

EFFECT OF PATELLAR MOBILIZATION ALONG WITH VASTUS MEDIALIS OBLIQUE STRENGTHENING IN PATELLOFEMORAL PAIN SYNDROME

Akshara Thite¹, Vaishali Jagtap²

1 . Musculoskeletal Sciences, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed to be University) Karad, Maharashtra, India

2 . Associate Professor, Musculoskeletal Sciences, Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth (Deemed to be University) Karad, Maharashtra, India

ABSTRACT

Background:

Patellofemoral Pain Syndrome is a prevalent musculoskeletal disorder, especially in adolescents and young adults, characterized by anterior knee pain and functional limitations. It often arises due to patellar maltracking, quadriceps muscle imbalance, and Vastus Medialis Oblique weakness. Patellar mobilization combined with Vastus Medialis Oblique strengthening may enhance patellar alignment and reduce symptoms.

Objective:

To evaluate and compare the effectiveness of patellar mobilization combined with Vastus Medialis Oblique strengthening versus conventional physiotherapy on pain and functional performance in individuals with Patellofemoral Pain Syndrome.

Methods:

This experimental comparative study included 80 participants aged 18–44 years, randomly divided into conventional physiotherapy and experimental: patellar and tibiofemoral mobilization with Vastus Medialis Oblique strengthening. Both groups received therapy 5 days/week for 6 weeks. Outcome measures included the Visual Analog Scale, Range of Motion, and Anterior Knee Pain Scale. Pre- and post-intervention scores were statistically analyzed using paired and unpaired t-tests.

Results:

Group B demonstrated significant improvement in all outcome measures compared to Group A. Visual Analog Scale scores (at rest and on activity), Range Of Motion (flexion and extension), and Anterior Knee Pain Scale scores showed statistically significant differences ($p < 0.0001$) post-intervention in the experimental group.

Conclusion:

Patellar and tibiofemoral mobilization combined with Vastus Medialis Oblique strengthening is significantly more effective than conventional physiotherapy alone in reducing pain and improving function in individuals with Patellofemoral Pain Syndrome. The integration of manual therapy with targeted muscle strengthening yields superior clinical outcomes.

Keywords:

Patellofemoral Pain Syndrome, Patellar Mobilization, Vastus Medialis Oblique, Anterior Knee Pain, Range of Motion, Visual Analog Scale

How to cite this article: Thite A, Jagtap V. Effect of Patellar Mobilization Along with Vastus Medialis Oblique Strengthening in Patellofemoral Pain Syndrome. *Int J Drug Deliv Technol.* 2026;16(61s):1743-1778. DOI: 10.25258/ijddt.16.61s.198

INTRODUCTION

Patellofemoral Pain Syndrome:

Patellofemoral Pain, sometimes called Anterior Knee Pain, is a common musculoskeletal disease. When it comes to retropatellar or peripatellar knee discomfort, Patellofemoral Pain Syndrome is the most frequent cause.[1] The knee joint is a modified hinge that allows limited rotation when flexed or semi-flexed. In extension, medial rotation of the femur on the tibia locks the limb and tightens the capsular structures. Normal bony features, including the cam-shaped curve of each femoral condyle in lateral profile, play a role in this function.[2] Because each condyle has a flatter end and a

heavily curled free posterior edge, the ligamentous structures are shorter in flexion but tighter in extension. The tibial plateaux serve as articular surfaces for the femoral condyles. The medial tibial plateau is slightly concave, while the lateral facet has a cartilage cap that curves backward over the posterior margin of the tibial condyle. This characteristic has clinical significance in two domains. The popliteus initiates flexion by unscrewing the locked extended knee, allowing for the retraction of the lateral meniscus to prevent impaction during flexion. When anterior cruciate support is removed and the tibia is free to move forward, it can gently subluxate beneath the femoral condyle due to quadriceps contraction.[3] This is connected

with the clinical symptom of "the pivot shift," when the subluxation reduces with a snap as the knee flexes, forcing it to collapse or give way.[4] Such subluxations disrupt normal joint mechanics, resulting in articular surface shearing, meniscal injury, and joint degeneration. The patella first seems irregular, with a vertical ridge dividing it into a big lateral and smaller medial surface. The medial surface is separated into two smaller regions.[5] During the gait and activity cycle, contact regions of the patella fluctuate as significant stresses are applied to tiny locations.[5] Abnormal articulation can cause a variety of symptoms, including patella dislocation, Patellofemoral arthritis, and "Patellalgia" caused by Chondromalacia, despite no significant morphologic alterations to the articular cartilage.[5]

The Patellar Mobilization is a clinically effective manual therapy approach commonly employed in the management of Patellofemoral Pain Syndrome due to its ability to relieve pain, restore joint mobility, and improve patellar alignment. Patellofemoral Pain Syndrome is often associated with altered patellar tracking, muscle imbalance (particularly weakness or delayed activation of the Vastus Medialis Oblique, and restrictions in joint glides, which contribute to anterior knee pain, swelling, and reduced function. Maitland Mobilization involves the application of graded oscillatory movements to specific joint surfaces—typically Grades I and II for pain relief and Grades III and IV for improving joint mobility. In patients with Patellofemoral Pain Syndrome, Patellar Mobilization targets key dysfunctions such as limited Patellofemoral or Tibiofemoral joint gliding. For example, distal and medial glides of the patella help correct maltracking caused by lateral soft tissue tightness, while Tibiofemoral anterior or posterior glides improve overall knee joint motion. These mobilizations stimulate type II mechanoreceptors, which help modulate pain through spinal cord inhibition pathways, and improve joint nutrition and synovial fluid movement. Moreover, by reducing joint stiffness and alleviating pain, Patellar Mobilization facilitates earlier and more efficient recruitment of the Vastus Medialis Oblique muscle, a crucial stabilizer of the patella. When combined with specific strengthening exercises, especially those targeting the Vastus Medialis Oblique, Patellar Mobilization not only accelerates recovery but also ensures better long-term outcomes by addressing both biomechanical and neuromuscular deficits. Its evidence-based use enhances joint function, reduces pain, and improves overall quality of life in individuals suffering from Patellofemoral Pain Syndrome, making it an integral part of modern Physiotherapy Rehabilitation protocols.

Anatomy Of The Patellofemoral Region:

The patella, the biggest sesamoid bone in the human body, improves flexion efficiency. The artery connects with the descending branch of the lateral collateral femoral artery, supplying the Vastus Lateralis, Vastus Intermedius, along with femoral nerve.[6] The middle genicular artery provides to anterior and posterior cruciate ligaments by passing

anterior to the joint line and into the joint capsule.[7] The middle genicular artery supplies the anterior and posterior cruciate ligaments by passing anterior to the joint line and into the joint capsule.[8] The deep collateral ligaments are served by the medial inferior and lateral genicular arteries, which originate from the popliteal artery near the posterior joint.[8] The tibial (medial) collateral ligament receives blood supply from the medial inferior genicular artery, which connects to the saphenous branch of the descending genicular branch and the anterior tibial recurrent artery. The lateral inferior genicular artery connects to the anterior tibial recurrent artery, supplying the fibular (lateral) collateral ligament near the joint line.[8] Although adults and children have identical vascular structure, there are microscopic changes in blood supply to the epiphyseal plate during childhood.[8] Patellofemoral Pain Syndrome may be associated with decreased pulsatile blood flow in skeletally mature adults.[9] Mechanical forces that restrict genicular artery flow during passive flexion (20-90 degrees) may cause or contribute to pain in Patellofemoral Pain Syndrome patients.[10] Surgical disruption of the genicular arterial system does not result in permanent vascular abnormalities in the patella. The arterial supply can adequately revascularize the patella after a surgical insult during ligamentous reconstruction procedures of the knee.[11] Surgical interruption might happen during lateral retinaculum release of the patella [11], Surgical procedures are commonly used to treat Patellofemoral Pain Syndrome. If ischemia plays a role in the pathophysiology of Patellofemoral Pain Syndrome, an arteriogram or other advanced test may discover problems in collateral flow, leading to surgical or medicinal revascularization as a treatment. The concept of the word "Patellofemoral Pain Syndrome" is frequently used interchangeably with "Runner's Knee" or "Anterior Knee Discomfort," which refers to patella and retinal involvement and rules out other intraarticular and peripatellar pathologies. [11] The Patellofemoral joint is maintained by dynamic and static stabilizers that influence the movement of the patella within the trochlea, hence the term "Patellar Tracking". Imbalances in stabilizing forces can impact patellar tracking by modifying the distribution of forces across the Patellofemoral articular surface, quadriceps tendons, and soft tissues. The patella experiences forces which vary from one-third to one-half of a person's body weight while walking to three times during stair climbing and up to seven times the body weight after squatting. Symptoms usually develop gradually. Common symptoms include stiffness or discomfort when sitting with knees flexed for extended periods of time, as well as pain during activities that load the patella femoral joint, such as ascending or descending stairs, squatting, running, and kneeling. The exact cause of this condition is unknown.

Prevalence and Risk Factors:

Physical therapy is useful in treating Patellofemoral Pain Syndrome, according to several studies. Conservative therapies include quadriceps strengthening, stretching,

bracing, electrotherapy, foot orthosis, and Patellar Mobilization, among others. Conservative therapies are effective for most patients. In research one, 84 subjects were recruited, including 26 in the Patellofemoral pain group, 30 in the soft-tissue group, and 28 in the healthy group. The groups had similar mean ages. There were fewer female participants in the Patellofemoral pain group compared to the soft-tissue and healthy group.[12] The Rehabilitation program aims at repairing patella maltracking by evaluating physical examination findings. Weakness in the Vastus Medialis Obliquus muscle causes the patella to track too far laterally, leading to increased patellofemoral joint stress and articular cartilage erosion.

Vastus Medialis Oblique (VMO):

Origin: The muscle fibers largely originate from the pubic points of the adductor magnus tendon. The other points of origin include the medial lip of linea aspera and the medial supracondylar line.

Insertion: Vastus Medialis Oblique inserts onto the medial border of the patella and the knee joint capsule. It also has a

small area where it directly continues with the patella tendon.

Action: The primary function the Vastus Medialis Oblique muscle is to pull the patella medially. The alignment of the muscle fibres, which is horizontal, makes it the primary medial stabilizer of the patella. The Vastus Medialis Oblique helps align the patella within the trochlear groove during knee extension. The Vastus Medialis Oblique also participates in the last phase of knee extension.

Nerve Supply: Femoral Nerve

Blood Supply: Femoral Artery

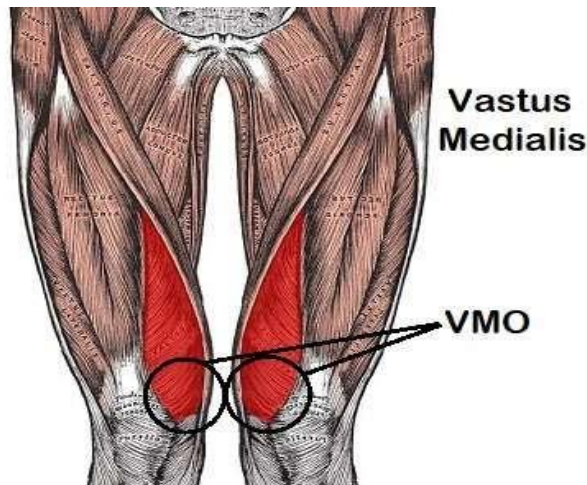


Fig 1.1. Vastus Medialis Oblique

Vastus Medialis Oblique Inhibition And Pathophysiology:

The Vastus Medialis Oblique has been extensively studied due to its critical role in Patellofemoral joint stability and its frequent involvement in Patellofemoral Pain Syndrome. In many cases of Patellofemoral Pain Syndrome, the Vastus Medialis Oblique fails to exert an adequate medial pull on the patella, resulting in abnormal patellar tracking and joint dysfunction [17]. This compromised function may be due to several contributing factors. Swelling, even in small amounts, significantly inhibits Vastus Medialis Oblique activity. Stoke and Young (1984) demonstrated that while 40 mL of intra-articular fluid is required to inhibit the Vastus Lateralis, only 10 mL is sufficient to inhibit the

Vastus Medialis Oblique [18], highlighting the sensitivity of the Vastus Medialis Oblique to effusion. Furthermore, traumatic incidents such as patellar dislocations or direct injury to the knee joint can lead to neural inhibition or damage to the motor pathways responsible for activating the Vastus Medialis Oblique. Another critical factor contributing to Vastus Medialis Oblique inhibition is pain, which can reflexively suppress muscle activity. Experimental studies using pain stimuli, such as injecting saline into the infrapatellar fat pad, have shown a rapid decline in electromyographic activity in the Vastus Medialis Oblique, confirming pain-induced neuromuscular inhibition [20]. These mechanisms underscore the importance of addressing swelling, trauma, and pain when

targeting Vastus Medialis Oblique reactivation in Rehabilitation protocols for Patellofemoral Pain Syndrome.

Patellar Mobilization:

There is limited data on the effectiveness of Patellar Mobilization in treating persistent Patellofemoral Pain Syndrome. Patellofemoral Pain Syndrome is a complex musculoskeletal condition commonly encountered in young adults, characterized by anterior knee pain that worsens with activities such as climbing stairs, squatting, or prolonged sitting. Among various treatment modalities, manual therapy, including joint Mobilization such as the Patellar Mobilization method, has gained clinical interest. However, despite its increasing use in physical therapy settings, evidence supporting the clinical efficacy of Patellar Mobilization, especially in individuals with long-standing Patellofemoral Pain Syndrome, remains sparse. Clinical trials and systematic reviews indicate that the therapeutic effect of joint Mobilization on this specific knee condition is not yet well-established, and its role in pain relief and functional improvement is not clearly defined.

There is limited data supporting its efficacy in controlling pain and function in this population. This limitation stems from the heterogeneous nature of Patellofemoral Pain Syndrome, where multiple factors, including altered biomechanics, soft tissue imbalance, neuromuscular dysfunction, and patellar maltracking, contribute to symptom persistence. Consequently, joint Mobilization alone may not be adequate to comprehensively address all underlying dysfunctions. In fact, some studies report that when used in isolation, Mobilization may have minimal or no significant impact on overall patient-reported outcomes. For example, Patellar Mobilization alone showed no significant reduction in discomfort [20]. These findings suggest that while Patellar Mobilization may temporarily improve joint mechanics or reduce stiffness, it may not provide sufficient stimulus to alter the course of chronic Patellofemoral Pain Syndrome symptoms or enhance long term recovery outcomes. Thus, the standalone use of Mobilization should be approached with caution, especially in cases with multifactorial etiologies. Manual therapy combined with multimodal treatment or exercise yielded only fair short and long-term results for Patellofemoral Pain Syndrome [20].

This observation aligns with current Rehabilitation practices that favor a multimodal approach over singular interventions. When Patellar Mobilization is integrated with targeted exercises, neuromuscular re-education, proprioceptive training, and activity modification, the outcomes appear to improve moderately. However, the overall clinical benefit still tends to be modest, highlighting the need for individualized and evidence-based treatment planning. Furthermore, the variability in Patellar Mobilization application, therapist experience, and patient-specific anatomy also influences treatment success. Studies emphasize that while some patients may respond positively to manual interventions, others may not experience clinically meaningful improvements unless Mobilization is

precisely tailored and appropriately timed within the Rehabilitation progression. Although manual therapy has been used to treat knee pain, there is currently no systematic assessment of the effects of Patellar Mobilization on persons with Patellofemoral Pain. Most literature to date includes isolated case studies, small cohort trials, or clinical anecdotes, lacking large-scale randomized controlled trials that could validate the effectiveness of such interventions.

