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Research Article

VMO Muscle Strengthening For Patellofemoral Pain Syndrome

Effect of Vastus Medialis Oblique Strengthening Versus Mulligan Knee Taping Technique (Mcconnell Tape) on Patellofemoral Pain Syndrome: A Comparative Study.

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Abstract: This study aims to determine the effectiveness of Vastus medialis oblique (VMO) strengthening and conventional therapy treatment (group A) and Mulligan knee taping technique(McConnell tape) and conventional therapy treatment (group B) in patients with patellofemoral pain syndrome by VAS for pain and KPS for anterior knee pain scale is to compare VMO strengthening Versus Mulligan knee taping technique using McConnell tape in patellofemoral pain syndrome using VAS for assessing pain and Kujala patellofemoral scale to assess knee pain and function. The most frequent cause of knee discomfort with retro patellar or peripatellar pain is patellofemoral pain syndrome (PFPS). The need for further studies to better understand the causes and treatment of PFPS is essential to provide optimal care for individuals experiencing pain in the knee. Physical therapy is considered the most effective treatment for PFPS, but more research is needed to determine each individual's best course of action. Proper diagnosis is the key to successful treatment and prevention of PFPS. Early intervention is also important for better outcomes. Patellofemoral pain syndrome (PFPS), which is often used interchangeably with "anterior knee pain" or "runner's knee," is the clinical entity of stiffness or pain or both on prolonged sitting with the knees flexed and pain with activities that load the patellofemoral joint, such as climbing or descending stairs, squatting, running and kneeling. Varieties of conservative treatments are suggested, like quadriceps strengthening, stretching, braces and straps, electrotherapy, foot orthosis, patellar taping, etc. Hence, a comparison between the vastus medialis obliqus muscle strengthening and patellar taping was undertaken to determine their effectiveness concerning pain and function. A well-organized research study was conducted over 12 months to investigate the impact of strengthening the vastus medialis oblique muscle and applying conventional therapy treatment. Group A received this combination of treatments, while Group B was assigned a treatment protocol involving the use of McConnell tape along with conventional therapy treatment. After taking informed and written consent, 30 subjects diagnosed with unilateral or bilateral PFPS were randomly selected and allocated into two groups - Group A (VMO muscle strengthening and conventional therapy treatment) and Group B (Mulligan knee taping technique (McConnell tape) and conventional therapy treatment). Both groups received 6 therapy sessions every alternate day for 6 weeks. The visual analog scale (VAS) and Kujala patellofemoral scale (KPS) measured pre and post-pain and function. "T-Test" was used for statistical analysis. There was a significant improvement in pain and function in patients with Patellofemoral pain syndrome at the end of 6 weeks regarding VAS and KPS within both groups, i.e., groups A and B ($p<0.01$). But there was no significant difference regarding improvement in pain and functional status in patients with Patellofemoral pain syndrome at the end of 6 weeks in terms of VAS and KPS between groups. The effect of conventional therapy treatment along with VMO muscle strengthening is similar to the conventional therapy treatment along with patellar taping in improving pain and functional level in patients with patellofemoral pain syndrome at the end of 6 weeks.

Keywords: Patellofemoral Pain Syndrome, Vastus Medialis Oblique Strengthening, Mulligan Knee Taping Technique (McConnell tape), Visual Analogue Scale, Kujala Patellofemoral Scale.

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1. INTRODUCTION

Patellofemoral pain syndrome (PFPS) is the most common cause of knee discomfort characterized by retro patellar or peripatellar pain[1]. It primarily affects adolescents and young adults[2], causing significant discomfort and functional limitations. PFPS is often referred to as runner's knee or anterior knee pain syndrome[3], and it is typically aggravated by activities that stress the patella during weight-bearing on a flexed knee, such as running, stair climbing, leaping, and squatting.[4] The defining feature of PFPS is the presence of pain around or behind the patella, exacerbated by specific activities. In 2016, a consensus statement comprehensively defined PFPS, highlighting its association with activities that load the knee joint in flexion or extension. It is crucial to note that PFPS occurs without other specific knee joint pathologies. Given the high prevalence of PFPS and its impact on the quality of life of affected individuals, there is a need for a better understanding of the condition and its management. Although numerous studies have investigated PFPS, further research is required to improve our knowledge and develop effective treatment strategies. The aim of this study is to by examining specific objectives; we seek to state the expected outcomes or contributions. This research will contribute to the existing body of knowledge regarding PFPS and provide valuable insights for clinicians, researchers, and individuals suffering from this condition.

