CHAPTER 2

REVIEW OF LITERATURE
2.1 Epidemiology of Patello Femoral pain syndrome (PFPS)

PFPS like any other musculoskeletal injury affect people from all walks of life including athletes and non-athletes. The condition is common in athletes who are associated with running says Lopes AD. In 2012, he conducted a systematic review to find out which is the most common musculoskeletal injury that occurs in athletes who has running as a part of their game. He concluded from his study that Achilles tendinopathy and patella femoral pain syndrome are the most running related musculoskeletal injuries particularly in marathon and ultra-marathon racers. Markers A conducted an epidemiological survey on patella femoral pain syndrome where he studied the pathophysiology and treatment methods.

Blond L in 1998 studied the prevalence of PFPS in 250 athletes spanning over 7.5 years in his retrospective follow up study. He concluded from his study that the athletes who involved in running and squatting in a consistent manner. Witman P spotted that athletes from metropolitan cities had more PFPS compared to athletes from other part of country.

Callaghan MJ in 2007 raised question through his study that whether the prevalence and incidence of PFP among the general population were properly evaluated. He concluded from his study that the strength of differential diagnosis of PFPS was found wanting in the professionals who provided Primary health care delivery. Goodman a et al in 2009 studied the prevalence and incidence of PFP and found that prevalence of Basketball Athletes in Middle School and High School was 26% in female athletes and 12% in male athletes which showed statistically significant difference between female athletes and male athletes. During the athletic season, PFP had a cumulative incidence of 10% in female athletes and 4% in male athletes. Among the athletes who got exposure, the incidence density for female athletes were 1.06 per 1000 and for male athletes it was 0.33 per 1000 males which demonstrated Females had 3.2 times greater rate of incidence and prevalence of PFP than males.

Gregory D, Myer et al in 2010 from Sports Medicine Bio dynamics Centre and Human Performance Laboratory, Cincinnati, Ohio, USA, studied patho-mechanics and incidence of PFPS in Female Athletes among 240 players. This study revealed that PFP had a point prevalence of 16.3 per 100 athletes. Among the middle and high school female basketball players when a Prospective tracking of exposures to sports was done it was
reported to be 12,822 athlete exposures annually. He also found that the rate at which unilateral PFP could develop was 9.66 per 100 athletes.

M. Boling et al in 2010 studied the prevalence and incidence of PFPS along with gender differences among 1525 subjects from the United States Naval Academy (USNA) and the participants had followed up till 2.5 years from the diagnosis of PFPS. Among 1525 participants 206 were found to have PFPS. His study concluded that 2.2% was the incidence rate of PFPS with females and males 3.3% and 1.5% respectively. A significant gender differences where 2.23 times females were more vulnerable to develop PFPS when compared to males.

Nejati P et al conducted a study in 2011 among Iranian female athletes to find out the prevalence of PFPS in 5 sports. This study included 418 female athletes aged between 15-35 years from 5 sports namely: volleyball, fencing, running, soccer and climbing. The athletes who had gradual onset of knee pain in the anterior region without any injury which lasted for at least 3 months that increased only during squatting or using stairs with no other knee surgery were diagnosed as PFPS in his study. The prevalence of PFPS was 16.7% among which soccer players, volleyball players, runners, fencers and rock climbers for this fraternity were 13.68%, 20.38%, 16.66%, 13.33% and 26.31% respectively. Hence, he concluded that among Iranian female athletes the incidence of PFPS was high in athletes involving in rock climbing and volleyball sport 20% to 25% when compared to other sporting activities.

Wood L. in 2011 studied the epidemiology of PFPS in adulthood through a review of literatures and concluded that out all pathologies resulting pain, PFPS accounts for maximum diagnosed condition. This phenomenon was observed in both paediatric and adult population in equal proportion. Witvrouw E in 2013 presented a paper at the third international Patello Femoral Pain research held at Vancouver. He estimated the prevalence of PFP to be 40% of all knee injuries and thus it is the primary cause for knee pain in Europe.

In 2015, Neal R. Glaviano et al studied that 2,188,753 citizens of USA were diagnosed with PFPS among them females (1,211,665) was more commonly diagnosed with PFPS when compared to males (977,088). This scenario was found between ages 50-59 which were gradually increasing during the year 2007-2011. Among the cases diagnosed with PFPS, the rate gradually increased from the lowest percentage happens to be 18.7% (410,852 cases) in 2007 to highest percentage of 22.7% (496,816 cases) in 2011. Statistically
A significant difference for PFPS over the 5-year period was found using Mantel-Haenszel test. Hence, he concluded that among the 1.1 billion patient records of USA 1.5% and 7.3% patients were found to have PFPS.