The absence of a standardized protocol, consistent dosing parameters, and consensus on outcome measures further limits the ability to draw definitive conclusions. Additionally, current clinical guidelines and consensus statements often prioritize exercise therapy, patient education, and motor control strategies over passive treatments like manual therapy, unless used as adjuncts. Therefore, while Patellar Mobilization may offer short-term symptom modulation or preparatory benefits for exercise engagement, its primary role in Patellofemoral Pain Syndrome management remains supplementary rather than curative. The Visual Analogue Scale is a widely used tool for self-assessment of pain, where patients rate their pain on a scale from 0 to 10, with 0 indicating no pain and 10 indicating the worst imaginable pain [23]. The visual analog scale is highly valued in both clinical and research contexts for its simplicity, ease of administration, and sensitivity to change. In the context of Patellofemoral Pain Syndrome, it serves as a fundamental metric for evaluating pain fluctuations in response to interventions, including manual therapy techniques. Its utility extends to session-to-session monitoring, enabling therapists to adjust treatment intensity or duration based on patient reported outcomes. However, due to its subjective nature, visual analog scale should be interpreted alongside objective functional assessments to ensure comprehensive evaluation. Another commonly used tool is the Kujala Patellofemoral Scale, also known as the Anterior Knee Pain Scale.

This scale is specifically designed to evaluate Anterior Knee Pain and functional limitations related to Patellofemoral disorders. It includes components that assess stair climbing, squatting, running, and prolonged sitting with knee flexion—activities that typically exacerbate symptoms in Patellofemoral Pain Syndrome. It has demonstrated high reliability, with an intraclass correlation coefficient ranging from 0.90 to 0.98, making it a dependable measure for both clinical and research settings [25]. The Kujala score offers a more comprehensive insight into how Patellofemoral Pain Syndrome affects daily activities and physical performance. When utilized in studies evaluating Patellar Mobilization, this scale can help correlate functional improvement with structural interventions, offering a broader picture of treatment efficacy. Despite the limited standalone effectiveness of manual therapy, tools like the Kujala Scale and visual analog scale remain essential in evaluating patient outcomes and guiding clinical decision-making. While the Patellar Mobilization and other manual therapy approaches are commonly applied in the management of Patellofemoral Pain Syndrome, current evidence points to

their limited standalone effectiveness. Patellar Mobilization alone does not appear to significantly reduce discomfort [20], and the combination of manual therapy with other modalities yields only fair outcomes [20]. Pain assessment tools like the Visual Analog Scale [23] and functional scales like the Kujala [25] are essential in measuring treatment response but should guide clinicians toward comprehensive, individualized programs that emphasize active Rehabilitation strategies. Future studies with rigorous methodologies are needed to better understand the optimal role of joint Mobilization in Patellofemoral Pain Syndrome management and to establish evidence-based protocols for its use.

Functional Impairment and Extension Lag:

Functional Impairment and Extension Lag are common clinical manifestations in individuals with Patellofemoral Pain Syndrome, significantly affecting mobility and quality of life. Extension Lag is defined as the inability to actively achieve full knee extension, despite the joint being able to passively extend fully. This condition is often due to a combination of factors, most notably weakness or inhibition of the quadriceps muscle group—especially the Vastus Medialis Oblique—as well as pain-related neural inhibition and joint stiffness. The Vastus Medialis Oblique plays a critical role in the final degrees of knee extension, particularly in stabilizing the patella medially and guiding its proper tracking within the femoral trochlea.

In Patellofemoral Pain Syndrome, the Vastus Medialis Oblique is frequently underactive or delayed in its activation compared to the lateral quadriceps components (e.g., Vastus Lateralis), leading to altered patellar biomechanics and impaired force generation. This dysfunction contributes directly to extension lag, where the knee cannot fully straighten during gait or weight-bearing tasks, resulting in compensatory movements, inefficient loading, and increased joint stress. Pain is another major factor in extension lag. When pain is present, particularly in the anterior knee, the body instinctively inhibits muscle activation around the joint through a phenomenon known as arthroscopic muscle inhibition. Even mild joint effusion—such as 10–20 mL of intra-articular fluid—can significantly inhibit quadriceps activation, with the Vastus Medialis Oblique being the most sensitive to such changes. This leads to functional deficits, as patients may avoid terminal extension due to discomfort, further weakening the extensor mechanism and contributing to a cycle of disuse and muscle atrophy. In addition to muscle weakness and inhibition, soft tissue tightness, inflammation, and joint swelling also contribute to a reduced range of motion.

The discomfort associated with Patellofemoral Pain Syndrome often leads to a guarding response, where the patient subconsciously limits knee extension to avoid pain, resulting in joint stiffness over time. Furthermore, prolonged periods of disuse or altered loading patterns may cause adaptive shortening of the posterior structures, such as the hamstrings and capsule, exacerbating extension deficits. Research supports the use of targeted Vastus Medialis

Oblique strengthening exercises—such as straight leg raises, mini squats on a Vastus Medialis Oblique board, and biofeedback training—as effective strategies to restore active terminal knee extension. Additionally, incorporating manual therapy like Patellar Mobilizations can alleviate pain and improve Patellofemoral joint mechanics, thereby enhancing the effectiveness of neuromuscular re-education and functional training. Restoring full extension is critical not only for efficient gait and squatting mechanics but also for preventing further deterioration of joint health, reducing patellar maltracking, and improving overall functional performance in Patellofemoral Pain Syndrome patients. The conventional treatment group in this study followed a structured Physiotherapy protocol that aimed to alleviate pain, enhance muscle strength, and restore functional mobility of the knee joint in individuals with Patellofemoral Pain Syndrome. The initial phase of treatment involved cryotherapy, applied for 10 minutes.

This modality helped in reducing local inflammation and muscle spasm by lowering tissue temperature, which ultimately contributed to decreased pain and swelling. Muscle relaxation following cryotherapy enhanced the patient's readiness for subsequent exercises. To further address pain, Transcutaneous Electrical Nerve Stimulation was administered for 10 minutes using electrodes placed directly over the painful knee area. With pulse parameters set within a range of 50–250 milliseconds and frequency between 90–130 Hz, Transcutaneous Electrical Nerve Stimulation provided analgesia through pain gate control mechanisms and endorphin release. Complementing this, ultrasound therapy was delivered for 8 minutes at an intensity of 0.8 W/cm² over the affected region. The thermal and non-thermal effects of ultrasound helped in reducing inflammation, increasing tissue extensibility, and accelerating tissue repair. The therapeutic protocol also emphasized strengthening exercises to restore muscular support around the knee. Isometric exercises for the hamstrings, quadriceps, and adductors were incorporated to improve joint stability and muscle endurance without placing excessive stress on the joint. These exercises involved static contractions where the muscle length remained unchanged, thus preventing aggravation of symptoms. Straight leg raises were used specifically to engage the quadriceps, promoting controlled activation and maintaining correct lower limb alignment during functional movement. Stretching exercises were also integral to the conventional regimen. Quadriceps and hamstring muscles were targeted to improve flexibility and reduce tightness, which often contributes to altered Patellofemoral biomechanics.

Stretching not only alleviated muscular imbalances but also improved the overall range of motion of the knee joint. A key component of the intervention was the Vastus Medialis Oblique strengthening exercise, performed using a specially inclined Vastus Medialis Oblique board. Patients performed controlled shallow squats on the board, emphasizing the activation of the medial quadriceps to enhance patellar

tracking and stabilization. This comprehensive protocol of electrotherapy, static strengthening, flexibility training, and vastus medialis oblique-targeted activity formed the cornerstone of the conventional Physiotherapy approach. In contrast, the experimental group received an expanded Physiotherapy program that integrated all elements of the conventional protocol with additional functional exercises and Patellar Mobilization. The session began with cryotherapy for 10 minutes to mitigate pain and reduce muscle tension, followed by Transcutaneous Electrical Nerve Stimulation (pulse width 50–250 ms, frequency 90–130 Hz) and ultrasound therapy (8 minutes at 0.8 W/cm²), delivered in the same parameters and placement as the conventional group. This sequence of modalities prepared the knee for active Rehabilitation. Isometric strengthening for the hamstrings, quadriceps, and adductors was again performed, followed by straight leg raises and Vastus Medialis Oblique-focused shallow squats using the inclined board.

Additional dynamic strengthening was introduced in the form of knee extension exercises from 90° to 0° flexion, designed to mimic daily functional movements and enhance active control through full range of knee motion. Functional strengthening exercises played a significant role in the experimental protocol. Wall squats combined with isometric hip adduction were performed using a pillow between the knees, which targeted both the quadriceps and hip stabilizers. Forward lunges encouraged dynamic knee

alignment and control through eccentric and concentric quadriceps activation. Side-lying clam exercises and side leg raises were added to engage the hip abductors, crucial for pelvic stability and lower limb alignment. Step-ups onto a stable platform improved closed kinetic chain control and simulated stair-climbing and daily mobility tasks, enhancing lower limb coordination and proprioception. Furthermore, three key Patellar Mobilization were incorporated.

Tibiofemoral posterior glide mobilization in sitting aimed to enhance knee extension by Mobilizing the tibia posteriorly relative to the femur. Anterior glide in the prone position was utilized to improve overall knee Range Of Motion. Additionally, patellofemoral distal glide was performed in the supine position with a caudal movement of the patella to facilitate patellar mobility, reduce stiffness, and improve tracking. These Mobilization, based on the Patellar Mobilization concept, were designed to restore joint play, improve accessory motion, and reduce pain via mechanoreceptor stimulation. Overall, the experimental protocol was more comprehensive, addressing not only muscular imbalances and pain but also restoring functional movement patterns and joint mechanics through evidence-based manual therapy and task-specific strengthening. This integrative approach was hypothesized to produce superior outcomes in terms of pain relief, functional improvement, and neuromuscular control when compared to conventional treatment alone.

NEED FOR STUDY

- The knee joint is an important weight-bearing joint in the human body that is utilized for daily activities such as walking, sitting, standing, and running. According to current evidence, it most usually occurs in adolescents as a result of overuse, injury, or muscle imbalance. It is also more common in women than in men because women have a larger pelvis, which increases the angle at which the bones of the knee joint contact.[26,27]
- Previously patellar mobilization for patellofemoral pain syndrome effectively reduced pain and made the patellofemoral joint function.
- This study conducted to assess the severity of associated patellofemoral pain syndrome.
- The effectiveness of patellar mobilization with vastus medialis oblique strengthening in patellofemoral pain syndrome have been studied to assess the severity of associated patellofemoral pain syndrome.
- It is necessary to study the effectiveness of patellar mobilization with vastus medialis oblique strengthening in patellofemoral pain syndrome and its relation to functional disability.
- The study will also help us to find out related strengthening exercises of lower extremity in sedentary lifestyle of people.
- Whereas this study will help in gaining focus on developing enhanced strength, normal patellar tracking and will help in reducing pain which will help in improvement of movement.
- This study aimed to assess the effectiveness of tibiofemoral and patellofemoral mobilization prior to an exercise protocol in improving pain and functional ability, as well as the effectiveness of knee strengthening and stretching activities after tibiofemoral and patellofemoral mobilization.
- One of the current treatment methods for musculoskeletal problems is the tibiofemoral and patellofemoral mobilization approach, which is a painless manual method of treatment that involves gliding performed by the physiotherapist, as well as active movement in the painful joint.
- It is the need of the hour to pay attention to these problems associated with the patellofemoral pain Syndrome in order to minimize the early consequences in the later life.
- Hence, this study has been undertaken to see the effect of patellar mobilization along with vastus medialis oblique strengthening in patellofemoral pain syndrome.

AIM AND OBJECTIVES

AIM AND OBJECTIVES

AIM

- To study the effect of patellar mobilization along with Vastus Medialis Oblique strengthening in Patellofemoral Pain Syndrome.

OBJECTIVES

- To determine the effect of patellar mobilization along with Vastus Medialis Oblique strengthening on pain in individuals with Patellofemoral Pain Syndrome.
- To determine the effect of patellar mobilization along with Vastus Medialis Oblique strengthening on functional performance in individuals with Patellofemoral Pain Syndrome.
- To compare the effect of patellar mobilization and conventional exercises with Vastus Medialis Oblique strengthening on pain and functional performance in individuals with Patellofemoral Pain Syndrome.

HYPOTHESIS

HYPOTHESIS

- Null Hypothesis:

There is no significant effect of patellar mobilization along with vastus medialis oblique strengthening in patellofemoral pain syndrome.

- Alternate Hypothesis:

There is significant effect of patellar mobilization along with vastus medialis oblique strengthening in patellofemoral pain syndrome.

LITERATURE REVIEW

LITERATURE REVIEW

1. **Earl JE, Hoch AZ. A proximal strengthening program improves pain, function, and biomechanics in women with patellofemoral pain syndrome. The American journal of sports medicine. 2011 Jan;39(1):154-63.**
- This study examined the improvement in hip strength, core endurance, lower extremity biomechanics, and patient outcomes after proximally focused rehabilitation for patellofemoral pain syndrome patients. Nineteen women with patellofemoral pain syndrome participated in an 8-week program to strengthen the hip and core muscles and improve dynamic malalignment with visual analog scale and manual muscle testing outcome measures. Significant improvements in pain, functional ability, lateral core endurance, hip abduction, and hip external rotation strength were observed. In conclusion an 8-week rehabilitation program focusing on strengthening and improving neuromuscular control of the hip and core musculature produces

positive patient outcomes, improves hip and core muscle strength, and reduces the knee abduction moment, which is associated with developing patellofemoral pain syndrome. [25]

2. **Prieto-García LF, Cortés-Reyes E, Lara-Cotacio G, Rodríguez-Corredor LC. Therapeutic effect of two muscle strengthening programs in patients with patellofemoral pain syndrome. A randomized controlled clinical trial. Revista de la Facultad de Medicina. 2021 Jun;69(2).**

- In this experimental randomized controlled clinical trial conducted in 40 patients with patellofemoral pain syndrome, aged 15-40 years. Participants were randomly distributed into 2 interventions. The level of pain was measured using the Visual Analog Scale and the Kujala Anterior Knee Pain Scale. The results of the study concluded Including core muscle strengthening exercises in the conservative management of patellofemoral pain syndrome increases its effectiveness to reduce pain and improve the quality of life of these patients. [26]
- . **Alba-Martín P, Gallego-Izquierdo T, Plaza-Manzano G, Romero-Franco N, Núñez-Nagy S,**

