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Core Stability in Patellofemoral Pain Syndrome

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Abstract:- The participants with patellofemoral pain syndrome and core stability in their functional daily activities will be examined in this article. accompanied by the prevalence ratio and definition of patellofemoral pain. It is relatively widespread knowledge of the mechanism of damage as well as risk factors and variables influencing signs and symptoms. This article also examines clinical categorization and treatment, encompassing conservative, therapeutic, and surgical approaches. In patients with patellofemoral pain syndrome, the paper described how to employ core muscles and the concepts of core muscles and core stability.

Keywords:- *Core Stability, Pilates, Patellofemoral Pain Syndrome, Management.*

I. INTRODUCTION TO PFPS

Active adults and adolescents frequently suffer from patellofemoral pain syndrome (PFPS). Patients frequently report generalised peripatellar and retro patellar discomfort, which can make it difficult for them to carry out everyday tasks requiring stress on a flexed knee. These include sitting for extended periods of time, crouching, and descending stairs.[1]

Abnormal patella tracking causes excessive compressive stress on the patellar facets, which in turn causes PFPS. An increased quadriceps angle (Q-angle), hip weakness, quadriceps muscle imbalances, excessive knee soft tissue tension, quadriceps weakness, and changed foot kinematics are some of the factors that may lead to aberrant patella tracking. The goal of therapies used to treat PFPS is to enhance patella tracking and lessen aberrant load on the components of the patellofemoral joint, according to this clinical hypothesis.[2]

Soft tissue tightness in the gastrocnemius, quadriceps, hamstring, and ITB/TFL has also been proposed as a factor influencing PFPS. It is hypothesised that during athletic activities, a limited range of motion in the quadriceps may pull the patella superiorly, causing compression of the patellofemoral joint.[3]

It was suggested more recently that PFP may be connected to a decrease in hip strength and core endurance. To find out whether improvements in hip muscle strength and core endurance enhance rehabilitation results for individuals with PFPS, few randomised controlled studies have been conducted.[4]

One of the most prevalent lower extremity disorders in orthopaedic practise is patellofemoral pain syndrome.[5]There have been reports indicating that the likelihood of PFPS is substantially higher in females compared to males.[6]

II. DEFINITION

PFPS may be diagnosed in patients who have a clinical presentation of anterior knee pain; patients with intra-articular pathologies such as patellar tendinopathy, peripatellar bursitis, plica syndrome, Sinding Larsen Johanson's and Osgood Schlatter's lesions, Hoffa's disease, and other uncommon pathologies will not be eligible for this diagnosis.[7]

III. ANATOMY AND BIOMECHANICS

Allowing for knee extension is the patella's primary purpose. In addition, the patella serves to uniformly transfer the quadriceps' divergent forces to the patellar tendon and the underlying bone by centralising them.

By keeping the patella apart from the femur, the patellar tendon is thus shielded from friction. Patellar tracking is the process by which the patella articulates with and passes through the trochlea, or femoral groove. The patella sits superior and lateral to the trochlea at full knee extension. To articulate with the trochlea at the beginning of flexion, the patella must shift somewhat medially.The patella is fully engaged in the trochlea by 45° of knee flexion, and tracking is mostly controlled by the bony architecture and the congruity of the patella and trochlea's articular surfaces.

An increase in quadriceps tension is produced during vigorous knee flexion. A compressive force is produced that operates on the PATELLOFEMORAL articular surfaces as a result of this tension being transferred from the quadriceps to the patellar tendon. The name patellofemoral joint response force (PFJR) is given to this force. As active knee flexion rises, PFJR also increases gradually.[8]

A. Prevalence:

A frequent knee condition that affects both athletes and non-athletes is patellofemoral pain syndrome. Thirty percent of all injuries seen in a sports medicine clinic are related to it. Anterior knee discomfort affects women more frequently than it does men; among young athletes, it affects 10% of female athletes and 7% of male players. In female athletes, patellofemoral discomfort is responsible for 33% of all knee injuries, whereas in male athletes, it accounts for 18% of all knee injuries.[8]

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B. Pathophysiology:

Biologic elements are becoming more prominent in the origin of patellofemoral pain, replacing the decades-old paradigm of a purely structural and biomechanical explanation. It is becoming more and more clear that the majority of patients' patellofemoral discomfort is most likely the result of a diverse mosaic of potential pathophysiologic processes, many of which are brought on by simple overload.

