at improving functional outcomes. This is consistent with the articles published by Gomaa EF et al and Chavan SE et al. [10,11]

Prior to the intervention, the mean of knee range of motions (ROM) was flexion (m=117.76) extension (m=19.76), while after the intervention, it was flexion(m=128.67) extension(m=2.1). The knee range of motion significantly improves after the intervention. The findings of the study demonstrate a significant improvement in knee flexion and extension range of motions. This improvement in range of motion suggests that joint flexibility may be enhanced by using MFR to address fascial restrictions in iliotibial band. Increased range of motion can have a beneficial impact on a patient's capacity to carry out daily tasks and engage in exercise programmes. This is in consistent with the articles published by Gomaa EF et al and Chavan SE et al. [10,11]

The positive results in pain reduction, improved functional status (WOMAC), and increased range of motion support the inclusion of MFR as a valuable component in a multimodal treatment approach for knee osteoarthritis. Combining MFR with traditional interventions like exercise, medication, and physiotherapy may provide a more comprehensive approach to managing the complex issues associated with knee osteoarthritis.

In inter-group analysis, the pre-intervention p-values are VAS (p=0.65), WOMAC (p=0.16), knee flexion (n=0.31), knee extension (p=0.92), whereas the post-

intervention p-values are VAS (p=0.90), WOMAC (p=0.19), knee flexion (p=0.71), and knee extension (p=0.82).

The lack of significant differences in inter-group analyses suggests that, as of the measured outcomes, the interventions applied in group A and group B did not lead to divergent outcomes. In other words, there was no significant difference between the two groups in terms of pain levels, functional status, or knee range of motion. The null hypothesis (H0) of the study is true.

In conclusion, combining myofascial release techniques with conventional physiotherapy has shown significant progress in addressing functional disability and improving the overall lifestyle of people with knee osteoarthritis but the intergroup analysis of both the groups showed no significant difference and they are equally effective in the treatment of knee osteoarthritis.

Conclusion

The study revealed that there is no statistically significant difference in the effects of MFR in hamstring tightness vs MFR in IT band tightness in knee osteoarthritis patients but both are almost equally effective in reducing pain, tightness, and functional disability in knee osteoarthritis patients.

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Ethical Approval: The study was approved by institutional ethics committee.

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