RESEARCH PAPER

- Pecos-Martín D. Effectiveness of therapeutic physical exercise in the treatment of patellofemoral pain syndrome: a systematic review. Journal of physical therapy science. 2015;27(7):2387-90.**
- In this systematic review 10 studies were included, a total of 420 participants were assessed. They were assessed on visual analog scale, numeric pain rating scale, Patellofemoral Pain joint evaluation scale, MPQ, Dynamic Q- angle, WOMAC, Lower Extremity Function Scale, Functional Index Questionnaire. Thus, this study showed intervention programs that were most effective in relieving pain and improving function in patellofemoral pain syndrome included proprioceptive neuromuscular facilitation stretching and strengthening exercises for the hip external rotator and abductor muscles and knee extensor muscles. [27]
- 4. Patil K, Patil P. Effect of Patellar Realignment Training in Patellofemoral Pain Syndrome. Indian Journal of Public Health Research & Development. 2023 Jan 1;14(1).**
- The purpose of the current cross-sectional study was to evaluate the effect of effect of Patellar Realignment Training in Patellofemoral Pain Syndrome. 37 females were participated in 4 weeks exercises program. Outcome measures was visual analog scale, range of motion, manual muscle testing, Q angle, postural assessment. We found that realignment training showed significant improvement in the outcome variable concluding that it improves functional ability and reduce pain. It can be further concluded that Conventional treatment can be more efficacious if combined with realignment training.[28]
- 5. Lee JH, Jang KM, Kim E, Rhim HC, Kim HD. Static and dynamic quadriceps stretching exercises in patients with patellofemoral pain: a randomized controlled trial. Sports health. 2021 Sep;13(5):482-9.**
- This study compares quadriceps flexibility, strength, muscle activation time, and patient-reported outcomes after static and dynamic quadriceps stretching exercises in patients with patellofemoral pain who had inflexible quadriceps. In this Randomized control trial 44 patients were classified into two groups. Outcome measures included Quadriceps Flexibility Test (Ely Test), biodex Multi-Joint System 4 isokinetic device, Anterior Knee Pain Scale, Visual Analog Scale. This study concluded Both static and dynamic stretching exercises may be effective for improving pain and function in patients with patellofemoral pain syndrome who have inflexible quadriceps.[29]
- 6. Aghapour E, Kamali F, Sinaei E. Effects of Kinesio Taping® on knee function and pain in athletes with patellofemoral pain syndrome. Journal of bodywork and movement therapies. 2017 Oct 1;21(4):835-9.**
- This study compared the knee performance and pain in athletes with patellofemoral pain syndrome (PFPS) before and after applying Kinesio Tape on vastus medialis obliquus muscle following a four weeks Progressive training program in 15 participants. They were assessed on Isokinetic dynamometer, VAS, Kujala questionnaire. The results shown were applying KT on vastus medialis oblique can decrease pain and improve the functional performance, generally and quadriceps muscle strength, particularly, in athletes with patellofemoral pain syndrome.[30]
- 7. Avraham F, Aviv S, Ya'akobi P, Faran H, Fisher Z, Goldman Y, Neeman G, Carmeli E. The efficacy of treatment of different intervention programs for patellofemoral pain syndrome—a single blinded randomized clinical trial. Pilot study. The scientific world journal. 2007 Aug 24;7:1256-62.**
- To find the efficacy of Treatment of Different Intervention Programs for Patellofemoral Pain Syndrome. 30 patients were participated in this randomized clinical trial with outcomes VAS and Patellofemoral evaluation scale. At end of trial, all groups showed significant improvements in VAS and PFJES ($p < 0.0001$) these improvements did not vary significantly between the 3 groups. The conclusions were that the explored different rehabilitation programs showed a similar beneficial effect.[31]
- 8. Watson CJ, Leddy HM, Dynjan TD, Parham JL. Reliability of the lateral pull test and tilt test to assess patellar alignment in subjects with symptomatic knees: student raters. Journal of Orthopaedic & Sports Physical Therapy. 2001 Jul;31(7):368-74.**
- The aim of the study is to determine the inter- and intra-rater reliability of the lateral pull test and patellar tilt test. Fifty-two subjects (age range, 21-48 years) provided 95 knees (19 symptomatic and 76 asymptomatic) for assessment of the lateral pull test. Repeated lateral pull tests and patellar tilt tests had fair intra-rater and poor interrater reliability. Results suggest that care must be taken in placing too much emphasis on these tests when making clinical decisions.[32]
- Hossein HS, Sara A, Hasan D. The effect of three types of exercises programs on the patella location in athletes with patellofemoral pain. The Knee. 2023 Mar 1;41:97-105.**
- The aim of this study was to compare the effect of exercises focusing on the proximal and distal joints to knee and knee local exercises on the Patellar location in athletes with patellofemoral pain. A

RESEARCH PAPER

randomized controlled, single-blinded trial was conducted. Thirty-five athletes with patellofemoral pain were randomly divided into three groups; proximal, distal and local with outcomes of Q-angle and digital radiology. The findings of the present study indicated further improvement in patellar location and knee pain in the proximal group. Accordingly, proximal group exercises can improve the pain and performance of athletes with patellofemoral pain by patellar relocation to the normal position.[33]

10. Best MJ, Tanaka MJ, Demehri S, Cosgarea AJ. Accuracy and reliability of the visual assessment of patellar tracking. The American Journal of Sports Medicine. 2020 Feb;48(2):370-5.

- The purpose of the study is to determine the accuracy and reliability of the visual assessment of patellar tracking when viewed by surgeons with patellofemoral expertise and whether surgeon experience correlates with the ability to accurately identify the presence and severity of patellar mal-tracking. 29 patients were participated in this cohort study with Video capture, 4DCT Imaging outcomes measures. Using visual assessment alone, surgeons correctly identified patellar mal-tracking in approximately two-thirds of videos and correctly graded patellar mal-tracking in half. Inter- and intra-observer reliability were inadequate to support the use of visual assessment alone for detecting the presence or grade of patellar mal-tracking. [34]

11. Smith BE, Selfe J, Thacker D, Hendrick P, Bateman M, Moffatt F, Rathleff MS, Smith TO, Logan P. Incidence and prevalence of patellofemoral pain: a systematic review and meta-analysis. PloS one. 2018 Jan 11;13(1):e0190892.

- The aim of this systemic review was to find the incidence and prevalence of patellofemoral pain. 23 studies were included in this study. An electronic database search was conducted, as well as grey literature databases, from inception to June 2017. Annual prevalence for patellofemoral pain in the general population was reported as 22.7%, and adolescents as 28.9%. This review demonstrates high incidence and prevalence levels for patellofemoral pain. Within the context of this, and poor long term prognosis and high disability levels, patellofemoral pain should be an urgent research priority. [35]

MATERIALS AND METHODOLOGY

- Type of study: Experimental study

- Study design: Comparative study
- Sample size: 80 (40 in each group)
- $n = (Z\alpha + Z\beta)^2 \frac{2(S_1^2 + S_2^2)}{(m_2 - m_1)^2}$
- $Z\alpha = 1.96$
- $Z\beta = 0.84$
- $S_1 = S_2 = 10$
- $m_2 - m_1 \approx 8.85$
- $n = 80$
- Study duration: one year
- Sampling technique: Simple random sampling
- Place of study: Krishna Hospital, Karad
- Frequency: 5 days/week for 6 weeks

CRITERIA FOR SELECTION

INCLUSION CRITERIA

- Both genders
- Clinically diagnosed with Patellofemoral Pain Syndrome.
- Physically active people between the ages of 18-44 yrs who experience Anterior Knee Pain, Patellar Maltracking frequently experience such problems.
- Participants diagnosed with Patellofemoral Pain Syndrome stages 1 and 2.

EXCLUSION CRITERIA

- Recent traumatic knee injury.
- Lower limb deformities.
- Chronic systemic conditions such as rheumatoid arthritis.
- Previous knee surgeries.

MATERIALS

- Data collection sheet
- Consent form
- Pillow
- Pen
- Paper

OUTCOME

MEASURES

Visual Analog Scale:

This scale allows patient to visually gauge the amount of pain along solid 10 cm line. It is a measurement instrument that tries to measure a characteristic that believed to range across a continuum of values and cannot easily be directly measured. Visual analog scale is unidimensional measure of pain intensity, which has been widely used in diverse adult population.[36]

Anterior Knee Pain Scale:

The Anterior Knee Pain Scale, also known as the Kujala Score, is a validated questionnaire designed to assess symptoms and functional limitations associated with patellofemoral pain syndrome. It evaluates factors such as pain during activities, limping, swelling, and muscle atrophy. The anterior knee pain scale is widely used due to its high reliability and validity in both clinical and research settings. Its sensitivity to changes in

RESEARCH PAPER

patient condition makes it effective for monitoring treatment outcomes. Moreover, the scale has been adapted and validated in various languages and cultural contexts, ensuring its applicability across diverse populations.[37]

Reliability: The Anterior Knee Pain Scale demonstrates high reliability, with reported test-retest reliability coefficients ranging from 0.92 to 0.95, indicating excellent consistency over time (Thompson et al., 2006; Witvrouw et al., 2000).

Validity: The anterior knee pain scale shows strong validity, with construct validity confirmed through significant correlations with other knee function measures and clinical assessments, and criterion validity supported by its ability to discriminate between individuals with and without anterior knee pain (Kujala et al., 1993; Collins et al., 2011).

Range Of Motion:

Range of motion exercises are integral to managing patellofemoral pain syndrome because they help restore joint mobility, alleviate pain, and correct biomechanical imbalances. Limited Range Of Motion, particularly in the ankle and hip, can lead to compensatory movements like dynamic knee valgus, increasing stress on the Patellofemoral joint and exacerbating pain. Targeted interventions to improve lower limb range of motion have been shown to reduce pain and disability in the short term. Additionally, therapies such as high-intensity laser therapy have demonstrated effectiveness in increasing knee flexion angle and improving lower extremity function in

Patellofemoral Pain Syndrome patients. Overall, enhancing range of motion is a crucial component of Patellofemoral Pain Syndrome Rehabilitation, aiming to restore functional movement patterns and reduce joint stress.[38]

PROCEDURE

- This experimental study was carried out at Krishna Vishwa Vidyapeeth, Karad, after receiving approval from the Institutional Ethical Committee. Participants' permission to take part in the study was obtained through signed informed consent forms.
- A total of 80 individuals fulfilled the inclusion criteria and agreed to participate in the study. All 80 participants were actively involved throughout the study duration. These participants were randomly allocated into two Conventional and Experimental—using simple random sampling. The study was conducted over a one-year period in the Physiotherapy outpatient department of Krishna Hospital, Karad.
- The intervention was administered over a span of six weeks. Patients of all genders, aged between 18 and 44 years, who presented with symptoms of Patellofemoral Pain Syndrome lasting for more than three weeks and had abnormal patellar tracking, were included in the study. Participants were excluded if they had a recent history of fracture, previous knee surgery, ligament or meniscal injuries, or congenital deformities. Individuals in Conventional received conventional treatment, while those in Group B received Patellar Mobilization in addition to conventional treatment.
- Both groups were provided with a baseline treatment comprising 10 minutes of cryotherapy, followed by 8 minutes of ultrasound therapy and 10 minutes of transcutaneous electrical nerve stimulation.

Conventional (Group A)	Experimental (Group B)	
Cryotherapy(10 min)[39] TENS (10 min) 50-100 Hz Ultrasound (08 min) 0.8 W/cm ² Continuous Mode Knee isometric exercises (10sec hold×10 rep) 1. Hamstring isometrics 2. Quadriceps isometrics 3. Adductors isometrics Straight leg raises(10sec hold×5 rep) Quadriceps and hamstring stretching (10sec hold× 5 rep) Vastus medialis oblique strengthening using VMO board (5sec hold× 10 rep) Knee extension exercises(10sec hold×10 rep) Double leg squat with isometric hip adduction exercise (without hold×10 rep) Lunges exercise (without hold×10 rep)	Side lying clam exercises(10 rep×5sets) Step ups exercises(10 rep×5sets) Side leg raises(10 rep×5sets) Tibiofemoral mobilization Patellofemoral mobilization	

RESEARCH PAPER

Conventional Group A Exercises:

1. Cryotherapy : (10 min) [39]
cryotherapy for reducing pain and swelling. It is used for muscle relaxation.
2. Transcutaneous electrical nerve stimulation:(10 Min) [40]

TENS (pulsed width 50-250ms, pulse rate: 90-130 Hz) electrode placed over painful area.
3. Ultrasound :(8 min, 0.8 W/cm²) [41]

Ultrasound given over painful area of knee joint.
4. Hamstring isometric exercises: [42]
To perform them, start by lying down with patient legs extended. Place a resistance (like a towel) around the patient foot or the lower part of your leg. Press your foot against the resistance, engaging your hamstring as hard as you can while keeping your leg still. Hold the contraction for about 10 seconds, then relax. Repeat for several sets. These exercises are great for strengthening the hamstrings, improving stability, and preventing injury.
5. Quadriceps isometric exercises: [42]
Quadriceps isometric exercises involve contracting the quadriceps muscles without changing their length. To perform them, supine with your leg extended straight. Tighten the muscles on the top of patient thigh by pushing patient knee down toward the floor or against a surface. Hold the contraction for about 10 seconds, making sure to keep patient leg still. Relax, and repeat for several sets. This exercise helps strengthen the quadriceps, improve knee stability, and is often used in rehabilitation programs.
6. Adductors isometric exercises: [42]
Adductor isometric exercises target the inner thigh muscles by contracting them without any movement. To perform them, supine with flexed both knees . Place a soft object like a towel between patient knees. Squeeze your knees together as hard as patient can, engaging the inner thigh muscles, while keeping legs still. Hold the contraction for about 10 seconds, then relax. Repeat for several sets. These exercises help strengthen the adductors, improve hip stability, and prevent injuries in the groin area.
7. Straight leg raises: [42]
Lie flat on your back on a comfortable surface, like plinth. Keep one leg bent at the knee with your foot flat on the ground, and extend the other leg straight out. Tighten the muscles on the top of your thigh (quadriceps) of the leg that is straight. Keep patient knee fully extended. lowly raise the straight leg up to the height of the bent knee, keeping it straight throughout the movement. Patient foot should stay flexed, and the movement should be smooth and controlled.Hold the leg in the raised position for a moment (10 seconds), then slowly lower it back to the ground. Perform the exercise for 5 repetitions, then switch to the other leg.
8. Quadriceps stretching: [43]
Begin by standing with your feet hip-width apart. You can hold onto a wall or chair for balance if needed. Gently bend one knee and bring your heel up toward your glutes, reaching back with the hand on the same side. Hold your ankle or foot with your hand, making sure your knee stays pointing downward (not out to the side). Keep your other leg slightly bent for stability. Gently push your hips forward, keeping your torso upright, to increase the stretch in the front of your thigh. Patient should feel the stretch along the top of your thigh. Hold the stretch for about 20-30 seconds, breathing deeply and maintaining a steady, gentle pull. Slowly release patient ankle and return to the starting position. Repeat on the other leg.
9. Hamstring stretching: [43]
Extend one leg straight in front of you and bend the other leg so the sole of patient foot rests against the inner thigh of the extended leg. Keep patient back straight and shoulders relaxed. Slowly lean forward from your hips (not your lower back), reaching toward your toes on the extended leg. Keep your knee straight but not locked. You should feel a gentle stretch along the back of your thigh (hamstring). Don't force the movement or bounce. Maintain the position for 10 seconds, breathing deeply. Slowly return to the starting position and repeat on the other leg.
10. Vastus medialis oblique strengthening using VMO board:
Place the VMO board on a flat surface with the incline sloping downward and inward (toward the center). Make sure it's stable and non-slip. Stand on the board with patient feet shoulder-width apart, toes pointing slightly outward. Patient knees should be aligned with patient second toes. Slowly lower into a shallow squat (about 30–45 degrees of knee bend), keeping patient back straight and knees tracking over your toes. At the bottom of the movement, hold the squat for 10 seconds, focusing on contracting the VMO — the inner part of the quadriceps just above the knee. Slowly rise back to the starting position. Repeat for 10 reps, doing 5 sets. Maintain slow, controlled movement

RESEARCH PAPER

throughout. Avoid letting your knees collapse inward.

Experimental Group B Exercise:

1. Cryotherapy : (10 min)
cryotherapy for reducing pain and swelling. It is used for muscle relaxation.
2. Transcutaneous electrical nerve stimulation:(10 Min)
TENS (pulsed width 50-250ms, pulse rate: 90-130 Hz) electrode placed over painful area.
3. Ultrasound :(8 min, 0.8 W/cm²)
Ultrasound given over painful area of knee joint.
4. Hamstring isometric exercises:
To perform them, start by lying down with patient legs extended. Place a resistance (like a towel) around the patient foot or the lower part of your leg. Press your foot against the resistance, engaging your hamstring as hard as you can while keeping your leg still. Hold the contraction for about 10 seconds, then relax. Repeat for several sets. These exercises are great for strengthening the hamstrings, improving stability, and preventing injury.
5. Quadriceps isometric exercises:
Quadriceps isometric exercises involve contracting the quadriceps muscles without changing their length. To perform them, supine with your leg extended straight. Tighten the muscles on the top of patient thigh by pushing patient knee down toward the floor or against a surface. Hold the contraction for about 10 seconds, making sure to keep patient leg still. Relax, and repeat for several sets. This exercise helps strengthen the quadriceps, improve knee stability, and is often used in rehabilitation programs.
6. Adductors isometric exercises:
Adductor isometric exercises target the inner thigh muscles by contracting them without any movement. To perform them, supine with flexed both knees . Place a soft object like a towel between patient knees. Squeeze your knees together as hard as patient can, engaging the inner thigh muscles, while keeping legs still. Hold the contraction for about 10 seconds, then relax. Repeat for several sets. These exercises help strengthen the adductors, improve hip stability, and prevent injuries in the groin area.
7. Straight leg raises:
Lie flat on your back on a comfortable surface, like plinth. Keep one leg bent at the knee with your foot flat on the ground, and extend the other leg straight out. Tighten the muscles on the top of your thigh (quadriceps) of the leg that is straight. Keep patient knee

fully extended. lowly raise the straight leg up to the height of the bent knee, keeping it straight throughout the movement. Patient foot should stay flexed, and the movement should be smooth and controlled. Hold the leg in the raised position for a moment (10 seconds), then slowly lower it back to the ground. Perform the exercise for 5 repetitions, then switch to the other leg.