A Manoharan et al in 2016 did a study in a tertiary care hospital in India to find out the prevalence of anterior knee in patients aged between 20-40 years. This study included 968 patients with knee among which 30% (281) female and 28% (152) male were diagnosed to have anterior knee pain. he concluded that anterior knee pain has become a common problem leading to less productivity, reduced physical fitness and discomfort in their activity of daily living.

Smith BE in 2018 conducted a systematic review and met analysis of PFPS prevalence and incidence which included 23 observational studies. 22.7% was the yearly prevalence of PFPS among general population and 28.9 % for young adults. A point prevalence of PFPS for adolescent athletes was estimated to be 7.2% and for female athletes it was estimated as 22.7%. This systematic review concluded that though PFPS had a high prevalence and incidence rate, it was reported that this condition had a bad prognosis with the increase in disability levels.
2.2 Aetiology

Lankhorst NE et al in 2012 in his systematic review found that males and females who had reduced strength in knee extensors may develop PFPS. The same author performed another systematic review in 2013 that included 47 studies which examined 523 variables. The results of the study revealed that Q angle was larger, increased patellar tilt angle and sulcus angle, low peak torque of knee extension, reduced hip abduction strength and rotation strength in patients with PFPS. This study also concluded that PFPS was not associated with the height index of foot arch and the medial congruent arch angle.

Malone et al in 2002 have proved that PFPS can result from either weakness of quadriceps. Delaying in Activation of Vastus medialis in relation Vastus Lateralis can also lead to which was proposed by Cowan, Bennell, Crossley et al., 2002. Wright & van den Bogert in 2000 assumed that weakness of quadriceps or when vastus medialis oblique muscle was activated at a longer duration it can lead to the tracking of patella abnormally and thereby causing a dysfunction in patellofemoral joint.

Duffey MJ et al in 2000 studied the possible causes to anterior knee pain in long distance running athletes. The predictors or possible causes for anterior knee was concluded to be Pronation of foot in stance phase, index of the arch, shoe mileage and peak torque of foot extensors. Messier SP et al in 1991 found that Q angle, muscular endurance during knee extension and kinetic variables was a significant discriminator component when compared to rear foot movement variables in terms of aetiology for PFP among 20 injured players.
2.3. Anatomical speciality of Patello-femoral joint (PFJ)

The patella is a sesamoid bone formed in the tendon of the quadriceps muscle and it’s the largest in its variety in human body. Tria AJ in 1992 tried to bring about the average size of patella in human knee joint and reported that the average size of patella was 4 - 4.5 cms of length, 5 - 5.5 cms of width and 2 - 2.5 cms of thickness. Grelsamer in 1998 described the patellar articular surface with his study on biomechanics of the patellofemoral joint. He claimed that the patella is made out of a thin cortical shell, the anterior surface of which is arched in both anterior-posterior, and medial-lateral planes. The posterior surface of the patella is separated into an assortment of facets.

A noteworthy vertical edge separates this surface into a medial and lateral half. The two parts can be additionally isolated into seven facets, three even matches: proximal, centre, and distally and an odd feature that is situated on the far medial, posterior part of patella. The patellar facets are curved fit as a fiddle with the end goal to oblige the inward femoral surface with the lateral side more extensive to help keep up patellar position. Most of the articulating surface of the patella is secured with a thick layer of articular cartilage, up to seven millimeters. He confirmed that this thick cartilage is thought to disperse vast joint reaction forces that are made amid intense compressions of the quadriceps muscle.

Janice K. Loudon in 2016 described the distal aspect of femur in her study. She clarified that the distal femur frames into an altered U-formed intercondylar section (or trochlear sulcus) with curved lateral and therapeutic facets secured by a thin layer of articular cartilage. Similarly as with the patella, the lateral aspect of the femur is bigger and stretches out more proximally to give a hard support to enhance patellar solidness. A sulcus edge can be related to radiograph that estimates the point between the lateral and medial femoral condyle. Typically, this edge midpoints around 138 ± 6 degrees. A more prominent edge would demonstrate trochlear dysplasia (less depth of the trochlea) and an inclination for patellar subluxation.

Reider B Marshall in 1981 studied the anterior aspect of the knee joint and the pathologies associated with the anterior knee. He claimed that due to the non congruent association between the patella and trochlea, the stability factor of the PFJ is dependent on mainly the static and dynamic forces created by the surrounding soft tissue structures. Desio SM Burks in 1998 analysed the Soft tissue restraints to the lateral patellar translation in knee
joint and reported that the Static stabilisation of the PFJ is rendered by the patellar tendon, the joint capsule, and Ligamentum patellae. The medial structures end up critical in limiting lateral interpretation and the essential structure to lateral restriction is the medial patellofemoral tendon (MPFL).