It has been established that a number of factors, including inflammatory synovial lining and fat pad tissues, retinacular neuromas, elevated intraosseous pressure, and elevated osseous metabolic activity of the patella, can cause anterior knee discomfort. When taken into account together, these mechanisms may be described as a loss of tissue homeostasis and offer a fresh and different perspective on the mystery of anterior knee pain.

A few high loading circumstances of the patellofemoral joint may be large enough to cause the symptomatic loss of tissue homeostasis, which can then continue forever once it starts. From this new biologic perspective, if the pain-free state of tissue homeostasis is safely reached and maintained, then clinically, it makes little difference what structural variables may be present in a certain joint (e.g., chondromalacia, patellar tilt, or a Q angle over a certain value).[9]

C. Mechanism of Injury:

Trauma, overuse, and aberrant patellar tracking are the three primary processes that cause patellofemoral discomfort. These reasons can result in greater stress on the patellofemoral joint, increased strain on the peripatellar soft tissues, or both. The mechanism of damage is often complex and multifaceted.

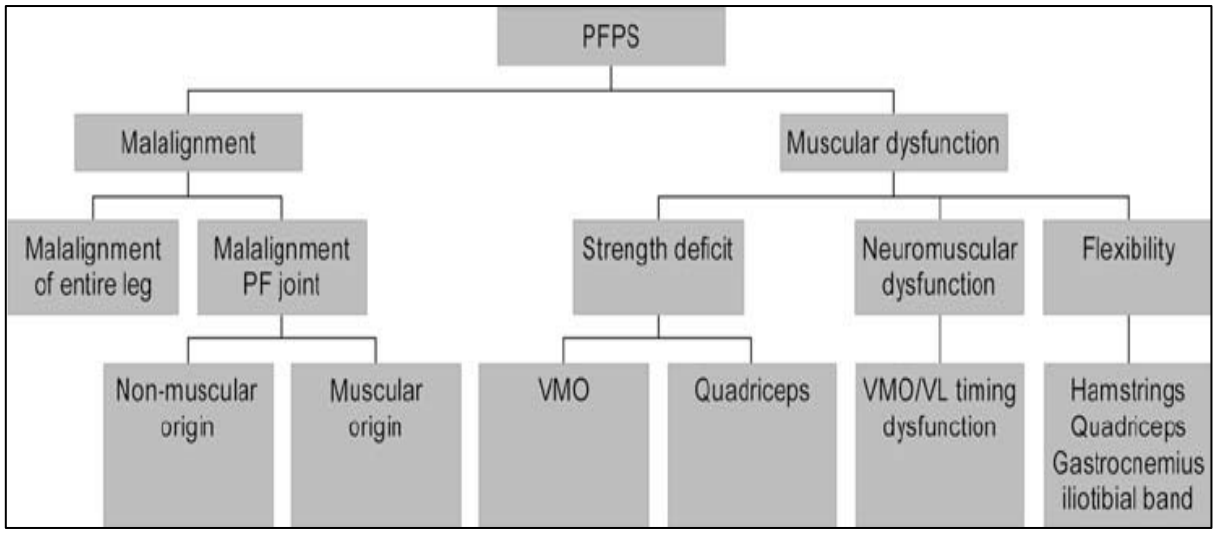

Fig. 1: Clinical Classification of Pfps:[7]

D. Ethology: [9]

➢ *Mechanical Environment*
- Direct patella femoral trauma
- Overly high inherent forces of compression and tensile strength
- Normal alignment
- Malalignment (load shifting)
- Intra-articular structural interference
- Increased intraosseous pressure
- Barometric pressure changes

➢ *Chemical environment*
- Presence of cytokines
- Altered pH of damaged tissues
- Localized peripheral neuropathy
- Painful neuroma

➢ *Nonpatellofemoral sources*
- Referred pain (such as hip arthrosis)
- Phantom limb discomfort in amputees above the knee.

IV. RISK FACTORS:[8]

A. Trauma

Articular cartilage can be crushed by blunt trauma to a flexed knee, such as that which happens after a fall or a direct hit on the dashboard in a car accident. Running causes periodic spikes in PATELLOFEMORAL stress, which might result in patellofemoral discomfort due to the repeating micro-trauma.

B. Overuse

Increased activity levels have been linked in clinical trials to patellofemoral pain, indicating that patellofemoral pain is more likely to occur when the patellofemoral joint and supporting soft-tissue structures are overworked and chronically overloaded.