1.1. Vastus Medialis Oblique Strengthening

The vastus medialis muscle collaborates with the other quadriceps muscles to straighten the knee and extend the leg. The vastus medialis plays a crucial role in the knee joint's locking mechanism during the last stages of knee extension[5]. The muscle's vastus medialis oblique (VMO) component also serves as a stabilizing and motion-controlling mechanism for the kneecap. Achieving balanced activation between the VMO and vastus lateralis(VL) is crucial to preserve the correct patellofemoral alignment. As a result, VMO training has become a crucial component of rehabilitation for PFPS sufferers[1].

1.2. Mulligan Knee Taping Technique (Mcconnell Tape)

An alternate method for treating PFP called Mulligan knee taping seeks to indirectly correct patellar maltracking, a contributing reason to PFP, by altering hip rotation. The use of rigid tape for taping is frequently used in clinical practice to manage PFP. Rigid tape taping can relieve pain and change lower limb biomechanics. There have been several different taping methods described, all with different outcomes. Mulligan describes one technique that involves wrapping stiff adhesive tape around the knee without touching the patella[6,7]

1.3. Pathophysiology of The Knee Pain[31]

The knee is the largest synovial joint in humans, consisting of bones, cartilage, ligaments, and a synovial membrane. It is prone to painful conditions such as osteoarthritis (OA), which can be primary or secondary. OA involves multiple factors like trauma, mechanical forces, inflammation, and metabolic issues, affecting not only the cartilage but also the joint capsule, synovium, subchondral bone, ligaments, and muscles. Inflammation in OA is chronic and low-grade, involving innate immune mechanisms. The synovial fluid contains various inflammatory mediators, leading to cartilage breakdown. White blood cells, particularly macrophages, contribute to tissue destruction. Protective molecular mechanisms are altered in knee OA patients.

2. MATERIALS AND METHODS

2.1. Study Design

The study was a comparative study approved by the Institutional Research and ethical committee number Adtu/Ethics/stdnt-lett/2022/32. All the experimental procedures were by the University's guidelines.

2.2. Participants

A total of 30 subjects, both males and females, fulfilling the inclusion criteria, were allocated into Group-A and Group-B where Group-A (n=15) received VMO strengthening exercises and Conventional therapy treatment, and Group-B (n=15) received Mulligan knee taping technique (McConnell tape) and Conventional therapy treatment. This study was conducted in the Department of Physiotherapy, Down Town Hospital Guwahati, and Private Physiotherapy Clinic.

2.3. Material Required

1. Consent form – A signed consent form from the patient to allow the patient to be included in the study.
2. VAS (visual analog scale)
3. KPS (Kujala patellofemoral scale)
4. Pen and pencil.
5. Towel.
6. Stopwatch
7. Chair and sitting stool.
8. Tape.
9. Ball.
10. Treatment couch.
11. Weight cuff.

2.4. Inclusion Criteria

This study includes both males and females in an age group between 17 to 35 years. Having patellar maltracking, pain in one or both the knee, duration of symptoms greater than 4 weeks, and pain during activities like prolonged sitting, stair climbing, running, kneeling bilateral squat, Single leg squat, step-up or step-down, bilateral anterior knee pain.

2.5. Exclusion criteria

The exclusion criteria were history of previous patellar subluxation/dislocation, knee surgery or intra articular corticosteroid injection, knee ligament injury or laxity, infection, malignancy, Skin irritability to tape, knee osteoarthritis, patellar tendinopathy, lower limb trauma, surgery or fractures.