This tendon keeps running from the adductor tubercle to the medial outskirt of patella. Desio et al. portray the MPFL as giving 60% aggregate limitation at 20 degrees of knee flexion. An auxiliary limitation incorporates the medial meniscopatellar tendon which begins from the anterior part of the menisci and inserts into the second rate 1/3 of patella and the medial retinaculum with shallow strands that interdigitate with the medial collateral tendon and the medial patellar ligament.

Powers CM Landel in 1996 studied the forces generated by the vastus muscle during functional activities. He reported that on the lateral side of the PFJ, lateral PF ligament, PF joint capsule, iliotibial band (ITB), and lateral retinaculum, aide in stability. He also reported that the joint must rely on the medial and lateral retinaculum and joint capsule at angles less than 20-30 degrees of flexion because there is almost no bony stability.

Chang W-D Huang did a cross sectional analysis of vastus medialis oblique (VMO) and vastus lateralis activity during exercises in patients with PFP syndrome. He proved that dynamically, the contractile structure of the quadriceps, pes anserine muscle and biceps femoris muscle help to keep up patellar arrangement. The same idea was echoed by Lack S Barton 2014 when he studied the PFPS management. Goh JC Lee studied the role of VMO on 17 fresh cadavers and came out with finding that the VMO attaches to the mid-segment of patella, the MPFL and adductor magnus ligament. He claimed its more oblique arrangement (when contrasted with the vastus medialis longus) gives mechanical favorable position to elevate medial balancing out power to the patella.

Lieb FJ in 1968 analysed the anatomical role of quadriceps in amputated limb and proved that the rectus femoris embeds on the anterior part of unrivalled part of patella. The vastus intermedius embeds posteriorly at the base of patella. Terry GC in 1986 analysed anatomy of the iliopatellar band and ITB and proved that the vastus lateralis furnishes lateral powerful support related to the ITB and the shallow oblique retinaculum. Poorly, the patella is anchored by means of the patellar ligament and its connection to the tibial tubercle.
2.4. Biomechanical considerations of PFJ

Biomechanically the patella plays a vital role in the energy cost for extension of knee both in closed kinematic and open kinematic mechanism. Huberti HII et al in 1984 studied the influence of Q angle in the extension mechanism of the knee joint and found out from their study that the patella helps in changing the direction of pull of the extensors (quadriceps). They also claimed that the patellar utilisation and role progressively increased as the knee moves into extension. To be specific they claimed that beyond 30 degrees of extension only the role of patella peaked.

Later, Hungerford DS in 1989 analysed the biomechanics of PFJ and explained that 31% of total knee extension torque is provided by patella when the knee is in full extension. But when the knee is in between 90 and 120 degrees of flexion the patella’s contribution is only 13%. McConnell J in 2002 studied the physiotherapist approach to PFP and he proved that the patella is in fact a bony shield to the anterior trochlea. Because of its positioning between the quadriceps due to its interposed position between the quadriceps tendon and femur it prevents excessive friction between the quadriceps tendon and the femoral condyles.

According to Watson CJ the patella position is a unique one for individual and abnormal positioning of patella cannot be visually determined and labeled unless clinical examination is performed. The position of patella according to him depends on the height of the two femoral condyles, height of the patella and the shallowness of the femoral articular surface (groove). Watson CJ also proved that the examination tool brought about by McConnell was not reliable because of the individual anatomical variations.

The position of the patella during full knee extension from the frontal plane was described to be exactly in the centre between the two femoral condyles and at the midline exactly but some researchers said it is slightly lateral (CM Power, et al, 2003). Witvrouw E studied the McConnell classification of patellar position. He compared subjects who were symptomatic as well as non symptomatic for patella pain. He proved that the Q-angle is vital in these cases which were normally around 13 for men and 17 for female. An increased Q angle caused a bowstringing effect there by pulling the patella laterally.

Freedman BR studied the relationship between the Q-angle and in-vivo patella-femoral kinematics in an effort to reassure the already existing claims about Q-angle in 2014. He proved that there was no relationship between the two and also warned the clinicians from
using it. The same findings was supported by Silva D de O Brian in 2015. He ascertained that peak valgus force in female has more correlation to patella femoral kinematics that Q-angle. Insall J salvati in 1971 came up with a finding that the normal patella diagonal length was similar to the length of the patella tendon. Even if anatomical variations occurred this cannot be more than 20%. He named two phenomena called patella alta and patella baja based on the patella length 20% more or 20% less than patella height respectively. Zhang D et al in 2011 coined a name lateral PF compression syndrome from his study on analysis the patella position from transverse plain when the knee is in full flexion. He observed that there was a lateral shift in patella when the medial condyle height was more than the lateral condyle and as a result the patella slides more laterally compressing the underlying structures and causing lateral PF compression syndrome.
2.5. Patho-physics and patho mechanics associated with PFPS