C. Mal alignment of lower extremity

Because lower extremity malalignment is believed to affect patellar tracking, it is frequently considered a significant risk factor for pelvis-related discomfort. Genu valgum, genu varum, genu recurvatum, leg-length discrepancy, femoral anteversion, external tibial torsion, lateral displacement of the tibial tubercle, and excessive

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pronation of the subtalar joint are some of the factors that cause malalignment.

D. Muscle imbalance or weakness

One of the most significant risk factors for patellofemoral discomfort may be weakness in the quadriceps. Certain researchers have proposed that the more particular issue might be imbalances in the neuromuscular regulation of the VMO and VL, or a relative weakening of the VMO.

E. Muscle and soft tissue tightness

The lateral patellofemoral joint is subjected to undue tension when the lateral retinaculum is too tight. A major cause of patellofemoral discomfort is lateral patellar compression syndrome, which can result from this. The patellar and quadriceps tendons, which are neighboring tissues, must bear the brunt of this strain since a taut quadriceps muscle is less able to absorb energy eccentrically.

F. Proprioception deficit

It has been demonstrated that patients with patellofemoral discomfort exhibit impaired knee joint proprioception. The peripatellar tissues' proprioceptive nerve fibres may be damaged or the source of abnormal patellar tracking.

G. Congenital anomalies of patella

Subluxation and dislocation of the patellar tendon have been linked to global flattening of the trochlear groove and hypoplasia of the medial trochlea.

H. Ligamentous laxity

Patients with chronic posterior cruciate ligament (PCL) deficit (48%) and patients with chronic ACL deficiency (20% to 27%) report having anterior knee discomfort. In knees lacking in PCL, elevated patellofemoral stresses have been reported.

I. Age

All age groups can experience patellofemoral discomfort; however, the prevalence is higher in the second and third decades of life.

J. Gender

Clearly, women experience patellofemoral discomfort more frequently than men.

K. Specific sports and training techniques.

Patellofemoral pain syndrome is the most common injury in runners the risk is higherwithrunning on crowned roads or hills. This is most likely because running on crownedRoads causes excessive subtalar pronation in the foot on the elevated side, and hill running increases patellofemoral contact stress.

V. MANAGEMENT

A. Conservative Management: [8]

- *Rest*

  It has been demonstrated that taking a break from taxing sports, especially running and leaping, might lessen patellofemoral discomfort.

B. Patellar taping and biofeedback

- *Shoe orthosis*

Despite the fact that research has not been able to link excessive subtalar pronation to an increased risk of patellofemoral discomfort. It has been demonstrated that individuals with severe subtalar pronation have less discomfort while wearing orthotic shoe inserts.

C. Knee sleeves

- *A resistive knee braces*

The progressive resistance exercise knee brace is designed to help with patellar tracking by providing resistance against flexion and extension motions of the knee during walking. The progressive resistance exercise knee brace has been demonstrated to reduce pain and enhance function in individuals with patellofemoral discomfort, while it is uncertain if the brace genuinely alters patellar position.

- *Acupuncture*

It seems that acupuncture works well for treating patellofemoral discomfort. Afferent nerve stimulation from acupuncture is thought to cause central pain inhibition, which in turn reduces pain, however the precise process is unknown.

D. Medical treatment:

- NSAIDS
- Intra articular and intramuscular injections of glycosaminoglycan polysulfide.

E. Surgical Treatment: [8]

- Arthroscopy**:** Understanding the ethology and pathophysiology of anterior knee pain in individuals who do not respond to conservative therapy can be aided by arthroscopy.
- The surgical management of a painful medial synovial plica may involve its removal.
- **Synovectomy:** For a patient with persistent synovial inflammation, a synovectomy could be beneficial.

F. Physiotherapy Treatment:[8]

- Strengthening of
  - ✓ Quadriceps muscles
  - ✓ Gluteal region muscles
  - ✓ Vastus medialis obliquus
- Stretching of Iliotibial band
- Patellar mobilisation from the mediolateral direction to reduce retinal
- Applying a deep friction massage to the delicate tissues of the patella.