2.6. Statistical Tools

1. VAS (visual analog scale).

A visual analog scale (VAS) is a measurement tool commonly used to assess subjective experiences or perceptions in

research and clinical settings. It consists of a horizontal line, typically 10 centimeters long, with two endpoints representing extreme opposite feelings or states. Participants are asked to mark their position on the line to indicate their response or rating. The VAS provides a continuous scale for fine-grained measurement of pain intensity, mood, satisfaction, or anxiety levels. It offers a simple and efficient way to capture subjective data, enabling researchers and healthcare professionals to quantify subjective experiences in a quantitative manner.

2. KPS (Kujala patellofemoral scale).

The Kujala patellofemoral scale is a clinical assessment tool used to evaluate patellofemoral pain syndrome's functional status and severity (PFPS). It consists of 13 items that assess pain, symptoms, function, and ability to perform daily activities related to knee function. Each item is scored on a scale from 0 to 5, with a higher score indicating better knee function. The total score ranges from 0 to 100, with higher scores indicating better functional outcomes. The Kujala patellofemoral scale provides valuable information for clinicians to monitor patients' progress with PFPS and guide treatment interventions to improve knee function and quality of life.

2.7. Protocols for Effects of Vastus Medialis Oblique Retraining Versus General Quadriceps Strengthening on Vasti Onset

An 8-week follow-up followed this 6-week intervention in this single-masked, randomized controlled experiment. A blinded assessor, a musculoskeletal physiotherapist with experience and training in the measuring techniques, evaluated participants before treatment (baseline), after treatment (final), and then 8 weeks afterward (follow-up). Participants were randomly assigned to the MCR or QS program after the baseline evaluation.

2.8. Interventions

Six musculoskeletal physiotherapists dispersed throughout the metropolitan area carried out standardized procedures. The therapists couldn't be made blind. A therapy manual was given to the therapists along with training. Individual sessions lasting 45–60 minutes were used for treatments. The first week saw two sessions, followed by four sessions over five weeks (a single weekly visit omitted at week 5). Each participant received a standardized home workout sheet with written and illustrated instructions and ankle weights for those in the QS group.

2.9. Mcr Program

The McConnell program, which was applied in our prior trial of anterior knee pain, served as the basis for the MCR program. Therapists explained the vast connections and the ideas underlying the training program to participants, emphasizing the need to focus on activating the VMO muscle during each exercise because that was the focus of the exercise. Dual-channel surface EMG biofeedback devices with electrodes positioned over VL and VMO were utilized to help with this. These biofeedback devices show the degree of VMO and VL muscle activity visually. One bar can be used to show the ratio of VMO to VL activity, or two bars can be placed side by side to reflect the absolute activity of VMO and VL. The participants employed the biofeedback device to ensure that they were obtaining a VMO contraction and, more specifically, a larger VMO than VL activation during the exercises. While receiving physical therapy, biofeedback devices were employed, but not for at-home activities.

2.10. Generalized QS Program

The exercises used in clinical therapy for anterior knee discomfort served as the foundation for the QS program. Three quadriceps exercises were included, and they were all carried out in non-weight-bearing, non-functional situations. To compensate for the standing isometric hip abduction exercise performed as part of the MCR program, a strengthening exercise for the hip abductor muscles was added to the non-weight bearing.

2.11. Instrumentations

To gather EMG data, two bipolar silver surface electrodes with preamplifiers (X 35), an amplifier (X 1000), An oscilloscope, and a computer were employed. A Therapeutics Unlimited GCS.67 electromyographic system (Iowa City, Iowa) was used to amplify the EMG signals further after they were communicated via a hard wire system. This system has a common mode rejection ratio of 87 dB at 60 Hz and a 40 to 4000 Hz bandwidth. The input noise is 1.5 mVRM, and the input resistance is larger than 25 MOhms. The knee flexion angle was tracked using an electronic goniometer (elgon), which also provided visual biofeedback via the oscilloscope[11].