Hungerford DS and Barry M. in 1979 wrote a book for describing the biomechanics of PF joint alone exclusively. He advocated that the PF joint reaction forces are compressive forces that are determined primarily by the knee joint angle and quadriceps muscle tension. This might be the cause of articular cartilage degeneration in PFPS. This phenomena was explained from a other perspective by Kusiak M in 2018. He read the knee of women who had increased Q angle, for the height of articular cartilage. He found that the height of the articular cartilage on the lateral condyle of femoral was lesser than that of the femoral medial condyle in 25 to 45 year aged women who had Q-angle more than 15°. This clearly states that the lateral condyle bear more weight than the medial condyle in subjects with increased Q angle. Smith and Boden later in 2018 understood that the adult PFP was analysed maximally but not the adolescent PFP syndrome.

He claimed that the adolescent PFP syndromes are always attributed to overuse, but it’s not the true scenario. He proved that increased Patellar Volume/Width and Decreased Femoral Trochlear Width were Associated With Adolescent PFPS. Dagneaux in 2018 proved from his study on the malrotation of distal femur and its association with PF pain syndrome that, excessive malrotation of femur from diaphyseal fractures resulted in an alignment changes in patellofemoral joint and higher PF stress. He also advocated from his study that Care should be taken for internal malrotation when treating femoral shaft fracture.

In 2018 Turkmen and Işık Y studied the Association between PF congruence and PF chondropathy in subjects with anterior knee pain. Their results concluded that there three detrimental factor that contributes pf anterior knee pain and they are decreased Insall Salvatti index, decreased lateral trochlear inclination angle, and increased patellar tilt angle, the analysis was performed using a T2 waited imaging with MRI and the study also found these three factors ca be used for predicting vulnerability to PF pain syndrome. Briani et al studied the association between the vertical ground reaction force and anterior knee pain and prove that there be an important relation between the increase in pain and VGRF loading rates in women with PFP. Based on these findings, interventions aimed at reducing VGRF loading rates are important in the context of PFP.

Cui L.H, in 2017, analysed the treatment options and the prognosis of PF joint using 121 patients both male and female subjects from all walks of life. He analysed the treatment
they underwent, the duration of treatment, frequency of treatment. Invasive treatment were analysed separately from non-invasive treatment. He also analysed the follow up of treatment programme at end of the treatment, at the end of first month and also at the end of 6th month from the commencement of treatment. His study results showed that there was very few subjects who did not had a recurrence in the 6 month duration.

The compliance with exercises directly impacted the recurrence rate and severity. He also concluded that the pain levels did showed an fluctuating pattern and was unique for individual patients because PF pain syndrome is a multi-factorial problem with too many variables influencing the position of patella in a three dimension angle.
2.6. Outcome measures

McGill is a self-reported pain rating scale invented to describe the intensity and quality of pain, this is a multidimensional scale which was developed by Melzack and Torgerson in 1971 at McGill University. The scale evaluates 4 subscales such as the sensory, affective and evaluative, and few miscellaneous aspects of pain. these subscales responds to the Pain Rating Index, and a 5-point pain intensity scales.

The Pain Rating Index contains 78 pain descriptor categories sorted into 20 subclasses, each containing 2– 6 words that fall into 4 major subscales: sensory (subclasses 1–10), affective (subclasses 11–15), evaluative (subclass 16), and miscellaneous (subclasses 17–20). There is also a 1-item pain intensity scale.

MaryByrne in 1982 did a study to find Cross-validation of the factor structure among Low back pain patients for MPQ. The principal factor method and direct oblique rotation procedures were used to factor analyse the response to MPQ by low back pain patients which resulted in 55% of total variance that was extracted from four factors. The results of this study showed a positive claim that the sensory pressure, evaluative, and affective sensory factors are constant dimensions of the MPQ responses among low back pain patients.

Carol S Burckhardt in 1984 in her study used of the McGill Pain Questionnaire to assess pain in arthritis patients. In her study Subjects from both inpatient and outpatient department selected a similar set of sensory words to express their arthritis pain. however, subjects from inpatient department, used high intensity affective words than the subjects from outpatient department. The analysis of the study showed 58.3% of covariance yielded from 6 factors. Hence this study concludes that MPQ responses among arthritis patients proved to be a substantial affective dimension along with a factor 3 solution.

IvanKiss et al in 1987 conducted a study in 30 cancer patients using translated version of MPQ in German language. The cancer pain patients who spoke German, chose words and pain rating values similar to words used by cancer patients who spoke English. The results of this study revealed that when MPQ multidimensional verbal questionnaire was compared with unidimensional pain scales in relation to pain analysis proved MPQ was superior to other pain scales.