- Proprioception training
- Exercise and patellar taping combined

G. Introduction To Core

➢ *Core Muscles:*
Major Muscles Include in Core Stability:

- Pelvic floor muscles
- Transversus abdominis
- Multifidus
- Internal and external oblique
- Rectus abdominis
- longissimus dorsi
- Diaphragm

➢ *Minor Muscles*

- Latissimus dorsi
- Gluteus maximus

The diaphragm acts as the top of the muscular box that is the core, with the pelvic floor and hip girdle musculature as the bottom, the paraspinals and gluteus in the rear, and the abdominals in the front. There are 29 pairs of muscles in this box that support and stabilise the kinetic chain, pelvis, and spine during functional motions.

The two main purposes of the abdominal muscles in human motion and sports are: (1) movement, which includes rotation, forward trunk flexion, and lateral trunk flexion (bending to the side), and (2) stabilisation of the low back and trunk. A single muscle group or many muscle groups can be activated simultaneously to produce the previously described actions.

Four paired muscles that go from the rib cage to the pelvis make up the abdominal wall. There are two sets of muscles: one anterior group and two lateral groups that are mirror images of one another. The rectus abdominis, the only paired muscle in the anterior group, is split into a right and left half by the body's midline. The remaining three paired muscles, the transversus abdominis, internal oblique, and external oblique, are each represented by a side in one of the two lateral groups.

The spine would become mechanically unstable under compression stresses without this muscle support. Proper force distribution and maximal force generation with minimum compressive, translational, or shearing forces at the joints of the system indicate that it is functioning as intended.[1]

VI. CORE STABILITY

The body's core is made up of the proximal lower extremities, hips, pelvis, spine, and abdominal area.[11] Eleven The capacity of the lumbopelvic-hip complex to keep the vertebral column from buckling and to restore balance after a disturbance is known as core stability.

The capacity to stabilise one's core is referred to as core stability. It needs to be seen as the capacity to regulate the core's location and motion.[12] Twelve A well-known fitness fad that is beginning to spread throughout the field of sports medicine is core stability. Popular exercise regimens like Pilates, yoga, and tai chi are based on fundamental strengthening concepts. The interacting components that make up the spine stability system are as follows:

- Neuromuscular control (neural elements)
- Passive subsystem (osseous and ligamentous elements)
- Active subsystem (muscular elements)

Coordination of all the muscles around the lumbar spine is essential for stability and mobility. Despite the fact that current studies support the notion that all of the core muscles are necessary for the best possible stability and performance, [13]

To put it another way, adequate sensory input—which informs the central nervous system about interactions between the body and its surroundings and provides continuous feedback—is just as important for spine stability as muscle strength. This allows for the optimisation of movement. For the best spinal stability, a comprehensive core stabilisation plan would take into account the sensory and motor elements associated with these systems.

A recent study by the Queensland physiotherapy group highlights the importance of the transversus abdominis and multifidi deep core muscles for core stability.[10]

Conventional exercises for strengthening the core have gained popularity and are beginning to be used in sports medicine. Exercises that strengthen the core have been linked to a variety of advantages, including reduced back discomfort, enhanced sports performance, and injury prevention. Sports and other activities need the strength of the core muscles, whose endurance is crucial for maintaining core stability over extended periods of physical exertion and for preventing injury. Fatigue affects the neuromuscular control elements that contribute to spinal stability. The main factor in stability is the mechanical rigidity of the muscles that support the spine and contract actively.[10]

In order to maintain core stability, the transversus abdominis and multifidi deep core muscles are critical, according to a new study by the Queensland physiotherapy group.[10]

Traditional core strengthening exercises are becoming more and more popular and are starting to be applied in sports medicine. Core-strengthening exercises have been associated with several benefits, such as decreased back pain, improved athletic performance, and injury avoidance. The strength of the core muscles is essential for sports and other physical activity because their endurance is key to preserving core stability during prolonged physical exertion and avoiding injury. The neuromuscular control components that provide spinal stability are impacted by fatigue. The mechanical stiffness of the muscles that actively contract and support the spine is the primary determinant of stability.[10]

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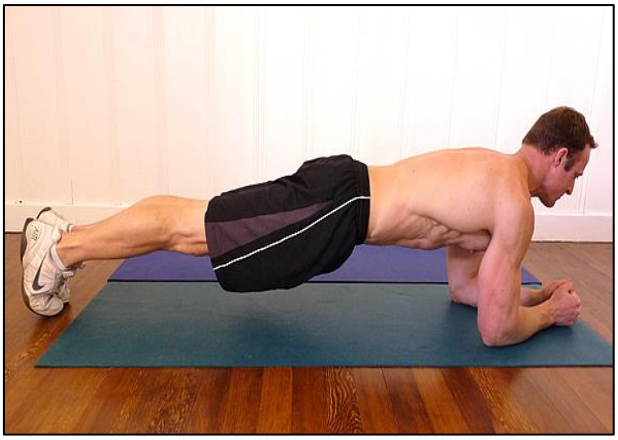
VII. PRINCIPLES OF PILATES