2.12. Subject Screening Procedure

The researcher looked at each subject's right lower leg after they had read and signed the consent form to see if their foot was excessively supinated or pronated. The volunteer stood bilaterally with his feet shoulder-width apart and straight forward when these two angles were measured. The line that bisects the calcaneus and bisects the distal H of the leg forms an acute angle known as the rear foot angle. The line connecting the medial malleolus and the navicular tuberosity, the line connecting the navicular tuberosity, and the first metatarsal head's most medial aspect, form an obtuse angle known as the longitudinal arch angle. A foot could be classified as severely pronated if (1) the rear foot angle was greater than 12" of eversion and (2) the longitudinal arch angle was less than 127". A foot could be classified as severely supinated if (1) the rear foot angle was greater than 0" of inversion and (2) the longitudinal arch angle was greater than 157'. The subject's right leg, which was prone, was stretched about 20 cm from the edge of the examination table. The subject's left leg was placed in hip flexion/abduction/external rotation to maintain the right lower extremity in a neutral rotation. With the ankle joint relaxed, four transverse reference lines were created parallel to the calcaneus and the distal leg (Figure 1). The proximal calcaneal reference line was drawn three centimeters above the distal calcaneal line at the palpable base of the calcaneum. The proximal leg reference line was drawn 8 cm above the distal line, which was drawn 6 cm above the palpated proximal margin of the calcaneus. The line joining the distal calcaneal bisection mark and the proximal calcaneal bisection mark and line joining the distal leg bisection mark and the

proximal leg bisection mark were used to quantify the rearfoot angle. The first metatarsal head's most medial aspect, the navicular tuberosity, and the medial malleolus were all delineated while the individual was still standing. The line from the medial malleolus to the navicular tuberosity and the line connecting the navicular tuberosity to the most medial portion of the first metatarsal head produced an obtuse angle used to estimate the longitudinal arch angle[11].

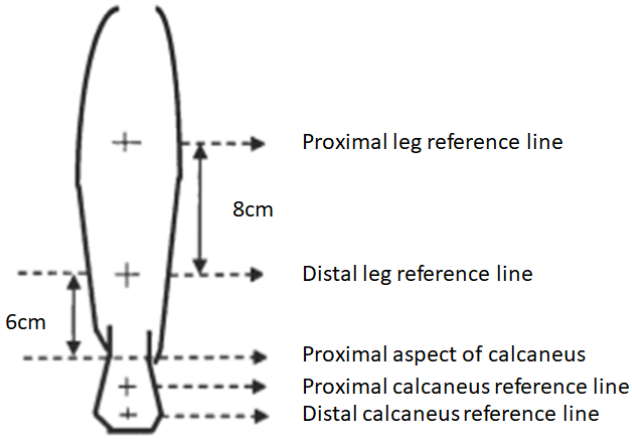

Fig 1: Four reference lines and leg bisections in the frontal plane (posterior view) used for drawing lines to measure a rearfoot angle.