Ronald Melzacket al in 1986 conducted a study among 74 patients with Trigeminal neuralgia and atypical facial pain in Pittsburgh. The aim of this study was to find
whether the MPQ was capable of distinguishing between Trigeminal neuralgia patients and atypical facial pain patients which can be used as a diagnostic aid. This study showed an exact prediction for 90% of the subjects. Hence, he concluded that MPQ can be an essential tool to help in differential diagnosis.
2.7. Visual Analogue Scale (VAS)

VAS measures the pain subjectively by psychometric analysis. This tool was first utilized in psychological research by Freyd in 1923. It was accepted in the early 1970’s as a generic pain measure. This scale measures the attitude of pain using a set of values that cannot be measured directly. It is used to measure the intensity or frequency of pain in clinical or epidemiological researches. This scale is widely in use since decades which measures pain in single dimension because of its wide range of adaptability and simplicity to use among different population and different settings.

The Visual Analog Scale (VAS) comprises of a horizontal line with the endpoints characterizing extreme points of limits, for example, 'no physical pain' and 'agony as awful as it could be'. The patient is requested to select his level of pain on horizontal line between the two endpoints. The separation between 'no physical pain' and the point at which the subject marked characterizes the subject's level of pain. In case of descriptive event that uses terms like 'mild', 'moderate', 'extreme' or a numerical scale is added to the VAS where numbers are used along with the face descriptions. A line-length of 10 or 15 cm demonstrated the smallest estimation mistake compared with 5-and 20-cm forms and is most advantageous for investigators.

Woodforde and Merskey were the first to report the use of the VAS pain scale with the descriptive terms “no pain at all” and “my pain is as bad as it could possibly be” in different conditions. Later, Huskisson EC, Jensen MP, Karoly P, Braver S and many other authors began using VAS scale to measure pain in rheumatology, arthritis and post-operative patients who were also receiving drugs for pain.

Joyce et al in 1975 in his study used VAS scale, which showed sensitivity to changes that occur during pain in patients who suffer with degenerative arthritis or joint pain and chronic inflammatory when the pain was assessed following an analgesic treatment session for a maximum duration of four hours and upto four weeks weekly($P < 0.001$).

A study to determine VAS validation as ratio scale to measure chronic and experimental pain was done by Donald D.Price in 1983. This study was done among chronic pain patients and healthy volunteers and revealed that VAS sensory intensity responses to experimental pain and different levels of chronic pain. Thus, this study proves that VAS is a valid tool to measure and compare different types of pain.
Wolfe in 2007 assessed pain in patients with rheumatoid arthritis which proved minimal clinically significant difference and a predictor when VAS was used. The minimal clinically significant change in rheumatoid arthritis patients was been estimated to be 1.1 points on an 11-point scale (or 11 points on a 100-point scale).

Tashjian RZ et al in 2009 conducted a study in patients who had 6 weeks of non-surgical management for rotator cuff injury which demonstrated a minimum clinically significant difference as 1.37 cm which was determined for a 10-cm pain VAS. Ferraz MB et al in 1990 assessed the Reliability of VAS among literate and illiterate rheumatoid arthritis patients. In this study, he concluded the Test–retest reliability for VAS has been demonstrated to be good among rheumatologic out patients, but showed a higher reliability among literate patients ($r = 0.94, P < 0.001$) than illiterate patients ($r = 0.71, P < 0.001$) which might be due to their understanding levels.

Downie WW in 1978 found the construct validity was evaluated in a variety of rheumatoid arthritis patients using VAS and was showed a high correlation of 0.71–0.78 with a 5-point verbal descriptive scale and a numerical rating scale with correlations of 0.62–0.91. A criterion validity cannot be assessed when a gold standard outcome measure does not exist. Scott J, Huskisson EC in 1979 found the correlation of VAS between vertical and horizontal orientations as 0.99.
2.8. Anterior Knee Pain Scale (AKPS)

AKPS was first devised by Kujala in 1993, hence it derived its other name Kujala scale. It is a self-reported questionnaire containing 13 items that are knee specific. This scale documents the patient’s response to activities such as walking, running, jumping, climbing stairs, squatting, and sitting for prolonged periods with knees bent that are specifically related to symptoms produced during knee pain. The highest score in the scale is 100 whereas the lowest score is 0 that indicates the highest percentage of patient’s disability. A Score of 70 is considered indicates moderate percentage of patient’s disability.