- Cantering: All energy originates at the centre of the body, sometimes referred to as the "powerhouse," from whence it radiates to the extremities.
- Concentration: Since the mind controls the body, doing Pilates movements requires paying close attention to the complete body throughout each activity.
- Control: One will be in control of the performed motions when the exercise is performed from the centre with attention.
- Breathing: Pilates maintained that learning to breathe correctly is the most crucial component of his system, even if you don't follow any other guidelines. Forcible exhalation is regarded by Pilates as the secret to a complete inhale. Breathing fully and rhythmically is a must for all workouts. Inhale at the point of exertion to oxygenate all body tissues, and exhale to remove all waste products from the cells.
- Precision: Instead of doing several clumsy movements, the emphasis is on performing one exact and flawless action. Teachers frequently use the proverb "It's not how many, but how" to emphasize this.
- Flow: There aren't any single, immobile motions since that's not how our bodies work by nature. In order to create purposeful and economical movement, each exercise flows into the next with a seamless transition and a "minimum of motion" that translates into daily life.14

VIII. CORE STABILITY EXERCISES

A. Traditional Core strengthening exercises



A. Prone plank

B. Side plank

C. Bridging

D. Bird dog

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E. Dying bug

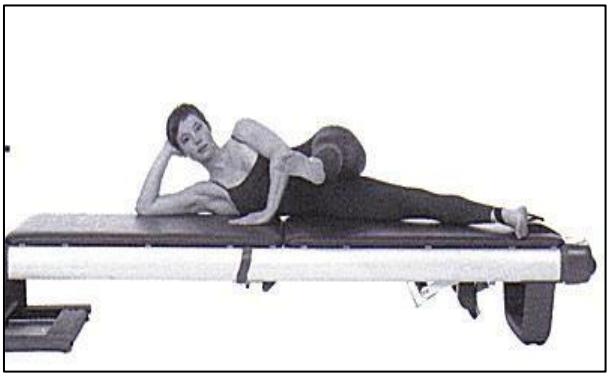
F. Leg drop

IX. FIGURE: PILATES

A. The hundred

B. Single leg stretch

C. Double leg stretch



D. Side kick front and back

E. Kneeling side kick

F. Leg pull prone

X. CORE STABILITY IN RELATION WITH PATELLOFEMORAL PAIN SYNDROME

The body of current research points to the hip's multifaceted role in knee dysfunction over the life course. An increasing amount of research indicates that hip weakness and abnormal lower extremity mechanics may be factors in a variety of lifetime knee problems. Moreover, authors of more current research have deduced that hip therapies may enhance knee function. To avoid a potential knee injury, screening for hip weakness and limited rotation mobility appears appropriate.[15]To preserve the integrity of the spinal column, offer resistance to disturbances, and provide a secure foundation for extremity movement, core stability is essential.

The intricate link between hip and trunk muscular capacity and motor control determines an individual's potential to exhibit core stability. According to recent research, core stability measures may be compromised by lower extremity injuries.

Furthermore, the likelihood of lower extremity damage may be elevated by an underlying core weakness. For those with reduced core stability measures, identifying them and providing the right kind of assistance may better prepare them for the workforce or sports.[12]

The findings of the studies imply that PFPS patients have altered neuromuscular control of the core. In contrast to the healthy group, the unanticipated lateral pelvic disturbance caused the gluteus maximus to contract later, whereas the deep abdominal muscles and the erector spine engaged earlier and for a longer period of time. Furthermore, there were differences in the recruitment patterns of the chosen core muscles between the two groups.[15]