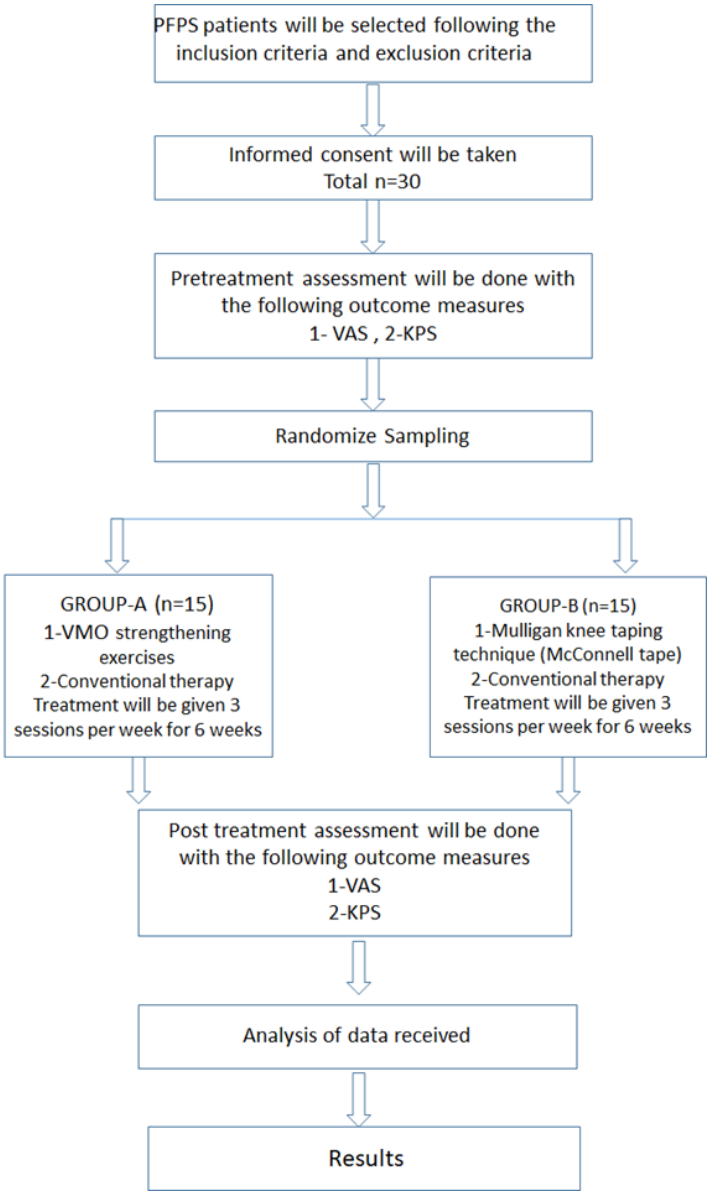

Fig 2: Flow Chart of Participants Throughout Each Stage of the Study

2.13. Procedure

The subject was assigned to two groups- Group A & Group B. 30 subjects with patellofemoral pain syndrome meeting the inclusion criteria will be recruited and randomly divided into two groups, i.e., Group A (VMO strengthening) and Group B (Mulligan knee taping technique (McConnell tape)), each group containing 15 subjects informed consent was obtained from the subjects. The pre-treatment assessment was conducted on groups A and B by visual analog scale (VAS) and Kujala patellofemoral scale (KPS). The post-treatment assessment was conducted on Group A and Group B by visual analog scale (VAS) and Kujala patellofemoral scale (KPS). All subjects received 3 treatment sessions per week for 6 weeks of therapy sessions.

2.14. Intervention

GROUP A

Treatment began with VMO strengthening exercises[8].Conventional therapy. (SLR, Quadriceps setting exercise, stretching exercise for hamstring)[1].

VMO Strengthening exercises

1. VMO Activation

The patient sits in a comfortable chair with the knees bent, ball between the knees, and feet flat on the floor. Ask the patient to contract the glutes and gently squeeze the ball, ensuring the movement comes from the knee rather than the inner thigh. The patient should feel a tightening that shows they are activating the vastus medialis and the VMO. If you can't feel it, try contracting the buttocks, contracting the knees, and squashing the backs of the thighs down into the chair. Test both sides together, particularly if they have knee pain or swelling, as may well notice a difference between sides. (figure 3).

2. Ball Clench Extensions

The patient is supine with a rolled-up towel underneath the knees and place the ball between the knees. Contract the buttocks and gently squeeze the ball, then lift one heel off the ground until the knee is straight. Keep contracting the ball and hold for 3 seconds, then slowly lower the foot back down. Repeat 10 times, gradually increasing the number of repeats as they get stronger, aiming to get up to 25. (figure 4).

3. Ball Bridges

The patient is supine with the knees bent, feet hip distance apart, and the ball between the knees. Contract the glutes, gently squash the ball and lift the bottom as high as possible without arching your back. Hold for 3 seconds and slowly lower down. Keep squashing the ball and contracting the glutes throughout**.** (figure 5.1) and (figure 5.2)

4. Ball Wall Squats

Vastus Medialis Strengthening: Wall Ball Squats. Stand with back against a wall, squashy ball between the knees, heels about 6" away from the wall, toes pointing forwards. Contract the glutes and gently squash the ball to activate the vastus medialis oblique, then slowly slide down the wall, bending the knees. Slide down as far as you feel in control, hold for 3 seconds, and slowly push yourself back up. Keep the glutes and the ball contracted throughout. (figure 6.1) and (figure 6.2).