A study was done by da Cunha RA et al in 2013 to determine cross-cultural adaptation among patients with patellofemoral pain syndrome (PFPS) for the Anterior Knee Pain Scale (AKPS), the Functional Index Questionnaire (FIQ), and the Pain Severity Scale (PSS) in Brazilian population. The AKPS, the FIQ, and the PSS produced required internal consistency (Cronbach alpha ranging from .75 to .87) and excellent reliability (intraclass correlation coefficients [model 2,1] ranging from 0.90 to 0.97). The AKPS and the PSS yielded very good agreement (standard error of measurement, 2.9% and 3.5% respectively). Among the scales assessed AKPS, the FIQ, and the PSS (Pearson r ≥ 0.60, P < 0.05) was observed to have highest correlation. These scales did not have floor or ceiling effects, the highest external responsiveness was produced by NPRS and the AKPS. Hence this study concluded that the Brazilian versions of the AKPS, FIQ, PSS, NPRS, and Global Perceived Effect scale possessed measurement properties that was acceptable.

Kievet AJ et al in 2013 did a study to evaluate validation of kujala anterior knee pain scale in Dutch language after knee arthroplasty. This study concluded that The AKPS was reliable and valid in knee arthroplasty patients with no ceiling and floor effects, and can be utilized in post-operative joint replacement patients to assess anterior knee pain.

A prospective study was conducted by Natalie J Collins et al in 2010 among 179 PFPS patients to find out long term and short-term outcome predictors. Using multivariate linear regression models’ factors associated with poor outcomes of PFPS were identified. This study showed that patients who had poor prognosis had scored less on AKPS which was irrespective of sex, age and BMI.

A good test-retest reliability has been demonstrated by AKPS. Kujala et al in 1993 and Timm in 1998 demonstrated the Validity for this scale. Paxton et al in 2003 in his study
revealed that the scale does not differentiate between patient’s suffering from recurrent patella dislocation and patella being dislocated only once. Crossley et al in 2004 in his study revealed that AKPS does not correlate with usual or worst pain from visual analogue scale measures. A number of authors Bennell et al in 2000, Crossley et al in 2004 and Watson et al 2005 investigated the sensitivity of the scale and found that the scale can detect minimal changes up to 7 points.
2.9. WOMAC

A widely used scale for osteoarthritis of hip and knee is Western Ontario and McMaster Universities OA Index (WOMAC). This scale was developed in 1982 at Western Ontario and McMaster Universities. WOMAC is currently translated and utilized in over 65 languages and has linguistic validation. The WOMAC Osteoarthritis Index is a disease-specific self-report questionnaire for measurement of the symptoms of OA of the hips and knees containing 24 items subdivided into 3 subsets. It is reliable, valid, and sensitive scale that gets adapted to the changes in the health status OA knee patients. WOMAC index assess Activities of Daily Living, Functional Mobility, Gait, General Health and Quality of Life.

A cross sectional study was done by Sathiyanarayanan S et al in 2017 to find out the purpose of WOMAC index in osteoarthritis of knee as a screening tool in Tamil Nadu among the patients older than 50 years of age attending a Rural Health Centre. 103 subjects were enrolled as OA knee, among them 45 were males and 58 were females. Using WOMAC Index Scores, 20 (19.4%) subjects belonged to high risk (score ≥ 81) and 38 (39.6%) subjects belonged to moderate risk (score 60 - 80). When WOMAC was compared to score percentages with American College of Rheumatology criteria for knee OA which revealed statistically significant agreement (p-value, 0.009) indicating WOMAC’s diagnostic accuracy index.

Mohammad II Ebrahimzadeh et al 2014 performed a study in Persian speaking patients using WOMAC scale to determine the cultural adaptation, validation and reliability of WOMAC scale. Using the translated version of WOMAC scale 169 Persian speaking OA knee patients were studied for psychometric analysis. To assess the construct validity SF-36 and KOOS were used. Reliability quality testing brought about a Cronbach’s alpha of 0.917, demonstrated the interior consistency of the questionnaire to be a reliable instrument. Inter-correlation matrix among various scales of the Persian WOMAC list yielded a profoundly critical correlation between all subscale’s measurements of the SF-36 wellbeing overview (P<0.005) and KOOS (P<0.0001).

E.M Roos et al in 2009 did a study to find the validity, reliability and internal consistency among 52 patients to validate WOMAC in OA patients from Sweden. All WOMAC scales had internal consistency with Cronbach’s alpha coefficients of 0.83, 0.87,
and 0.96 pre-operatively. Test-retest reliability was acceptable with intraclass relationship coefficients of 0.74, 0.58, and 0.92. As assumed more terrible post-agent however not pre-agent results were related with radiographic OA. When comparing with the SF-36 the correlation was discovered when estimating comparative and unique constructs, supporting the ideas of concurrent and dissimilar develop legitimacy. Three months after arthroscopy critical mean improvement was found in all WOMAC scales.