XI. REVIEW OF LITERATURE

- **Mohomed Faisal Chevidikunnan: ET AL. 2016:** To evaluate the impact of core muscle strengthening in patients with patellofemoral pain syndrome, a study was conducted on the efficacy of this treatment for enhancing pain and dynamic balance in female patients. Twenty female patients with patellofemoral pain syndrome, ages 16 to 40, were split into two groups: ten for the trial and ten for the control. According to the study's findings, female patients with patellofemoral pain syndrome experience less discomfort and better dynamic balance when a core muscle-strengthening programme is added to their traditional physical treatment regimen.
- **Reed Ferber. ET AL. 2015:** Research was done on the benefits of strengthening the hip and core muscles over the knee muscles in treating patellofemoral discomfort. An investigation comparing PFP pain, function, hip- and knee muscle strength, and core endurance between KNEE and HIP treatments following six weeks of rehabilitation, using a multicentre randomised controlled trial design. The HIP treatment produced better overall increases in strength and a quicker remission of discomfort than the KNEE protocol, despite equal results.
- **Zahra RojhaniShirazi ET. AL .2014:** Compared the electromyographic activity of the core muscles in patients with patellofemoral pain syndrome and healthy individuals in order to assess the recruitment patterns of these muscles in response to abrupt external disturbances. Women between the ages of 18 and 40, including 27 PFPS-diagnosed cases and 27 healthy controls. The findings of this study imply that, in order to provide core stability, the core muscles are engaged differently in people with PFPS. Enhancing core neuromuscular function seems to be a promising approach for PFPS sufferers' rehabilitation.
- **Lori A. Bolgla ET AL. 2011**: Conducted a study comparing the neuromuscular activity and hip and knee strength of participants with and without patellofemoral pain syndrome, which has hitherto been thought to be only a knee issue. In this study, 18 females with PFPS and 18 matched controls took part. Hip and quadriceps strengthening should be the main goals of rehabilitation. Even though gluteus Medius training has been included by physicians in rehabilitation programmes, it could be beneficial to pay more attention to the external rotators.
- **Lori A. Bolgla ET. AL. 2010:** A comprehensive evaluation of the literature was conducted to provide an update on the conservative therapy of patellofemoral pain syndrome. We looked through the databases of PubMed, CINAHL, and SPORT Discus to find research that was released between January 1, 2000, and December 31, 2010. The available data is in favour of maintaining the cautious therapy of PFPS with quadriceps exercise. Prospective studies have to concentrate on pinpointing groups of PFPS patients who might profit from the additional therapeutic modalities covered in this comprehensive analysis.
- **Sara R. Piva ET. AL. 2005**: Investigated whether differences in lower extremity muscle strength and soft tissue length exist between patients with patellofemoral pain syndrome (PFPS) and age- and gender-matched control subjects. The study focused on hip strength and soft tissue flexibility in individuals with and without PFPS. The study included 30 age- and gender-matched controls without PFPS and 30 patients with PFPS. According to this study, more investigation is necessary to determine if individuals with PFPS have these deficits in soft tissue length and muscle strength.
- **Werner S. ET. AL.2005:** Research on the clinical classification of patellofemoral pain syndrome and the impact of non-operative treatment was carried out in order to develop a system of classification that can assist clinicians in determining the underlying cause of pain and in choosing the best non-operative treatment plan that is unique to each patient with pfps.
- **Mary Lloyd Ireland. ET. AL.2005:** To demonstrate the advantages of core stability, a study was done on the connection between lower extremity function and damage. Movement of the lower extremities and trunk muscular activation are clearly related. According to available data, injuries may be more likely to occur in people with lower core stability and may be less common in those with proper training. It is possible to examine core stability via isometric, isokinetic, and is

inertial approaches. Reducing the frequency of lower extremities and back injuries may be possible with appropriate management.

- **Venu Akuthota. ET AL. 2004:** Investigated the benefits of core training as a preventative programme and a type of therapy for a variety of lumbar spine and musculoskeletal ailments. The purpose of this review is to comprehend the notion and use a theoretical framework to describe the existing literature on core strengthening.
- **Mary Lloyd Ireland. ET AL. 2003:**To find out if women with anterior knee discomfort are more likely than a comparable, asymptomatic, age-matched control group to exhibit hip abduction or external rotation weakness, research on hip strength in women with and without patellofemoral pain syndrome was conducted. Fifteen female participants experiencing discomfort in the patellofemoral joint had measures of their isometric strength for hip abduction and external rotation on the side that was damaged. According to the findings, compared to age-matched women without symptoms, young women with patellofemoral discomfort are more likely to exhibit weakness in both hip abduction and external rotation.

XII. CONCLUSION FOR STUDY

For individuals with patellofemoral pain syndrome, core strengthening activities are particularly helpful in lowering pain and suffering as well as enhancing dynamic stability.

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