Fig 3: VMO Activation

Fig 4: Ball Clench Extension

Fig 5.1: Position 1 of Ball bridges

Fig 5.2: Position 2 of Ball bridges

Fig 6.1: Position 1 of wall squat

Fig 6.2: Position 2 of wall squat

2.15. Conventional Therapy Treatment

Conventional therapy treatment given to the subjects of both groups was in the form of straight leg raising, quadriceps setting exercise, and stretching exercises for the hamstring. Frequency: 3 sets of 10 repetitions daily for the first week. If the patient is comfortable, progress to 20 repetitions (2 sets of 10 repetitions per session) during the second week and 30 repetitions (3 sets of 10 repetitions per session) during the third week. Continue with 30 repetitions for up to 6 weeks.

Fig 7: Conventional Therapy

Group B: 15 subjects will receive Mulligan knee taping technique (McConnell tape)[7]. Conventional therapy (SLR, Quadriceps setting exercise, stretching exercise for hamstring)[1].

3. MULLIGAN KNEE TAPING

The tape was applied while participants stood with the affected leg in full tibiofemoral internal rotation and 20 degrees of knee flexion. The tape began at the neck of the fibula. It was applied spirally in an anteromedial direction inferior to the tibial tuberosity and medial knee joint line across the popliteal fossa to the anterolateral thigh.

Fig 8: Mulligan Knee Taping

3.1. Conventional Therapy Treatment

Conventional therapy treatment given to the subjects of both groups was in the form of straight leg raising, quadriceps setting exercise, and stretching exercises for the hamstring. Frequency: 3 sets of 10 repetitions daily for the first week. If the patient is comfortable, progress to 20 repetitions (2 sets of 10 repetitions per session) during the second week and 30 repetitions (3 sets of 10 repetitions per session) during the third week. Continue with 30 repetitions for up to 6 weeks.

Fig 9: Conventional Therapy

4. DATA ANALYSIS

Descriptive data was presented as mean, standard deviation, and number (percentage). The paired sample t-test was used to compare the results after 6 weeks in each group. The significance level of this study was set $p<0.01$.

5. RESULTS

This 12-monthly structured study was performed to determine the effects of Vastus Medialis Oblique strengthening. Conventional therapy treatment was received in Group A, and Group B was set on a treatment protocol of McConnell tape and conventional therapy. Subjects of both groups were assessed to find the VAS score for pain and KPS for the anterior knee pain scale. Based on the inter-group analysis, we conclude that the effect of conventional therapy treatment along with VMO strengthening is similar to the conventional therapy treatment along with McConnell tape in improving pain and functional level in patients with Patellofemoral pain syndrome at the end of 6weeks.

Table 1: Intra – group analysis of Group A and Group B of VAS							
Group	**VAS**	**Mean±SD**	**N**	**t**	**df**	**P**	**Remarks**
Group A	Pre Treatment (Pre-Test)	6.40±1.12	15	11.225	14	< 0.01	Highly significant
	Post Treatment (Post–Test)	5.20±1.14	15				
Group -B	Pre Treatment (Pre–Test)	6.73±1.09	15	11.225	14	< 0.01	Highly significant
	After Treatment (Post–Test)	5.53±1.06	15				

Table 1 shows that in group A, there is a significant difference between the pre-test and post–test since p<0.01, and the protocol (VMO strengthening and Conventional therapy treatment) is effective since the mean VAS score decreases from 6.40 to 5.20. In group B, there is a significant difference between the pre-test and post–test since p<0.01 and the protocol (McConnell Tape and Conventional therapy treatment) is effective since the mean VAS score decreased from 6.73 to 5.53.