2.10. Intervention strategies in PF pain syndrome.

Patellofemoral joint pain is a multifactorial problem which is treated with physical therapy more effectively, if the causative factors are clearly understood. Anterior knee pain does affect people who are active as well as sedentary. Since the reason for anti knee pain is not known in most of the conditions and the trajectories of the petal position are not measurable visually or clinically, treating pedal femoral joint pain is always a challenge for a physical therapist.

The most common problem associated with patellofemoral joint pain as understood from the review of literature are the extensor mechanism disorder and the mal positioning of patella. These 2 factors are under Research and yet to be clarified. patella-femoral joint pain do occurs in adolescents as well as patients who are in the 4th and 5th decade. The signs and symptoms of both type of Petal female joint pain are similar to each other but the prognosis rate are much better for adolescents compared to elderly. The most researched part of anterior femoral pain syndrome is the position of patella.

The Dark Horse of the patlo femoral pain is the length of the ligamentum patellae which often results in mal positioning of patella which has not got the researchers attention yet. Hence as a physiotherapist it’s mandatory to correct the extensor mechanism in the management of PFPS. Pattyn in 2012 analysed what are all the predictors that could be useful in assessing the outcome of treatment after a petrochemical joint pain. He Statated that when the cross section of the quadriceps muscle was good the outcome in the rehabilitation of PFPS was also good. Further he added that the frequency of pain before the treatment session when less the better was the treatment outcome. Beckman in 1989 did an analysis on the athletes who had Patlu femoral pain and concluded that the treatment has to be taylormade and cannot be generalized particularly for the athletic population.
Witvrouw in 2005 stated that the clinical outcome of athlete should be kept in mind while determining the treatment protocol for fat loss simple pain syndrome. The recommended fast pain relief for athletes for a better Restoration of Sporting activity. Tommy R in 1997 developed pain monitoring system for Young women who suffered with PF pain syndrome. The severity of pain is always important factor determining the recurrence of pain in PF pain syndrome. This system used a visual analogue scale for rating pain severity. The scale comprised of 0 to 10 numerical values, where “0” signifying no pain and “10” signifies the most severe pain and the patient have to rate the pain according to the severity. If the pain is reported at the level of 2 it is considered to be “safe” if the pain levels increases by 5 then it was “acceptable” and pain above 5 are the subjects who are in high risk of having a subsequent episode of anterior knee pain syndrome.

At the commencement of the rehabilitation, the main goal for the majority of patients with PFPS is to strengthen the VM. This is due to appropriate timing and amplitude of VMO activation in relation to Vastus Lateralis (VL) has been identified as a the key aspect in subjects with anterior knee pain. Hence, the balance between VMO and Vastus Lateralis should be restored before commencement to train the entire group of quadriceps.

Muscular debulking and a reduced and delayed EMG activity of the Vastus Medialis are not rare in patients with PFPS, resulting in an imbalance in activity of VM and VL. Thus is recommended that the initial treatment should consist of reinstating the function of VM in an attempt to improving the patellar stabilization. In the research review, many types of exercises have been advocated for increasing the power of VM over that of VL. (Mariani PP, 1989, Witvrouw E, 1996, Laprade J, 1998, Cesarelli M, 2000)

Werner S in 1993 did a study on stimulation of vastus medialis electrically and stretching of lateral thigh muscles subjects with PF pain symptoms. He concluded saying that the transcutaneous electrical muscle stimulation is the ideal way to selectively contract and improve the strength and function of VM. With the help of computer tomography they also reported that there was a significant increase in area of the VM after TENS for this muscle, while the cross section of VL was unchanged. Majority of those patients who underwent TENS also improved from a functional point of view even after after 10 weeks of daily treatment. At the follow-ups after one year and 3.5 years, the same patients were still showing sustained improved. (Doucette SA, 1996)
Past literature have emphasized the importance of training the knee extensor in subjects with anterior knee pain inorder to enhance the extensor mechanism and functional performances. The higher the eccentric knee extensor torque at a lesser angular velocity, the higher is the functional performance and the lower knee pain has been identified by PFP subjects. (Palmitier RA 1993)

It’s not only the knee but Stability at the hip joint through strengthening of the muscles is inevitable in order to absorb the imposed load. It is also suggested that Strengthening of the quadriceps in combination with strengthening the hip abductors along with the external rotators have been reported to diminish knee pain during functional tasks. (Heintjes E, 2003)

The quadriceps can be strengthened with both closed kinetic chain (CKC) exercises and open kinetic chain (OKC) exercises. Palmitier et al. suggest that weight-bearing exercises such as during CKC exercises possess a greater transition in to functional activities, as function of the lower extremity in activities of daily living involves multiple muscle groups firing in synergy. Systematic review of literature states that optimal knee function can be attained by strengthening the knee extensors during both CKC and OKC,which is in agreement with many authors. (Witvrouw E, 2003)