8. Quadriceps stretching:

Begin by standing with your feet hip-width apart. You can hold onto a wall or chair for balance if needed. Gently bend one knee and bring your heel up toward your glutes, reaching back with the hand on the same side. Hold your ankle or foot with your hand, making sure your knee stays pointing downward (not out to the side). Keep your other leg slightly bent for stability. Gently push your hips forward, keeping your torso upright, to increase the stretch in the front of your thigh. Patient should feel the stretch along the top of your thigh. Hold the stretch for about 20-30 seconds, breathing deeply and maintaining a steady, gentle pull. Slowly release patient ankle and return to the starting position. Repeat on the other leg.

9. Hamstring stretching:

Extend one leg straight in front of you and bend the other leg so the sole of patient foot rests against the inner thigh of the extended leg. Keep patient back straight and shoulders relaxed. Slowly lean forward from your hips (not your lower back), reaching toward your toes on the extended leg. Keep your knee straight but not locked. You should feel a gentle stretch along the back of your thigh (hamstring). Don't force the movement or bounce. Maintain the position for 10 seconds, breathing deeply. Slowly return to the starting position and repeat on the other leg.

10. Vastus medialis oblique strengthening using VMO board:

Place the VMO board on a flat surface with the incline sloping downward and inward (toward the center). Make sure it's stable and non-slip. Stand on the board with patient feet shoulder-width apart, toes pointing slightly outward. Patient knees should be aligned with patient second toes. Slowly lower into a shallow squat (about 30–45 degrees of knee bend), keeping patient back straight and knees tracking over your toes. At the bottom of the movement, hold the squat for 10 seconds, focusing on contracting the VMO — the inner part of the quadriceps just above the knee. Slowly rise back to the starting position. Repeat for 10 reps, doing 5 sets. Maintain slow, controlled movement throughout. Avoid letting your knees collapse inward.

11. knee extension exercise: [44]

The subject was seated on a raised platform with both feet off the floor and thighs supported to the popliteal fossa .

RESEARCH PAPER

A single leg extension was performed between the angles of 90 degrees to 0 degrees knee flexion.

12. Double leg squat with isometric hip adduction exercise : [44]

This exercise was achieved by compression of a folded pillow placed between the medial joint lines of the knees. The exercise was performed with the back flat against a wall while squatting to 45 degrees. The adduction force was maintained throughout the entire exercise, and a pillow was chosen to maximize comfort because there was concern that a more rigid object could lead to discomfort, thus inhibiting muscle activity and affecting electrode placement.

13. Lunge exercise [44]

A lunge exercise was performed with the measured leg foremost in a stride stance with both knees fully extended. Feet were hip-width apart and both feet were angled forward. The measured knee was flexed to 45 degrees, followed by the return to full extension while maintaining the knee in a neutral alignment over the second metatarsal. The rear knee remained in full extension throughout the exercise, and both heels remained in contact with the floor.

14. Side lying clam exercise [44]

Lie on patient one side position on an exercise mat, keeping patient upper body straight. Rest patient head on patient arm, which can either be bent or stretched out. Place the hand of patient other arm on the floor in front of patient belly to stabilize patient upper body. Place the top leg and foot on top of the other, and bend patient legs so your thigh and lower leg are at a right angle (90 degrees). Now slowly lift patient top leg toward the ceiling and lower it again, keeping patient feet together the whole time. Only lift the knee as far as you can without moving the rest of your body. Repeat 10 times. Change sides. Do 5 sets in total.

15. Side leg raises [44]

Lie on patient side on an exercise mat with patients legs stretched out. Rest patient head on your arm, which can either be bent or stretched out. Place the hand of your other arm on the floor in front of your belly to stabilize your upper body. Lift patient top leg sideways towards the ceiling, briefly hold it there, and then lower it again. Repeat this exercise 10 times. Do the same using the other leg. Do a total of 5 sets of repetitions for each leg. Make sure you keep patient body stable and carry out the movements slowly and in a controlled way. Patients upper body shouldn't move when your leg moves.

16. Step-ups [44]

Patient will need a stable bench or an aerobic step for this exercise. Stand about 10 cm in front of the step or bench. Put patient right foot on it and then step up onto it by straightening your right leg. Lift patient left leg

until your thigh is horizontal (parallel to the ground). Put patient left leg back down on the ground again. To help keep patient balance, move patient arms in the opposite direction to your legs. Repeat 10 times and then change sides. Do 5 sets in total.

Tibiofemoral Posterior Glide Mobilization (Sitting) [45]

Indication:

- To improve tibiofemoral joint flexion

Patient Position:

- Seated on the edge of a treatment table, hips and knees flexed to about 90°, feet resting on the floor.
- Place a small rolled towel proximal to the patella to minimize compression forces against the patella during the mobilization.

Therapist Hand Placement:

- One hand stabilizes the distal femur anteriorly (front of thigh).
- The other hand contacts the proximal tibia anteriorly, just below the joint line.

Mobilizing Force:

- Apply a sustained posterior glide force on the proximal tibia, directed backward (posteriorly) relative to the femur.
- Maintain the force along the tibial plateau plane, ensuring mobilization is firm but controlled.

Tibiofemoral joint: anterior glide (prone) [46]

Indication

- To improve knee extension

Patient Position:

- Patient lies prone on the treatment table with the knee slightly flexed (about 20–30 degrees)
- Place a small towel under the distal femur to prevent patellar compression.

Therapist Hand Placement:

- Grasp the distal tibia with the hand that is closer to it and place the palm of the proximal hand on the posterior aspect of the proximal tibia.

Mobilizing Force:

- Apply force with the hand on the proximal tibia in an anterior direction. The force may be directed to the lateral or medial tibia plateau to isolate one side of the joint.

Patellofemoral Joint: Distal Glide [27]

Patient position:

- Supine, with knee extended; progress to positioning the knee at the end of the available range in flexion.

Hand placement:

- Stand next to the patients thigh, facing the patients feet. Place the web space of the hand that is closer to the thigh around the superior border of the patella. Use the other hand for reinforcement.

Mobilizing force:

RESEARCH PAPER

- Glide the patella in a caudal direction, parallel to t



RESEARCH PAPER

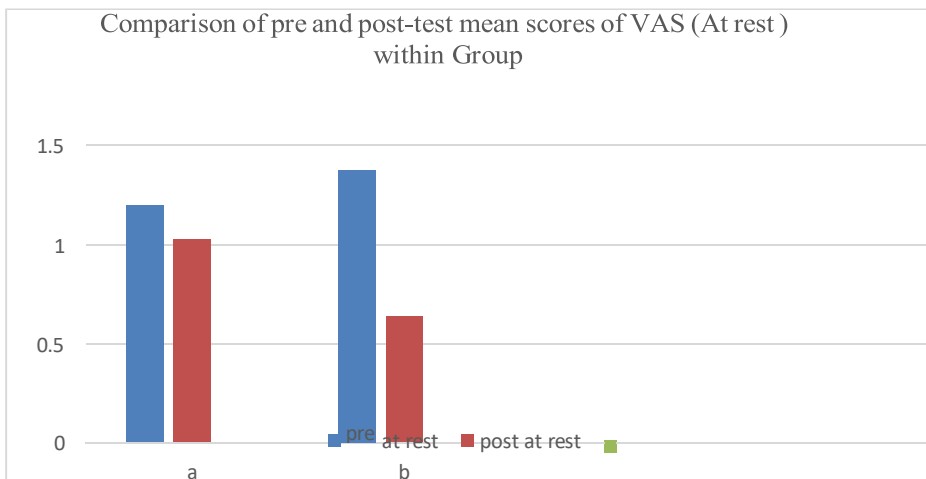
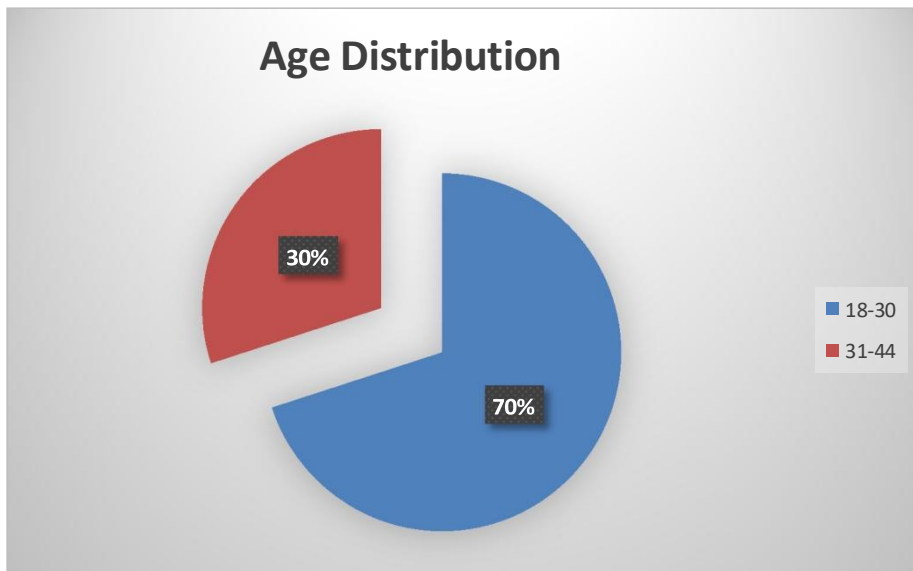
•

DATA ANALYSIS PRESENTATION AND INTRPRETATIONAGE DISTRIBUTION

Age Group	Males	Females	Total
18-30	27	29	56
31-44	11	13	24
Total	38	42	80

Interpretation Table 3.1: The study included 80 participants aged between 18 and 44 years, with the majority (56) in the 18–30 year group. This indicates that patellofemoral pain syndrome is more common in younger adults. A slightly higher number of females (42) than males (38) participated, reflecting the condition's higher prevalence among females.

Interpretation: The graph shows that 70% of participants were aged 18–30, while 30% were aged 31–44. This indicates patellofemoral pain syndrome is more common in younger adults.



RESEARCH PAPER

Gender Distribution :

Gender	Number of individual	Percentage
Female	42	52.5%
Male	38	47.5%
Total	80	100%

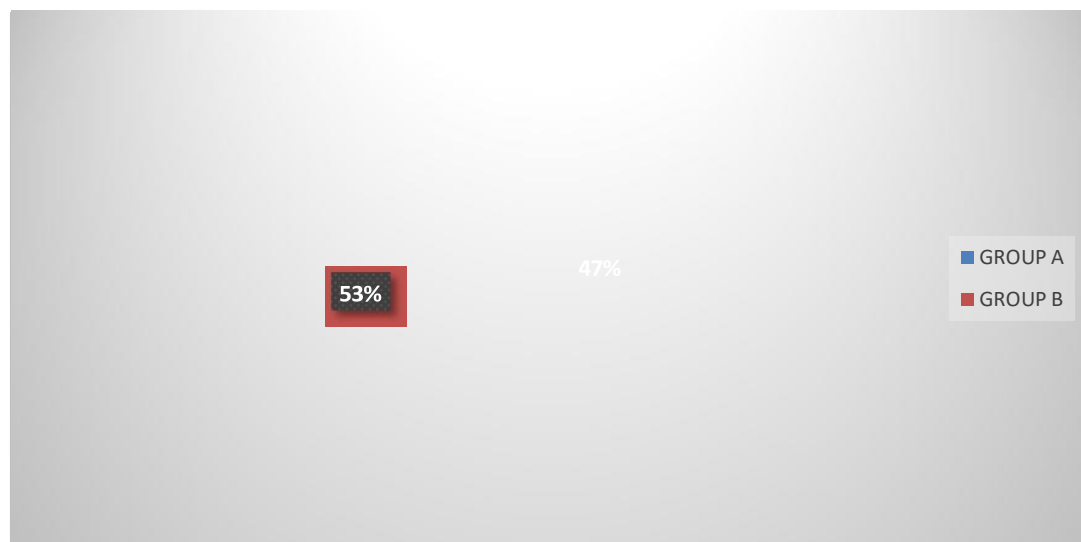
Interpretation Table 3.2: Out of 80 participants, 42 were females (52.5%) and 38 were males (47.5%). This indicates a slightly higher female participation in the study. The gender distribution reflects a higher prevalence of patellofemoral pain in females.

Interpretation: The pie chart shows 53% participants were in Group B and 47% in Group A. This indicates a nearly equal distribution of participants across both study groups.

OUTCOME MEASURES- Visual Analogue Scale (VAS)

Comparison of pre and post-test mean scores of VAS (At rest) within Group

	Pre at rest	Post at rest	Man diff.	P value
Group A	1.2±0.9115	1.025±0.8619	0.175	0.0176



Group B	1.375±1.254	0.6360±0.425	0.95	<0.0001
---------	-------------	--------------	------	---------

RESEARCH PAPER

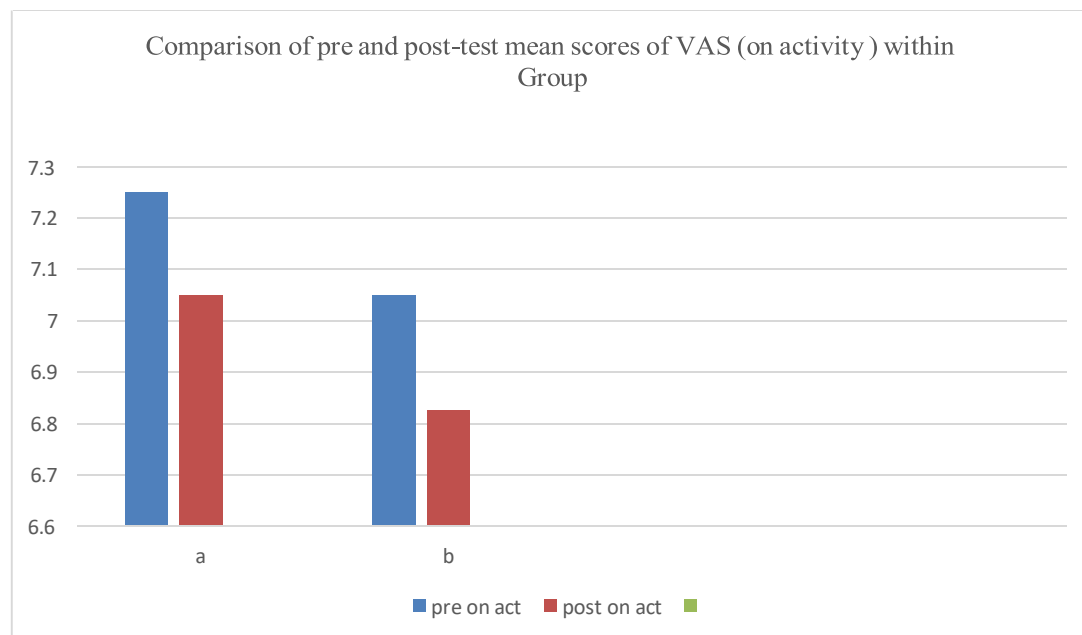
	Pre On Activity	Post On Activity	Mean diff.	P value
Group A	7.25±0.9541	7.05±0.8756	0.225	0.0107
Group B	2.15±1.210	6.825±0.9578	5.1	<0.0001

Interpretation Table 3.3: The pre and post-test mean scores of VAS (At rest) within the Group A and Group B showed that pre test and the post test mean for group A was

1.2±0.9115 and 1.025±0.8619 whereas for the group B was 1.375±1.254 and 0.6360±0.425 respectively. The p value for the pre test and post test score was <0.0001 which was considered extremely significant.

Comparison of pre and post-test mean scores of VAS (on activity) within Group

Interpretation Table 3.4: The pre and post-test mean scores of VAS (on activity) within the Group A and Group B showed that pre test and the post test mean for group A 7.25±0.9541 was and 7.05±0.8756 whereas for the group B was 2.15±1.210 and 6.825±0.9578 respectively. The p value for the pre test and post test score was <0.0001 which was considered extremely significant.