Table 2: Intra – group analysis of Group A and Group B of KPS							
Group	**KPS**	**Mean ±SD**	**N**	**t**	**df**	**P**	**Remarks**
Group –A	Before Treatment (Pre-test)	47.00±10.47	15	-9.405	14	<0.01	Highly significant
	After Treatment (Post-Test)	60.93±10.18	15				
Group -B	Before Treatment (Pre-Test)	45.13±10.8	15	-7.850	14	<0.01	Highly significant
	After Treatment (Post-Test)	59.13±9.59	15				

From Table 2: it is seen that in group A, there is a significant difference between the pre-test and post–test since p<0.01, and the protocol (VMO strengthening and Conventional therapy treatment) is effective since the mean KPS score increases from 47.00 to 60.93. In group B, there is a significant difference between the pre-test and post–test since p<0.01 and the protocol (McConnell Tape and Conventional therapy treatment) is effective since the mean KPS score increases from 45.13 to 59.13.

Table 3: Intergroup analysis between Group A and Group B to compare and find the effectiveness of the intervention on VMO versus McConnel tape in patients with Patellofemoral Pain Syndrome						
SCALES	**GROUP**	**Mean ±SD**	**t**	**df**	**P**	**Remarks**
VAS	Group A	5.20±1.14				
	Group B	5.53±1.06	16.155	29	<0.01	Highly significant
KPS	Group A	60.93±10.18				
	Group B	59.13±9.59	-12.26	29	<0.01	Highly significant

Table 3 shows that the VAS mean score of group A post-treatment (VMO strengthening exercises and conventional therapy treatment) is 5.20, and the score of group B post-treatment (McConnell tape and Conventional therapy treatment) is 5.53. Therefore, according to VAS mean score, group A and group B treatment protocols relieve pain. But since p<0.01, it is found to be significant; it is seen that the KPS mean score of group A post-treatment (VMO strengthening exercises and conventional therapy treatment) is 60.93, and the score of group B post-treatment (McConnell tape and Conventional therapy treatment) is 59.13. Therefore, according to KPS mean score, group A and group B treatment protocols relieve pain. But since p<0.01, it is found to be significant. Therefore, based on the inter-group, both VAS and KPS, it was observed that VMO strengthening and McConnell tape helped improve patients with PFPS. Still, group B which received McConnell tape showed faster pain relief and improved function compared to group A, which received VMO muscle strengthening.

6. RELIABILITY

All foot locations showed good repeatability across trials for the brief squat. The maximum voluntary isometric quadriceps muscle contraction for the supinated and pronated foot positions had acceptable reliability, whereas the contraction for the neutral foot position had poor reliability. The lower ICC value for the normalized VMO/VL ratios for the maximum voluntary isometric quadriceps muscular contraction at the neutral foot position may have been caused by the consequent reduction in subject variability for this testing condition. Further ICC testing of the raw VMO EMG and VL EMG among the 3 trials was done to determine the maximum voluntary isometric quadriceps muscle contraction data for the neutral foot position to shed more light on this matter[11].

7. DATA PROCESSING

Using a specially built Labview program (Labview v2011 SP1; National Instruments) and each participant's static calibration trial and inertial properties, a 3D model of each participant's test limb was produced after data collection. Before calculating the lower limb kinematics, joint forces, and moments, the kinematic, GRF (ground reaction force), free moment, and center of pressure data were filtered using a

zero-phase-shift, fourth-order, low pass Butterworth digital filter (fc = 10 Hz; determined via residual analysis). During the eccentric phase of the SLSq, each participant's peak 3D knee and hip joint angles, forces, and external joint moments (normalized to body mass) were calculated. To produce linear envelopes (mV) roughly resembling the muscle tension curves, raw EMG signals were demeaned (zero-offset removal), full-wave rectified, and then filtered using a zero-phase-shift, second-order, lowpass Butterworth filter (fc = 20 Hz). The integrated profile approach was used to calculate the peak amplitude of each muscle and the timing of the onset of muscle activation at the start of the SLSq[6].7.