In orderto reduce the PF joint reaction forcesexercises performed in closed kinematic exercises, such as step exercises, leg press literature has suggested the activity to be within the last 30 degree of knee extension. Later, Bizzini et al have recommended a comparativelyincreasedROM during squat and leg press. On the contrary, OKC exercises,such as high sitting knee extension, were suggested to train between 90 and 40 degree of knee flexion. ( Steinkamp LA 1993 and Bizzini M, 2008)

Isokinetic training (IKT) is the most optimal method of musclestrengthening using OKC. IKT provides ideal loading of the muscles and permits muscular performance at different velocities. It is recommended that high angular velocities shall be used in order to diminish compressive forces on the joint surfaces of the knee. This means that IKT at high angular velocity should be done when knee extensors are strengthened in anterior knee pain subjects during concentric contraction. (Baltzopoulos V et al 1989 and Werner S et al, 1993 )

Often eccentric actions are more difficult to perform for many subjects due to unfamiliarity in performing decelerating type of movement. This is also difficult because of
inability of the subjects in performing an activity which involves coordinated action of different muscles of the quadriceps. Thus it is advised to perform isokinetic eccentric contractions of quadriceps at 90° degree. The advantage with IKT in PFPS patients is, that the training can be varied according to possible knee pain and hence lowering the risk for overload. (Werner S et al, 1993 and Werner S et al 1995)

Paoloni M, et al in 2012 had shown that a two week period of patellar taping along with an exercise programme for subsequent 10 weeks can improve the strength of VMO that can led to a 12 months of pain control in PFPS with muscle imbalance of VMO and VL.

Apart from exercises there are certain passive approaches were tried in the past for controlling the mobility and position of patella. Supportive devices such as braces to stabilise patella, Patellar taping which are aimed at improving patellar tracking problems (Lysholm J, 1984 and Felício LR, 2011)Some researchers have suggested patellar stabilizing orthoses for anterior knee pain patients, although there is no evidence for the same. This was proved by Fulkerson JP in as early as 1990.

Palumbo a French researcher reported that there was a decrease in symptoms in 92 percent by using patella stabilizing brace subjects with anterior knee pain. Sega et al. reported that a medial support orthosis gave a good pain reduction in subjects with instability of patellar. McConnell studies the effect of patellar taping with a medial glide technique and reported a success rate of 92 %. He claimed that such effort can modify patellar tracking and therefore relieve pain.

Gilleard et al. [28] found that during step-up and step-down activity, when the patella was taped the onset of VMO contraction occurred earlier, which did not happen during untapped. During the step-up task, the activity of VL was unchanged and it was classically seen to be delayed during the step-down activity with taping. Ng and Wong reported that there was improvement of VM activity with patellar taping.

Swiss researcher Powerset al. analysed the effect of patellar taping devised by McConnell on functional outcomes and found out that an average pain reduction of 78 percent using the patient rated visual analogue scale for pain. Kowall et al. conducted a prospective intervention study where they compared the two groups that followed the similar
exercise programme, with one group patella taped and untapped for the other. Both the group subjects improved, irrespective of taping or not.

Contrasting to these study results Whittingham et al. reported that taping of patellar and exercise programme was superior to exercise programme alone in reducing knee pain and improving function of knee. Christou et al reported that there was an increased VM activity and diminished VL activity in subjects with anterior knee pain when the patella was taped medially.

The patellar taping benefits probably not because of change in patellar position, but rather because of enhanced support of the PF ligaments and/or pain controlling through cutaneous stimulation. Werner et al. studied the patients with patellar hypermobility and had reported that there was an improved knee extension torque along with increased agonist EMG activity during isokinetic quadriceps activity, when taping was used to stabilized the patella, while subjects with a normal patellar kinematics did not benefit from taping.

Werner S, in 1993 found that for optimising the management using taping for supporting patella mobility, it is imperative to check the direction of the subject’s patellar hypermobility or laxity which can be lateral, medial or both. Furthermore, during concentric and eccentric knee extension in order to determine the need for patella support or orthosis or taping, it is advisable to check for patellar tracking within the PF joint (‘patellar tracking’- test). From this extensive review it’s clear that patellar taping can be advised only when patellar hypermobility exists and it’s a temporary treatment to enhance physiotherapeutic exercises, especially strengthening of quadriceps.

A number of patients with PFPS show tightness predominantly at the IT band and lateral muscles, quadriceps muscle, and occasionally of the hamstrings and the gastrocnemius. The stretching procedures are recommended to be performed by the subjects on themselves, and hence, they should be taught how to stretch their own tight muscles. The lateral retina culumare also proved to be tight, which could be the reason for interference with a normal patellar tracking, and this must be therefore be treated with glides in medial direction.