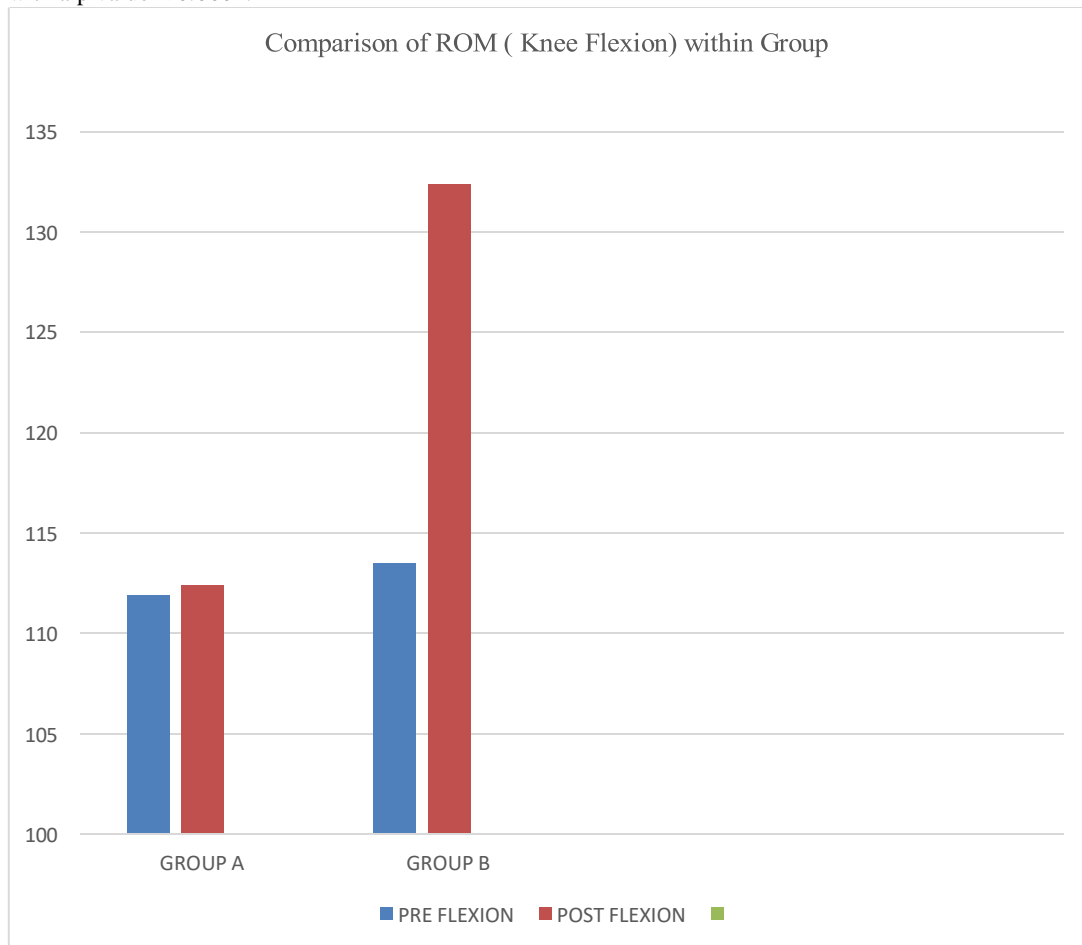


RESEARCH PAPER

Comparison of ROM (Knee Flexion) within Group

	Pre Flexion	Post Flexion	Mean diff.	P Value
Group A	111.9±21.471	112.4±21.126	-2.425	0.0119
Group B	113.5±20.474	132.375±2.932	-13	<0.0001

Interpretation Table 3.5: These graphs show the pre-test and post-test values of Range of Motion for flexion in patients with patellofemoral pain Syndrome , for both groups A and B respectively. Group B were found to be extremely significant with a p value < 0.0001.



RESEARCH PAPER

Comparison of ROM (Knee Extension) within Group

	Pre Extension	Post Extension	Mean Diff	P value
Group A	2.925±1.817	0.55±0.6385	0.15	0.0124
Group B	3.05±1.934	0.625±0.7048	2.525	<0.0001

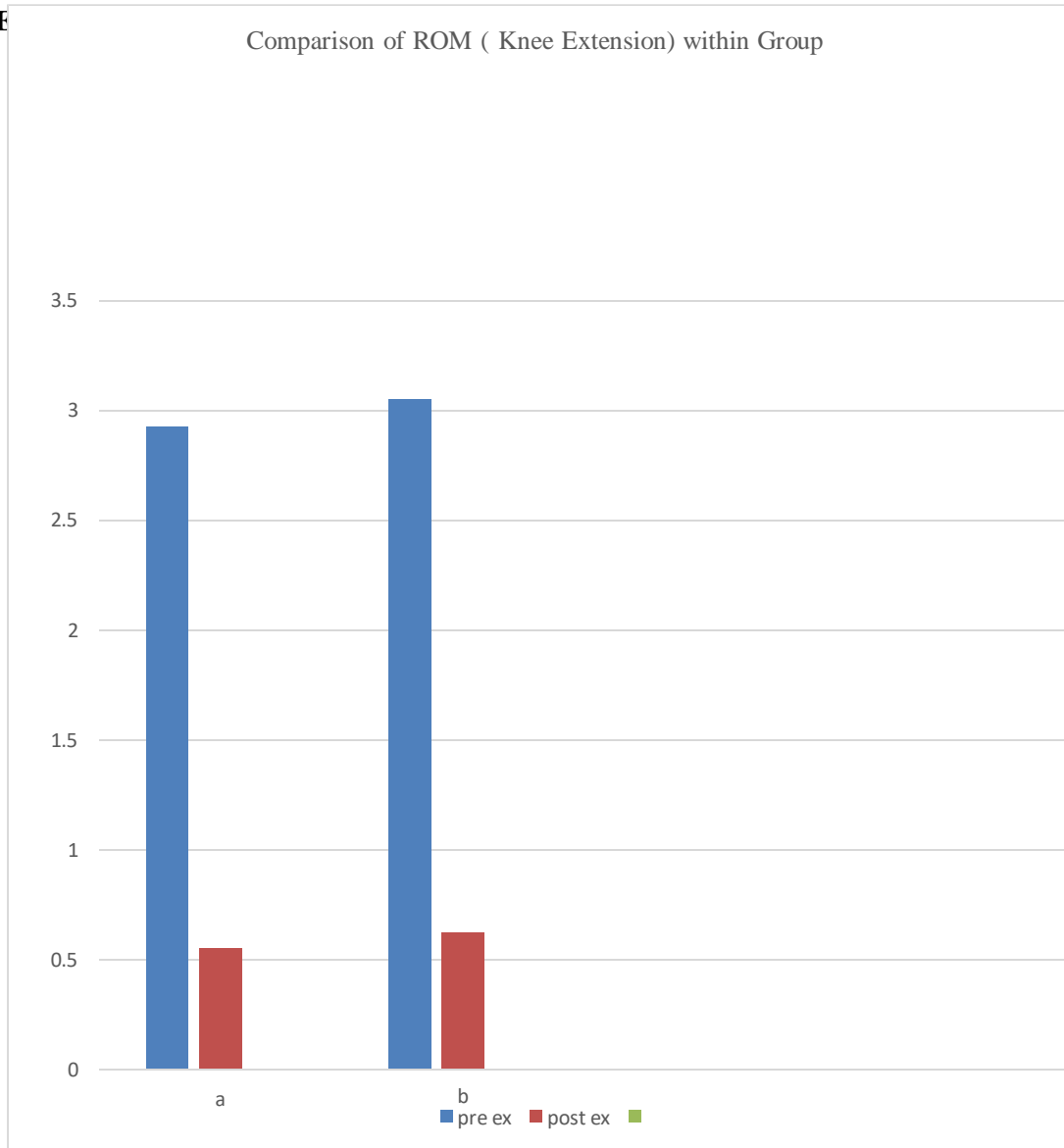
Interpretation Table 3.6: These graphs show the pre-test vs post-test values of Range of Motion for Extension in patients with patellofemoral pain Syndrome , for both groups A and B respectively. Group B were found to be extremely significant with a p value < 0.0001.

Comparison of Anterior Knee Pain Scale within Group

	Pre AKPS Score	Post AKPS Score	Mean Diff	P value
Group A	44.4±7.679	45.45±7.785	-1.05	0.0105
Group B	44.4±7.679	83.45±3.802	-39.05	<0.0001

Interpretation Table 3.7: The above table and graph shows the pre-test and post-test values of Anterior Knee Pain Scale score both the groups A and group B respectively. Group B were found to be extremely significant (p<0.0001).

RF

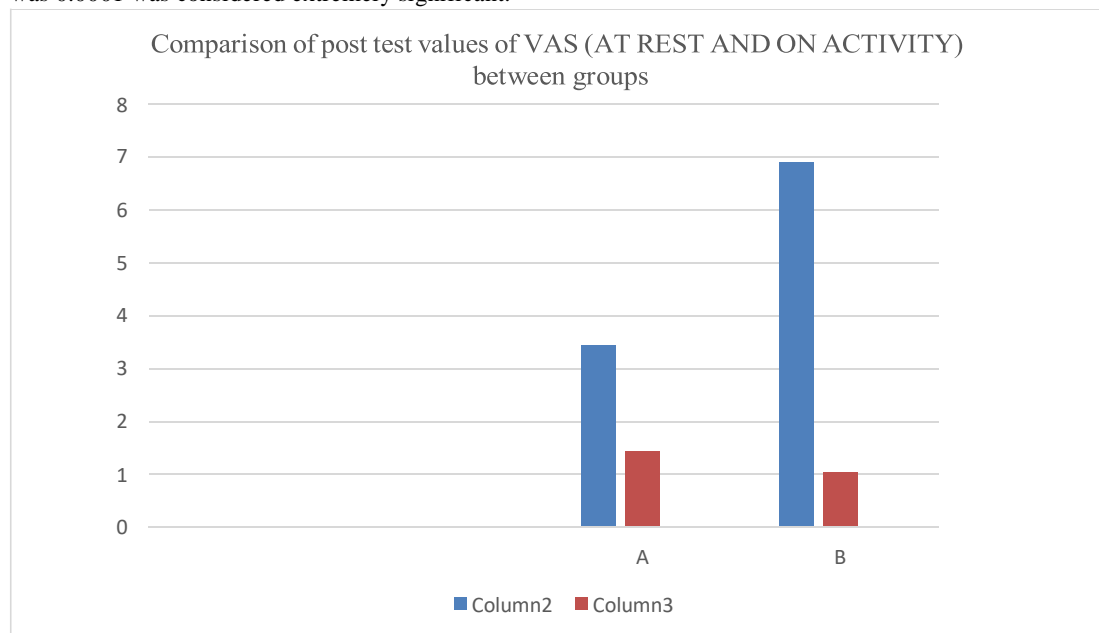


RESEARCH PAPER

Comparison of post test values of VAS (AT REST AND ON ACTIVITY) between groups

POST TEST VALUES	VAS (AT REST)	VAS (ON ACTIVITY)	P VALUE
GROUP A	3.425±0.6360	1.425±0.8619	0.0007
GROUP B	6.9±0.9001	1.025±1.210	<0.0001

Interpretation Table 3.8: The above graph and table depicts the post test values for the VAS (at rest and on activity) between group A and B respectively. The p value for group A was 0.0007 considered significant whereas for group B was 0.0001 was considered extremely significant.

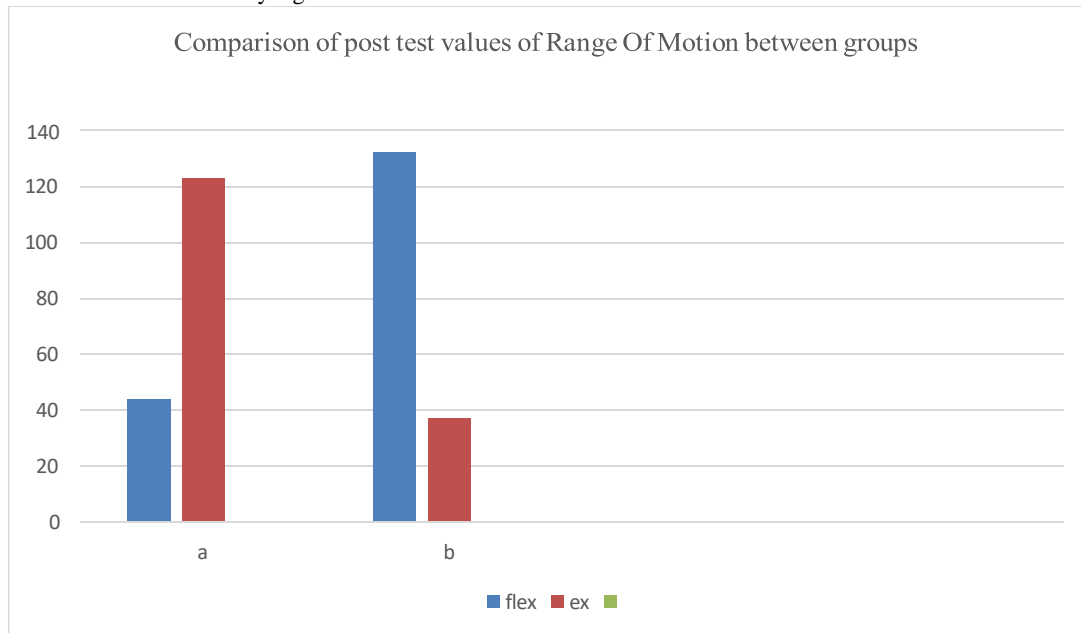


RESEARCH PAPER

Comparison of post test values of Range Of Motion between groups

POST ROM VALUES	FLEXION	EXTENSION	P VALUE
GROUP A	44.05±1.934	122.825±13.138	0.0105
GROUP B	132.375±2.932	36.925±0.6385	<0.0001

Interpretation Table 3.9: the above graph and table depicts the post test values for the VAS (at rest and on activity) between group A and B respectively. The p value for group A was 0.0105 quite significant and group B was 0.0001 was considered extremely significant.

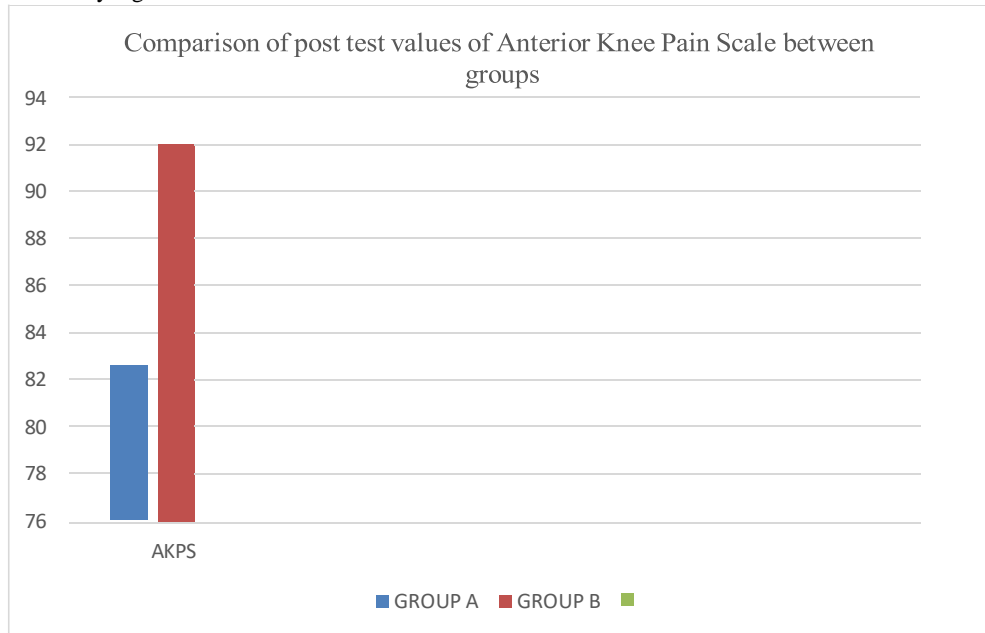


RESEARCH PAPER

Comparison of post test values of Anterior Knee Pain Scale between groups

POST SCORE	Group A	Group B	P VALUE
Anterior Knee Pain Scale	82.575±1.767	92.275±3.942	<0.0001

Interpretation Table 3.10: The above graph and table depicts the post test values for the Anterior Knee Pain Scale between group A and B respectively. The p value for group A and group B was <0.0001 and was considered extremely significant.