8. DISCUSSION

Our study reports that Mulligan knee taping produced clinically significant pain reductions in 26% to 42% of participants. It highlights the need for a tailored approach when using taping to optimize the management of PFP[12-15]. It is consistent with how Mulligan knee taping is used clinically, where it is only utilized if it produces a clinically significant reduction in pain.[16,17]. The effects of Mulligan's knee taping for other population groups, such as male patients, obese patients, and patients with more severe PFP, remain unknown. Second, recent literature has suggested that patients with PFP may be sub-grouped according to the factors that contribute to their presentation to tailor and optimize management and that patellar malpositioning and malt racking is only relevant for a subset of those with PFP[12,16,18] The current study did not recruit according to this concept. Thus, it remains to be seen whether the Mulligan knee-taping technique is more effective in those with evidence of malt racking, but is another area for future research[20,21]. The Mulligan knee taping technique in patients with PFP and its effect on knee pain, as well as the 3D knee and hip joint angles, forces, moments, and muscle activation patterns. As hypothesized, the results of this study indicated that Mulligan knee taping effectively reduces knee pain in participants with PFP when performing a symptom-exacerbating task, such as an SLSq. Despite this improvement, not all participants had reduced pain with the application of Mulligan tape[22]. It has been hypothesized that McConnell patellar taping optimizes the patellar tracking pattern and alters the timing and activation of the vastus medialis oblique and vastus lateralis, subsequently resulting in a reduction of patellofemoral pain[23,24,25,26,27]. The changes achieved by the McConnell taping technique are likely due to the direct influence that tape has on the patella, components of which include medial glide, tilt, or rotation, individualized to the requirements of the patient[28,29]. The vastus medialis obliqus (VMO) is of primary importance because the weakness of this muscle allows the patella to track too far laterally, which increases patellofemoral joint stress and subsequent articular cartilage wear. Achieving a balanced activity between the VMO and vastus lateralis (VL) is vital to maintain normal patellofemoral alignment. Therefore, VMO training has become an integral part of rehabilitation for patients with PFPS.[30] This study aimed to determine the effectiveness of VMO strengthening and Conventional therapy treatment (group A) and McConnell taping and Conventional therapy treatment (group B) in patients with patellofemoral pain syndrome by VAS for pain and KPS for anterior knee pain scale. Each group consisted of randomly assigned subjects, and every subject completed their therapy session. So, in this study, group A mean VAS score decreased from 6.40 to 5.20. In group, B mean VAS score decreased from 6.73 to 5.53. In the group, A KPS mean score increased from 47.00 to 60.93. In group B, the mean KPS score increased from 45.13 to 59.13. It can state that inter-group analysis of the effect of conventional therapy treatment along with VMO strengthening is similar to the conventional therapy treatment along with McConnell tape in improving pain and functional level in patients with Patellofemoral pain syndrome at the end of 6 weeks.

9. LIMITATIONS OF THE STUDY

This study consisted of a short course of treatment of 6 therapy sessions. The result only showed the short-term effects of the interventions. The sample size was small (Group A, n=15; Group B, n=15). Apart from VMO, the rest of the knee complex musculature was not considered.

10. CONCLUSION

The study findings indicate that all the interventions implemented in both Group A (Vastus Medialis Oblique strengthening and Conventional therapy treatment) and Group B (Mulligan knee taping technique (McConnell tape) and Conventional therapy treatment) resulted in some improvement in both pain and functional levels, as observed from the mean scores. However, the significance of these improvements varied between the two groups. In conclusion, this study demonstrates that the treatment protocols of Vastus Medialis Oblique strengthening and Mulligan knee taping technique (McConsnell tape) have a positive impact on individuals with Patellofemoral Pain Syndrome (PFPS), leading to improvements in pain reduction and functional capabilities.

11. AUTHORS CONTRIBUTION STATEMENT

Donicia.A. Kharsyntiew, MPT Scholar, carried out the research work in data collection and literature review and prepared the thesis as a part of the curriculum of Masters in Physiotherapy. Dr. Abhijit Dutta, Dean Faculty of Paramedical Sciences Assam down town University, guided as the main supervisor in the study along with methodology, result analysis, and study discussion. Dr. Abhijit Kalita, Assistant Professor, Dept. of Physiotherapy, helped review the literature and the methodology of the research work. All the authors read and approved the final version of the manuscript.

12. CONFLICT OF INTEREST

Conflict of interest declared none.

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