RESEARCH PAPER

DISCUSSION

Patellofemoral Pain Syndrome is a multifactorial disorder commonly characterized by anterior knee pain, typically resulting from imbalances in patellar tracking, abnormal joint mechanics, and insufficient muscular control around the knee joint. The patella's position is maintained dynamically by the quadriceps muscle group, with particular emphasis on the Vastus Medialis Oblique, which plays a crucial role in stabilizing and guiding patellar motion during knee flexion and extension. In many individuals with Patellofemoral Pain, Vastus Medialis Oblique weakness is frequently observed, which contributes to the lateral displacement of the patella and results in altered biomechanics, increased joint loading, and pain during functional movements such as stair climbing, squatting, and prolonged sitting.

The present study aimed to evaluate the efficacy of Patellar mobilization in conjunction with Vastus Medialis Oblique strengthening in individuals diagnosed with Patellofemoral Pain Syndrome. The investigation compared two intervention groups to determine the relative effectiveness of combined mobilization and strengthening on pain levels, range of motion, and functional ability as measured by the Anterior Knee Pain Scale. The findings demonstrate that the group receiving both patellofemoral and tibiofemoral mobilization in addition to Vastus Medialis Oblique strengthening exhibited significant improvements across all outcome measures, particularly in reducing pain and enhancing functional performance.

Patellofemoral Pain Syndrome is widely recognized as a common musculoskeletal condition, especially among younger and physically active populations. Several studies have identified a higher prevalence among females, likely due to anatomical and biomechanical factors such as wider Q-angle and decreased strength in the vastus medialis oblique. In the present study, out of 80 participants, the majority (70%) belonged to the 18–30 age group, confirming that the syndrome is more frequently seen in younger individuals. Moreover, the female participants accounted for 52.5% of the total sample, aligning with previous literature that emphasizes the greater occurrence of patellofemoral pain in females. This demographic representation is crucial in understanding the population most at risk and tailoring preventive and rehabilitative strategies accordingly.

The study by Peters JS and Tyson NL, et al. systematically reviewed the impact of proximal strengthening exercises in individuals with patellofemoral pain syndrome. This review

consolidated findings from several randomized controlled trials that focused on hip and core muscle strengthening, especially the gluteus medius and external rotators, based on the premise that proximal muscle weakness contributes to dynamic knee valgus and patellar maltracking. Participants in these studies were mostly young, physically active females, and the interventions typically included side-lying hip abductions, clamshells, bridging, and resistance band exercises over a period of four to eight weeks. The outcome measures across these trials included the Visual Analog Scale for pain, the Kujala Anterior Knee Pain Scale, and various functional performance tests. The findings showed that proximal strengthening significantly reduced knee pain and improved function in the short to medium term. However, the review also highlighted certain limitations, such as methodological variability, lack of uniform protocols, and absence of interventions addressing local joint mechanics. Notably, the systematic review focused exclusively on proximal musculature and did not include any manual therapy techniques, nor did it target distal components such as the patella or quadriceps muscle control, particularly the vastus medialis oblique. In contrast, the present study expands upon this foundation by incorporating several key components not addressed in the Peters and Tyson review. One major additional intervention is the inclusion of patellofemoral and tibiofemoral mobilization techniques, which directly address joint stiffness, patellar maltracking, and accessory motion deficits—mechanical factors that proximal strengthening alone cannot resolve. Another significant addition is the focused strengthening of the VMO, a key medial stabilizer of the patella, whose weakness is a primary contributor to abnormal patellar tracking. Furthermore, by using manual mobilizations to reduce pain and improve joint mechanics, the study enhances neuromuscular re-education and facilitates more effective VMO recruitment, overcoming the inhibitory effects of pain and swelling. The exercise protocol also includes functional and task-specific movements such as step-ups, lunges, and wall squats with hip adduction, which offer greater relevance to daily activities and better dynamic knee control. Overall, while the previous study supports the importance of proximal control in managing PFPS, the current study introduces a more comprehensive and biomechanically integrated approach, targeting both proximal and distal contributors to patellofemoral dysfunction, thereby offering superior clinical benefits.[47]

RESEARCH PAPER

The study by Sara R. Piva et al., aimed to examine the association between hip strength, soft tissue flexibility, and patellofemoral pain syndrome (PFPS). This observational study involved two groups: individuals diagnosed with patellofemoral pain syndrome and asymptomatic controls. Participants were assessed for hip abduction and external rotation strength, iliotibial band (ITB) flexibility using the Ober's test, quadriceps and hamstring flexibility, and also underwent clinical screening for patellofemoral symptoms. The results revealed that individuals with patellofemoral pain syndrome demonstrated significantly lower hip strength and reduced soft tissue flexibility compared to those without patellofemoral pain syndrome. The study concluded that deficits in hip strength and soft tissue flexibility are characteristic features of patellofemoral pain syndrome and may play a critical role in its pathomechanics. However, the study did not include a structured intervention protocol or physiotherapeutic treatment to address these deficits; rather, it was limited to cross-sectional analysis. In contrast, the additional strengths of the present study lie in its interventional design and incorporation of a structured rehabilitation protocol targeting not only the quadriceps and hip muscles but also including patellar mobilization and functional strengthening. Unlike Piva et al.'s purely observational approach, this study employed an evidence-based treatment strategy, combining electrotherapy, vastus medialis oblique-specific exercises, and dynamic movement training to actively improve strength, pain, and functional performance. Notably, patellofemoral mobilization techniques, VMO-focused board squats, and functional wall squats with hip adduction—absent in the previous study—were systematically implemented, offering a more comprehensive and therapeutic approach to correcting the underlying biomechanical dysfunctions in patellofemoral pain syndrome. This interventional depth represents a clear advancement over the passive assessment approach in Piva et al.'s work.[48]

The study conducted by Özge Özlü and Esra Atilgan et al. aimed to assess the therapeutic efficacy of High Intensity Laser Therapy in individuals with Patellofemoral Pain Syndrome. This randomized controlled trial included participants clinically diagnosed with Patellofemoral Pain Syndrome, who were divided into two groups: one receiving High Intensity Laser Therapy in combination with conventional Physiotherapy and the other receiving only conventional Physiotherapy. The High Intensity

Laser Therapy group was treated with a specific protocol involving high-power laser pulses that delivered energy at deeper tissue levels, aiming to reduce inflammation, enhance tissue repair, and modulate pain through photothermal and photochemical effects. The sessions were administered over multiple weeks, and the primary outcome measures used for assessment were the Visual Analog Scale for pain and the Kujala Anterior Knee Pain Scale for function. The findings revealed that the group receiving High Intensity Laser Therapy showed significantly greater reductions in pain and improvements in functional scores compared to the control group, leading the authors to conclude that High Intensity Laser Therapy could be an effective adjunct in the conservative management of Patellofemoral Pain Syndrome by improving pain and functional capacity through non-invasive means. In comparison, the present study introduces several additional and active therapeutic components that directly target the mechanical and neuromuscular contributors to Patellofemoral Pain Syndrome. One key advancement in this study is the use of patellofemoral and tibiofemoral joint mobilization techniques, which are not addressed in the laser therapy protocol. These manual therapy interventions help restore joint mobility, correct patellar maltracking, and reduce stiffness—factors that laser therapy does not modify. Another significant inclusion is Vastus Medialis Oblique strengthening, which specifically targets the medial stabilizer of the patella, crucial for proper patellar alignment and knee joint stability. Your protocol also incorporates task-specific functional strengthening exercises such as step-ups, lunges, wall squats with hip adduction, and side-lying clamshells, which enhance dynamic lower limb control and replicate real-world movement demands. Furthermore, this study combines manual mobilization with active exercise, thereby promoting neuromuscular re-education and reducing arthrogenic inhibition, ultimately yielding superior improvements in pain, range of motion, and functional outcomes. These additional components make your intervention more comprehensive and biomechanically corrective, offering long-term benefits that extend beyond symptom relief alone.[49]

The study by David A. Lake and Nancy H. Wofford et al. aimed to evaluate the effectiveness of various therapeutic modalities used in the treatment of Patellofemoral Pain Syndrome. This systematic review assessed existing randomized controlled trials and clinical trials that utilized

RESEARCH PAPER

modalities such as Transcutaneous Electrical Nerve Stimulation, ultrasound, iontophoresis, phonophoresis, and electromyographic biofeedback. The review focused on pain relief, function, and muscle activation as outcome measures. Across the studies analyzed, results varied: some showed moderate improvements in pain reduction, while others demonstrated limited or inconsistent functional gains. The authors concluded that although certain modalities may provide short-term pain relief, the overall evidence supporting their effectiveness as standalone treatments for Patellofemoral Pain Syndrome was weak or inconclusive. They emphasized that passive modalities alone are insufficient for managing Patellofemoral Pain Syndrome and recommended combining them with active rehabilitation for better outcomes. In comparison, your study incorporates the use of therapeutic modalities such as Transcutaneous Electrical Nerve Stimulation and ultrasound as part of both the control and experimental groups, aligning with standard conservative Physiotherapy. However, the key additional and positive elements in your study go well beyond the scope of passive modalities. Firstly, your protocol uniquely includes patellofemoral and tibiofemoral joint mobilization techniques, directly targeting joint mechanics, patellar alignment, and accessory motion—components not considered in the Lake and Wofford review. Secondly, your study focuses on Vastus Medialis Oblique strengthening, which plays a crucial role in improving dynamic patellar stability and is vital for correcting muscle imbalances typically seen in Patellofemoral Pain Syndrome. Thirdly, your intervention includes functional, task-specific exercises such as lunges, squats with hip adduction, step-ups, and side-lying leg exercises, which simulate real-life movement demands and promote neuromuscular control. Moreover, the integration of manual therapy with exercise not only enhanced range of motion and reduced pain but also provided superior statistically significant improvements across all outcome measures, as demonstrated in your results. Therefore, while the Lake and Wofford study highlights the limitations of relying solely on modalities, your study presents a more comprehensive and effective treatment approach by combining passive, active, and manual therapy techniques tailored to the underlying biomechanical and neuromuscular deficits in Patellofemoral Pain Syndrome.[50]

The study by Vanessa Baker, Kim Bennell, Barry Stillman, Sallie Cowan, and Kay Crossley et al.

investigated proprioceptive deficits in patients suffering from patellofemoral pain syndrome. The researchers conducted a cross-sectional study comparing individuals with clinically diagnosed Abnormal knee joint position sense in individuals with patellofemoral pain syndrome to a control group without knee pain. The study specifically assessed knee joint position sense using a weight-bearing test where participants, blindfolded to eliminate visual feedback, were asked to reproduce specific joint angles. The primary outcome measure was the absolute angular error, which served as an indicator of proprioceptive accuracy. Results revealed that participants with Abnormal knee joint position sense in individuals with patellofemoral pain syndrome had significantly poorer joint position sense compared to healthy individuals. The authors concluded that proprioceptive dysfunction is a key factor in Abnormal knee joint position sense in individuals with patellofemoral pain syndrome and may contribute to poor joint control and symptom persistence. However, the study was observational in nature and did not implement or assess any therapeutic intervention to correct the identified sensory deficits. In contrast, your study not only acknowledged mechanical and neuromuscular deficits in Patellofemoral pain syndrome but also addressed them through a structured intervention protocol. Additional elements in your study included patellofemoral and tibiofemoral mobilization, which may enhance proprioceptive input by stimulating joint mechanoreceptors—something not explored in Baker's research. Moreover, your incorporation of Vastus Medialis Oblique (VMO) strengthening and functional exercises such as wall squats with hip adduction, step-ups, and lunges served not only to improve muscle function and patellar tracking but also to retrain neuromuscular control. These task-specific movements inherently stimulate proprioceptive pathways, offering a rehabilitative solution to the deficits identified in the Baker study. Thus, while the previous research highlighted the presence of impaired joint position sense in PFPS, your study added therapeutic value by integrating clinical techniques that could potentially restore both mechanical alignment and sensory-motor function.[51]

Therefore, the present study was conducted to explore the effectiveness of a combined intervention approach targeting both joint mechanics and muscular imbalances. The study incorporated patellofemoral and tibiofemoral mobilization techniques in conjunction with Vastus Medialis Oblique (VMO) strengthening to address

RESEARCH PAPER

pain and functional limitations in individuals with Patellofemoral Pain Syndrome. A total of 80 participants were divided into two groups—conventional receiving conventional therapy and experimental undergoing the experimental protocol. Outcome measures such as Visual Analog Scale, Range of Motion, and Anterior Knee Pain Scale were assessed pre- and post-intervention. The results demonstrated that participants in experimental exhibited significantly better improvements in all parameters compared to conventional, suggesting that the inclusion of joint mobilization and vastus medialis oblique-specific strengthening led to superior clinical outcomes. This study offers an integrated and evidence-based approach for clinicians aiming to enhance functional recovery in patients with anterior knee pain, and contributes new insight to the growing body of literature supporting multimodal rehabilitation strategies in Patellofemoral Pain Syndrome.

CONCLUSION

This study was carried out to understand how Patellofemoral and Tibiofemoral mobilization, along with vastus medialis oblique strengthening, can help people suffering from Patellofemoral Pain Syndrome. Patellofemoral Pain Syndrome is a common knee condition that affects daily activities like walking, climbing stairs, and sitting for long periods. It often causes pain around the front of the knee due to problems with patellar tracking, muscle imbalance, or overuse. The results of this study showed that people who received both joint mobilization and Vastus Medialis Oblique strengthening had much better outcomes than those who only received conventional treatment. They experienced less pain while resting and during activity, improved range of motion in their knees, and better function in everyday tasks. This suggests that the combination of manual therapy and muscle training is more effective in treating Patellofemoral Pain syndrome than using either one alone. The reason for this success may be that joint mobilization helps improve the movement and flexibility of the knee, while Vastus Medialis Oblique strengthening improves muscle balance and support around the patella. Together, they not only relieve pain but also help the knee work better and prevent future problems. The exercises and therapy used in this study were simple and practical, making them easy to include in regular physiotherapy sessions. Overall, this study shows that using Patellofemoral and Tibiofemoral mobilization along with Vastus Medialis Oblique strengthening is a useful and safe

approach for treating people with Patellofemoral Pain Syndrome. It provides a better recovery path by improving pain relief, joint function, and movement, which are essential for returning to a normal and active lifestyle. Physiotherapists can apply these findings in clinics to help patients recover faster and more effectively from knee pain related to Patellofemoral Pain Syndrome

SUMMARY

The present experimental study, conducted at Krishna Vishwa Vidyapeeth Hospital, Karad, involved a total of 80 physically active individuals aged between 18 to 44 who were diagnosed with patellofemoral pain syndrome. Participants were randomly divided into two groups of 40 each—Group A received conventional Physiotherapy treatment, while Group B was treated with a combination of Patellofemoral and Tibiofemoral Mobilization along with Vastus Medialis Oblique strengthening exercises. The study aimed to evaluate and compare the effectiveness of these two approaches in reducing pain, improving range of motion, and enhancing functional ability, assessed through the Visual Analog Scale, Anterior Knee Pain Scale, and range of motion measurements. Conducted over a period of one year with interventions performed five days a week for six weeks, the study found that Group B exhibited significantly greater improvements across all outcome measures. This reinforced the hypothesis that integrating joint Mobilization with targeted Vastus Medialis Oblique strengthening provides a more effective Rehabilitation protocol for Patellofemoral Pain Syndrome than conventional treatment alone. By addressing both joint mechanics and muscular control, the study offers strong clinical evidence in favor of a comprehensive, multimodal therapeutic strategy for managing anterior knee pain.

LIMITATIONS, SUGGESTION, RECOMMENDATIONS

LIMITATIONS

The study was conducted over a relatively short intervention period, which limits the ability to assess the long-term effectiveness of the treatment.

Variability in participant adherence to the exercise protocol may have influenced the consistency of the results.

SUGGESTIONS

Include a long-term follow-up evaluation to assess the sustainability of improvements in pain, range of motion, and functional ability,

RESEARCH PAPER

as this would strengthen the clinical relevance of your findings.

Incorporate patient adherence monitoring methods, such as home-exercise diaries or follow-up reminders, to evaluate the influence of compliance on treatment outcomes and enhance data reliability.

RECOMMENATIONS

Future research should include follow-up assessments over several months to evaluate the sustainability of the improvements in pain, range of motion, and functional ability. Studies with a larger and more diverse population, including different age groups, activity levels, and genders, can enhance generalizability and help determine subgroup-specific effects.

BIBLIOGRAPHY

1. Palak Ramanlal Mistry¹, Yagna Unmesh Shukla² Effect of VMO Strengthening Versus Patellar Taping in Patellofemoral Pain Syndrome- A Comparative Study October 2020
2. WELSH R. PETER M.B. CH.B. F.R.C.S.(C) Knee Joint Structure and Function. Clinical Orthopaedics and Related Research (1976-2007): March/April 1980
3. SteFaNO ZaFFaGNINI¹, DaVID DeJOUR², alBertO GraSSII, tOMMaSO BONaNZINGa¹, GIulIO MarIa MarChEGGIaNI MuCCIOII¹, FraNCeSCa COLle¹, FeDerICO raGGII, aNDrea BeNZII, MaurIIIO MarCaCCI¹ Patellofemoral anatomy and biomechanics: current concepts 2013;1(2):15-20
4. van der Heijden RA, Lankhorst NE, van Linschoten R, Bierma-Zeinstra SMA, van Middelkoop M Exercise for treating patellofemoral pain syndrome (Review) Cochrane Database of Systematic Reviews 2015, Issue 1. Art. No.: CD010387. DOI: 10.1002/14651858.CD010387.pub2.
5. Minahil Tanvee, Raheel Munawar, Aqsa Akram, Sumbal Salik Okara, Sania Maqbool Comparison of Tibiofemoral and Patellofemoral Mobilization in Improving Pain, Rom and Functional Disability in Patellofemoral Pain Syndrome
6. Benjamin E. Smith^{1,2}, Marcus Bateman¹ *, James Selfe³, Fiona Moffatt^{5,3}, Damian Thacker⁴, Paul Hendrick⁵, Michael Skovdal Rathleff^{6,7,5}, Toby O. Smith¹, Pip Logan² Incidence and prevalence of patellofemoral pain: A systematic review and meta-analysis January 11, 2018
7. MacIntosh, D. L.: The anterior cruciate ligament: over-the-top repair, Presented to Annual Meeting AAOS, Dallas, 1974.
8. Goodfellow, I., Hungerford, D. S., and Zindel, M.: Functional anatomy of the patello-femoral joint, J. Bone Joint Surg. 58B:287, 1976.
9. Shim SS, Leung G: Blood Supply of the Knee Joint: A Microangiographic Study in Children and Adults. Clinical Orthopaedics & Related Research 1986:119-125.
10. Moore KL, Dalley AF: Lower Limb. In Clinically Oriented Anatomy 5th edition. Edited by: Moore KL, Dalley AF. Philadelphia, PA: Lippincott Williams & Wilkins; 2006:555-724.
11. Naslund J, Walden M, Lindberg LG: Decreased pulsatile blood flow in the patella in patellofemoral pain syndrome. Am J Sports Med 2007, 35(10):1668-1673.
12. Paola Dey^{1*}, Michael Callaghan², Neil Cook¹, Ruth Sephton⁴, Chris Sutton³, Elaine Hough⁴, Jonathan James⁴, Rukhtam Saqib⁵ and James Selfe² A questionnaire to identify patellofemoral pain in the community: an exploration of measurement properties.
13. Scuderi G, Scharf SC, Meltzer L, Nisonson B, Scott WN: Evaluation of patella viability after disruption of the arterial circulation. Am J Sports Med 1987, 15(5):490-493
14. Gregory R Waryasz^{*1,2} and Ann Y McDermott^{1,3} Patellofemoral pain syndrome (PFPS): a systematic review of anatomy and potential risk factors
15. Robertson, C. Patellofemoral Joint Programme. Effective Quadriceps Training in Patellofemoral Pain. Plus. 2022.
16. Stokes M, Young A. Investigations of quadriceps inhibition: implications for clinical practice. Physiotherapy. 1984 Nov;70(11):425-8.
17. Hodges PW, Mellor R, Crossley K, Bennell K. Pain induced by injection of hypertonic saline into the infrapatellar fat pad and effect on coordination of the quadriceps muscles. Arthritis Care & Research. 2009 Jan 15;61(1):70-7.
18. Witvrouw E, Danneels L, Van Tiggelen D, Willems TM, Cambier D. Open versus closed kinetic chain exercises in patellofemoral pain: a 5-year prospective randomized study. The American journal of sports medicine. 2004 Jul;32(5):1122-30.
19. Yang JS, Fredericson M, Choi JH. The effect of patellofemoral pain syndrome on patellofemoral joint kinematics under upright weight-bearing conditions. Plos one. 2020 Sep 30;15(9):e0239907.

RESEARCH PAPER

20. AiShwARyA GulATi, MBBS, 2ChRiStopheR MCElRATH, MD, 3viBhoR wADhwA, MD, 2JAY p ShAh, MD and 2,4AvneeSh ChhABRA, MD Current clinical, radiological and treatment perspectives of patellofemoral pain syndrome
21. Baraa Hussain Alsulaimani, King Abdulaziz University, Almarwah, Jeddah, Saudi Arabia, Tel 00966544606142, Effectiveness of patellar mobilization in patellofemoral pain syndrome
22. Brad G. Simpson, Corey B. Simon Lower extremity thrust and non-thrust joint mobilization for patellofemoral pain syndrome: a case report
23. Ratan Khuman, Surbala Devi, V. Anandh, Thongam Kamlesh, Kalpesh Satani, Gopal Nambi Patello-Femoral Pain Syndrome: A comparative Study of Mobilization Verses Taping
24. Crossley K, Bennell K, Green S, McConnell J. A systematic review of physical interventions for patellofemoral pain syndrome. *Clin J Sport Med.* 2001;11(2):103-110.
25. Brantingham JW, Bonnefi n D, Perle SM, et al. Manipulative therapy for lower extremity conditions: Update of a literature review. *J Manipulative Physiol Ther.* 2012;35(2):127-166.
26. Jayaseelan DJ, Scalzitti DA, Palmer G, Immerman A, Courtney CA. The effects of joint mobilization on individuals with patellofemoral pain: A systematic review. *Clin Rehabil.* 2018;32(6):722-733.
27. Dhinu J. Jayaseelan, DPT, OCS, FAAOMPT1,4 Cameron Holshouser, DPT2 Michael W. McMurray, DPT, OCS, FAAOMPT3, FUNCTIONAL JOINT MOBILIZATIONS FOR PATELLOFEMORAL PAIN SYNDROME: A CLINICAL SUGGESTION
28. Earl JE, Hoch AZ. A proximal strengthening program improves pain, function, and biomechanics in women with patellofemoral pain syndrome. *The American journal of sports medicine.* 2011 Jan;39(1):154-63.
29. Prieto-García LF, Cortés-Reyes E, Lara-Cotacio G, Rodríguez-Corredor LC. Therapeutic effect of two muscle strengthening programs in patients with patellofemoral pain syndrome. A randomized controlled clinical trial. *Revista de la Facultad de Medicina.* 2021 Jun;69(2).
30. Alba-Martín P, Gallego-Izquierdo T, Plaza-Manzano G, Romero-Franco N, Núñez-Nagy S, Pecos-Martín D. Effectiveness of therapeutic physical exercise in the treatment of patellofemoral pain syndrome: a systematic review. *Journal of physical therapy science.* 2015;27(7):2387-90.
31. Alba-Martín P, Gallego-Izquierdo T, Plaza-Manzano G, Romero-Franco N, Núñez-Nagy S, Pecos-Martín D. Effectiveness of therapeutic physical exercise in the treatment of patellofemoral pain syndrome: a systematic review. *Journal of physical therapy science.* 2015;27(7):2387-90.
32. Lee JH, Jang KM, Kim E, Rhim HC, Kim HD. Static and dynamic quadriceps stretching exercises in patients with patellofemoral pain: a randomized controlled trial. *Sports health.* 2021 Sep;13(5):482-9.
33. Aghapour E, Kamali F, Sinaei E. Effects of Kinesio Taping® on knee function and pain in athletes with patellofemoral pain syndrome. *Journal of bodywork and movement therapies.* 2017 Oct 1;21(4):835-9.
34. Avraham F, Aviv S, Ya'akobi P, Faran H, Fisher Z, Goldman Y, Neeman G, Carmeli E. The efficacy of treatment of different intervention programs for patellofemoral pain syndrome—a single blinded randomized clinical trial. Pilot study. *The scientific world journal.* 2007 Aug 24;7:1256-62.
35. Watson CJ, Leddy HM, Dynjan TD, Parham JL. Reliability of the lateral pull test and tilt test to assess patellar alignment in subjects with symptomatic knees: student raters. *Journal of Orthopaedic & Sports Physical Therapy.* 2001 Jul;31(7):368-74.
36. Hossein HS, Sara A, Hasan D. The effect of three types of exercises programs on the patella location in athletes with patellofemoral pain. *The Knee.* 2023 Mar 1;41:97-105.
37. Best MJ, Tanaka MJ, Demehri S, Cosgarea AJ. Accuracy and reliability of the visual assessment of patellar tracking. *The American Journal of Sports Medicine.* 2020 Feb;48(2):370-5.
38. Smith BE, Selfe J, Thacker D, Hendrick P, Bateman M, Moffatt F, Rathleff MS, Smith TO, Logan P. Incidence and prevalence of patellofemoral pain: a systematic review and meta-analysis. *PloS one.* 2018 Jan 11;13(1):e0190892.
39. MasoodBarzegar1,* , Farideh Babakhani2, RaminBalochi2 and MohamadrezaHatefi1 Effect of Topical Cooling with Ice and Cold Spray on Knee Joint Position Sense of Athletes with Patellofemoral Pain Syndrome.
40. Col Laura A. Talbot, NC, USAFR (Ret.)*; LTC Zack Solomon, PT, DPT, SP, USA†; Dr. Lee Webb, PT, DPT, OCS, SCCE‡; Dr. Christopher Morrell, PhD§; COL E. Jeffrey Metter, MD, MC USAR (Ret.)* Electrical Stimulation Therapies for Active Duty Military with Patellofemoral Pain Syndrome: A Randomized Trial
41. Mikhled F. Maayah,1,2 Amr A. Abdel-aziem,2* Emad T. Ahmed2 Effects of Ultrasound Therapy versus Mikhled Knee Exercise Program for Treating Patellofemoral Pain Syndrome.
42. Daniel Harvie Timothy O'Leary Saravana Kumar A systematic review of randomized controlled trials on

RESEARCH PAPER

- exercise parameters in the treatment of patellofemoral pain: what works?
43. Jin Hyuck Lee, PT,†‡ Ki-Mo Jang, PhD, MD,‡§ Eunseon Kim, PT,‡ Hye Chang Rhim, MD,§ and Hyeong-Dong Kim, PhD, PT*† Static and Dynamic Quadriceps Stretching Exercises in Patients With Patellofemoral Pain: A Randomized Controlled Trial
 44. SIAN E. IRISH, ADAM J. MILLWARD, JAMES WRIDE, BERNHARD M. HAAS, AND GARY L.K. SHUM THE EFFECT OF CLOSED-KINETIC CHAIN EXERCISES AND OPEN-KINETIC CHAIN EXERCISE ON THE MUSCLE ACTIVITY OF VASTUS MEDIALIS OBLIQUE AND VASTUS LATERALIS
 45. Justin M. Lantz, DPT, OCS, FAAOMPT1 Alicia J. Emerson-Kavchak, DPT, OCS, FAAOMPT2 John J. Mischke, DPT, OCS, FAAOMPT3 Carol A. Courtney, PT, PhD, FAAOMPT2 TIBIOFEMORAL JOINT MOBILIZATION IN THE SUCCESSFUL MANAGEMENT OF PATELLOFEMORAL PAIN SYNDROME: A CASE REPORT
 46. Shabiethaa. D1, Jeyakumar. S2, Senthilkumar. S3, Saravanan. V.S4, Vicent Prabhakaran Sekar5 A Study to Compare the Effectiveness of Tibio Femoral Joint Mobilization Versus Maitland Mobilization in Patellofemoral Pain Syndrome
 47. Peters JS, Tyson NL. Proximal exercises are effective in treating patellofemoral pain syndrome: a systematic review. International journal of sports physical therapy. 2013 Oct;8(5):689.
 48. Sara R. Piva, PT, PhD, OCS, FAAOMPT1 Edward A. Goodnite, PT, MS2 John D. Childs, PT, PhD, MBA, OCS, FAAOMPT3 Strength Around the Hip and Flexibility of Soft Tissues in Individuals With and Without Patellofemoral Pain Syndrome.
 49. Ozge Ozlu, Esra Atilgan The effect of high-intensity laser therapy on pain and lower extremity function in patellofemoral pain syndrome: a single-blind randomized controlled trial
 50. David A. Lake, PT, PhD,* and Nancy H. Wofford, PT, DPT, OCS, Cert MDTEffect of Therapeutic Modalities on Patients With Patellofemoral Pain Syndrome: A Systematic Review
 51. Vanessa Baker, Kim Bennell *, Barry Stillman, Sallie Cowan, Kay Crossley Abnormal knee joint position sense in individuals with patellofemoral pain syndrome
 52. Richard F Ittenbach ^{1 2}, Guixia Huang ¹, Kim D Barber Foss ³, Timothy E Hewett ⁴, Gregory D Myer ² Reliability and Validity of the Anterior Knee Pain Scale: Applications for Use as an Epidemiologic Screener 2016 Jul 21;11(7):e015920

ANNEXURE –DATA COLLECTION SHEET

ANNEXURE DATA COLLECTION SHEET

Name:
Age:
Gender:
Address:
Occupation:
OPD No:
Chief complaint:
Duration:
Visual Analogue Scale:
At Rest –

On Activity –

RESEARCH PAPER

At Rest		On Activity	
Pre	Post	Pre	Post

Anterior Knee Pain Scale:

Pre Anterior Knee Pain Scale	Post Anterior Knee Pain Scale

Range Of Motion:

	Right	Left	Right	Left
Pre				
Post				

PATIENT INFORMATION SHEET

Guidelines for Patient information Sheet (English & Marathi translation)

Protocol No: 036/2023-2024

Name of Institute: Krishna Institute of Medical Sciences Name of Principal Investigator:

Miss Thite Akshara Anand

Name of co-Investigator: Dr. Vaishali Jagtap

Title of study: EFFECT OF PATELLAR MOBILIZATION ALONG WITH VATUS MEDIALIS OBLIQUE STRENGTHENING IN PATELLOFEMORAL PAIN SYNDROME.

RESEARCH PAPER

You are invited to take part in the above-mentioned research study. You are invited because you fulfil the eligibility (inclusion) criteria- i). Age 25-55 years classified according to Quebec Task force classification 3 to 6 ii) Participants with unilateral radiculopathy iii) Intensity of pain 3 to 7 on VAS iv) Reproduction of symptoms while SLR and Slump test

The purpose of study- To check Effect of patellar mobilization along with vastus medialis oblique strengthening in patellofemoral pain syndrome.

We want to find out Effectiveness of mobilization with vastus medialis oblique strengthening exercises in patellofemoral pain syndrome.

The study procedure- Once you are voluntarily enrolled in this study you are expected to follow all instructions given by investigator about the study Participants will be informed about the study and consent will be taken. After taking consent pre assessment will be done using the outcome measures. These exercises will be given for weeks for 8 weeks . The interpretation of the study will be done on basis of outcome measures and the data that will be collected. If you want to tell any treatment related problems/adverse effects, you are free to call or visit investigator.

Kujala Score (Anterior Knee Pain Scale - AKPS) Summary	
1. Limp None	(5 points)
2. Support Full support without pain	(5 points)
3. Walking Unlimited	(5 points)
4. Stairs No difficulty	(10 points)
5. Squatting No difficulty	(5 points)
6. Running No difficulty	(10 points)
7. Jumping No difficulty	(10 points)
8. Prolonged sitting with the knees flexed No difficulty	(10 points)
9. Pain None	(10 points)
10. Swelling None	(10 points)
11. Abnormal painful kneecap (patellar) movements None	(10 points)
12. Atrophy of thigh None	(5 points)
13. Flexion deficiency None	(5 points)
Kujala Score (Anterior Knee Pain Scale - AKPS): 100/100=100.0 percent.	
Graphical Kujala Score (Anterior Knee Pain Scale - AKPS):	
Pertinent Negative	Pertinent Positive

investigations. You will not be paying any charges for this. (Add information which suits your study)

Compensation- (Write here about conveyance allowance if applicable) In case of any study related injury of adverse effect you will be treated free of charge in this hospital.

Possible benefits to society-The results of this research may provide benefit to the society in terms of advancement of medical knowledge and therapeutic benefit to future patients Possible risks/adverse effects to participant
Common adverse effects - Nil Very rare adverse effects – Nil

Reports of earlier studies have proven safety of this drug/intervention. Your safety is the prime concern of this research. If you notice any other side effect you should bring it to the notice of investigator at the earliest. If the investigator

notices any side effect or any untoward effect in you he will be withdrawing you from study and inform you.

In case of any study related injury/medical problem you will be entitled to get medical treatment free of charge from this institute.

Benefit to participant- You will not be required to pay for study related investigations You will not be paid any amount for your participation in this study.

Confidentiality of information obtained- You have the right to confidentiality regarding the privacy of medical information (your personal details result of physical examination, investigations and medical history). Your identity will not be disclosed to unrelated persons. By signing the

RESEARCH PAPER

informed consent document, you will be allowing the research team investigators, institutional ethics committee, sponsors and any higher authority like drug controller General of India, to view your data if required.

The results of this research may be published in scientific journal or presented at scientific meetings without disclosing your identity.

Effect of you decision-Your decision not to participate in this research will not affect your medical care or you relationship with the investigator or the institute in future.

The participation in this study is purely voluntary and you have the right to withdraw from this study at any point of time with or without giving any reason through not mandatory it will be advisable to consult your investigator before you withdraw. Contact persons-For further information/questions you can contact any of the following Principal Investigator:

Co-Investigator:

क

036/2023-2024

स३थच नाव : शाखा िफजीओथरपी

मु% सशोधकाच नाव : अशा आनंद िथटे.

अपासाचे शीरशक - पटेलर मोबिलायझेशनसह पास िमडीयािलस ऑलवस वायू बळकट करपापा Dायामाचा पाटेलोफेमोरल वेदनासंवेदना

सिक्तोमवरील परणाम.

तुपाला या सशोधनामसहभागी होपासाठी आमिफत करीत आहोत, कारण तुपा यामसफनकष पाि आहात.

अपासाची िहया :- या िफणामसामील होपास पाि असलपा D4ीना क पा िालयात उपफ३थत राहपाची फवनती क ली जाईल व तयाना िफणफवषयी माफहती फदली जाईल पा D4ी या िफणामसहभागी होपास तयार आहत तयाच समती िप घतल जाईल व तयाना दोऱी पकी एका गटात सामील कवन घतल जाईल. या अपासामसदोन गट क ल जातील गट अ आफण गट ब,सहभाग घणाया D4ीना िफू टयस मपीमस वायची ताकद वाढवपा साठी िफण फदल जाईल. तमपा वीटमट पा आधी आफण वीटमट पा नतर चाचपा क ल जातील.

भरपाई :- या सशोधनामसतुपाला काही इजा झापास मु३ उपचार क ला जाईल.

सामाफजक िंायाद :- या सशोधनाचा परणाम सामाफजक ररतया

जस फक व३कीय माफहतीची िती आफण उपचारात्मक लाभ भफवपातील िाना होऊ शकतो. सहभापास सभाD कोणताही धोका नाही. तुमची सुरफभता हीच मु% फचता आहे. जर सभाफवत धोका आढळू न आपास सशोधकास तातडीन कळफवपात याव.

िसभागीना फायदा :- तुपाला तपासणीसाठी कोणतयाही िंकारच शु७ भराव लागणार नाही, तुपाला या

सशोधनामसभाग घपास कु ठपाही िंकारच शु७फदल जाणार नाही. या सशोधनामसतुमची वयफ३क गुमता ठवली जाईल. तुमची माफहती अफनळखी D4ीला फदली जाणार नाही. या िंमम वरती सही क पांतर तुपा सशोधक, स३थातमक फनतीफवषयक सफमती, पायोजक आफण उD३ीकारक माफहती दपास माकरीत आहात. या सशोधनाच परणाम फवपाफनक कफमटी आफण वपाफनक जनमलमस िफणशत क ल जातील, पण तमची ओळख गम ठवली जाईल. **हनणयाच परणाम :-** तुपा या सशोधनात सहभाग नाकारपास तुमपा मस व सशोधकामस कोणतयाही िंकारच फहत सबध फबघडणार नाहीत. या सशोधनामस तुमचा सहभाग हा 4D३न असन तपा िंकोणतयाही िणी या सशोधनामधन आपला सहभाग काढू शकता सपका D4ी:-

मु% सशोधक :-क .अशा आनंद िथटे

फडपाटममस िऑ
िफजीओथरपी.
स३थच नाव : क पा कॉलज
िऑ िफजीओथरपी.
िंोन न - ०२१६४ -
२४१५५५ EXT. २२१

CONSENT FORM

Protocol no. 036/2023-2024

Title of study : EFFECT OF PATELLAR MOBILIZATION ALONG WITH VATUS MEDIALIS OBLIQUE STRENGTHENING IN PATELLOFEMORAL PAIN SYNDROME.

Name of participant-

Name of principle investigator- Miss. Thite Akshara Anand

Name of department- Physiotherapy

I have read the information on and I have understood it. I have read by me. The nature of study, possible risk and benefits to me, precautions to be taken by me, my rights and responsibilities regarding this study have been explained to me by investigator to my

RESEARCH PAPER

satisfaction. I have understood that information/ data obtained from this study may be used for scientific purpose (publication/ presentation in scientific meeting) by the investigator without revealing my identity. I have no objection for it.

I understand that my participation is voluntary and I am free to withdraw from the project at any time, without having to give reason and without any consequences. I have understood whom to contact in case of any adverse effect / doubt.

I hereby give my consent to participate in this study titled "Name and Signature / thumb impression of participant Name and signature of impartial witness (in case of legal guardian/ parent are illiterate person)

Contact no.

मतीपत्र

पटलर मोबिलायझशनसह डॉ०स मिडयालिस ओ०एच० वायू मजबूत करणाचा पटलोफमोरल वदना सडोमवरील परणाम." या उपमात 4छिन िसरागी िंोपास तयार िओ.

मी _____ येथे नमूद कV डि०के कक, मी या वैBकीय संशोधन णाची सवव माहिती मला देात आलेली िओ. व णा संदरावतील सवव शंकांचे समाधानकारकरणा ननरसन करात आलेले

िओ.मी कबुल करतो कक, संशोधकीय उपमात 4छे ने िसरागी िंोत िओ. आण मला िंे माहित िओ कक, कोिंतेिंी कार देाछया बांधधलकी ववना, परंतु माझे वैBकीय उपचार व कायदेशीर िा न गमावता यातून बािंेर पडू शकतो.

मी या उपमातून बािंेर पडानंतर माझी जुनी वैBकीय माहिती माझे डॉ०र, उपमाचे पुर ते, नैनतकता सममतीचे सद4 माा परवानगी मशवाय या अथवा नवीन संशोधकीय उपमासाठी वापV शकतात. यासाठी माझी पूिंव परवानगी िओ. या संदरावत णामशत झालेा कोिंवािंी शोध ननबंधात माझी ओळख उघड के ली जािंार नािंी याची मला खाी देात आलेली िओ.

डिाची िसी

नातेवाईकांची िसी

सााीदाराची िसी

उपचार कर-या डॉ०रांची िसी

ANNEXURE 3- MASTERCHART MASTERCHART GROUP A

Sr.No	Name	Age	Gender	Pre at rest	Pre on activity	Post at rest	Post on activity	Pre flexion Right	Pre flexion left	Pre extention right	Pre extention left	Post flexion right	Post extention left	Pre AKPS	Post AKPS
1	S.P.	40	M	2	8	1	2	95	130	5	1	95	130	40	81
2	T.M.	20	F	3	7	0	2	133	106	1	3	133	106	55	81
3	R.C.	40	F	2	8	0	3	107	125	5	2	94	125	50	80
4	A.P.	38	M	2	7	0	2	130	91	1	4	130	91	41	82
5	D.A.	36	M	1	6	1	0	103	134	5	0	103	134	39	80
6	V.J.	35	F	1	7	0	2	103	132	5	1	91	132	39	81
7	S.M.	26	M	1	7	1	2	95	120	5	3	110	120	40	80
8	S.T.	38	F	2	6	1	1	134	96	1	5	134	96	41	83
9	B.M.	34	M	2	7	1	1	105	132	5	1	106	132	37	84
10	A.M.	36	M	2	7	1	2	133	93	1	5	133	93	33	81
11	N.M.	35	F	1	7	0	2	100	134	4	1	93	134	47	84
12	A.G.	40	M	1	7	1	1	110	135	4	0	107	135	36	82
13	A.G.	25	F	3	8	1	3	98	134	5	1	104	134	55	80

RESEARCH PAPER

Sr.No	Name	Age	Gender	Pre at rest	Pre on activity	Post at rest	Post on activity	Pre flexion Right	Pre flexion left	Pre extention right	Pre extention left	Post flexion right	Post extension left	Pre AKPS	Post AKPS
14	N.K.	38	M	2	8	0	3	100	135	4	0	97	135	60	83
15	K.P.	28	M	0	7	1	3	96	133	3	1	94	133	39	80
16	R.K.	40	F	1	8	0	4	108	134	4	0	109	134	58	81
17	R.S..	20	M	2	7	1	2	106	132	5	1	107	132	44	84
18	P.S.	30	M	1	8	0	1	133	98	1	5	133	98	42	85
19	W.S.	21	M	0	7	0	1	134	93	0	3	134	93	42	81
20	P.S.	32	M	0	7	1	1	98	108	5	2	98	108	40	81
21	S.A.	20	F	1	7	1	1	199	100	2	4	199	100	50	81
22	K.P.	40	M	2	7	1	1	107	131	5	0	98	131	39	84
23	J.G.	32	F	1	8	1	2	102	134	5	1	94	134	40	80
24	N.A.	38	F	2	7	0	2	103	130	5	1	97	130	40	82
25	M.D.	36	M	1	7	0	2	96	132	4	1	103	132	35	84
26	D.Y.	35	M	0	6	1	1	91	131	5	0	108	131	39	81
27	A.M.	33	F	1	8	1	3	109	134	3	0	105	134	59	82
28	S.G.	40	F	4	4	1	2	134	100	0	3	134	100	57	82
29	V.K.	42	F	1	8	0	3	100	133	4	0	92	133	40	81
30	V.J.	38	M	1	7	0	1	100	133	5	0	93	133	60	81
31	S.S.	16	M	1	6	3	2	92	134	3	0	107	134	44	83
32	S.S.	34	F	2	7	0	1	132	107	1	3	132	107	36	82
33	P.D.	37	F	0	7	1	2	106	131	5	1	96	131	42	86
34	B.R.	30	F	1	8	0	2	132	106	0	5	132	107	50	85
35	N.S.	35	M	1	7	0	3	91	132	4	1	99	132	46	86
36	R.P.	21	F	0	7	1	0	95	120	3	2	102	120	52	82
37	S.S.	46	M	2	8	1	3	132	92	0	5	132	96	49	82
38	P.S.	27	M	1	8	0	2	134	103	0	3	134	103	43	86
39	K.D.	32	F	0	6	1	1	132	109	0	2	132	109	33	83
40	A.S.	37	M	2	8	0	3	105	132	3	0	95	132	44	85

GROUP B

Sr.No	Name	Age	Gender	Pre at rest	Pre on activity	Post at rest	Post on activity	Pre flexion Right	Pre flexion left	Pre extention right	Pre extention left	Post flexion right	Post extension left	Pre AKPS	Post AKPS
41	D.A.	40	M	2	5	0	2	95	130	5	1	95	130	40	81
42	T.P.	20	F	1	7	0	1	133	106	1	3	133	106	55	81
43	G.S.	40	F	4	8	0	0	107	125	5	2	94	125	50	80
44	B.J.	38	M	2	7	1	0	130	91	1	4	130	91	41	82
45	Y.J.	38	F	1	8	0	0	103	134	3	5	93	132	33	81
46	M.S.	55	M	0	6	0	1	103	132	0	5	107	120	47	84
47	S.S.	21	F	0	7	0	2	95	120	0	5	104	96	36	82
48	N.K.	26	F	3	7	0	2	134	96	3	1	97	132	55	80

RESEARCH PAPER

49	A.H.	35	M	0	7	0	1	105	132	1	5	94	93	60	83
50	M.L.	36	M	0	7	0	2	133	93	5	1	109	134	39	80
51	S.C.	47	F	1	7	1	1	100	134	5	4	107	135	58	81
52	B.G.	43	F	0	7	0	1	110	135	0	4	133	134	44	84
53	S.V.	30	F	1	8	0	2	98	134	4	5	134	135	42	85
54	G.S.	40	F	6	7	2	2	100	135	4	4	98	133	42	81
55	N.R.	34	M	1	8	0	2	96	133	0	3	199	134	40	81
56	S.M.	23	M	0	7	0	1	108	134	3	4	98	132	50	81
57	P.S.	30	F	0	7	0	1	106	132	1	5	94	98	39	84
58	K.I.	44	F	1	7	0	1	133	98	5	1	97	93	40	80
59	M.A.	32	M	2	7	0	1	134	93	5	0	103	108	40	82
60	P.P.	59	F	1	7	1	1	98	108	3	5	108	100	35	84
61	M.J.	56	M	3	8	2	4	199	100	5	2	105	131	39	81
62	Y.S.	22	M	1	8	0	3	107	131	4	5	134	134	59	82
63	M.M.	33	F	2	7	1	4	102	134	0	5	92	130	57	82
64	G.S.	32	M	0	7	0	2	103	130	3	5	93	132	40	81
65	A.G.	55	F	0	7	0	1	96	132	2	4	107	131	60	81
66	B.D.	33	M	2	8	0	3	91	131	3	5	132	134	44	83
67	U.M.	54	F	1	8	0	2	109	134	3	3	96	100	36	82
68	U.K.	35	M	2	7	1	2	134	100	3	0	132	133	42	86
69	S.J.	34	F	0	6	0	1	100	133	0	4	99	133	50	85
70	S.K.	30	F	1	8	0	1	100	133	0	5	102	134	46	86
71	V.M.	32	F	2	7	1	3	92	134	3	3	132	107	52	82
72	G.S.	26	F	3	7	0	2	132	107	4	1	134	131	49	82
73	M.T.	33	M	2	8	1	3	106	131	0	5	132	107	43	86
74	G.V.	40	M	3	3	2	3	132	106	3	0	95	132	33	83
75	P.M.	35	M	2	7	1	5	91	132	0	4	93	120	44	85
76	K.K.	34	F	2	8	1	4	95	120	0	3	107	96	33	81
77	Y.S.	38	M	1	7	0	3	132	92	3	0	104	103	47	84
78	S.C.	41	F	2	7	1	4	134	103	1	0	97	109	36	82
79	R.O.	36	M	1	9	0	5	132	109	5	0	94	132	55	80
80	S.K.	40	F	2	9	1	2	105	132	5	3	109	132	60	83