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Comparison of Tibiofemoral and Patellofemoral Mobilization in Improving Pain, Rom and Functional Disability in Patellofemoral Pain Syndrome

Minahil Tanveer
Email Id: minahiltanveer29@gmail.com
Designation: Clinical Physiotherapist
Affiliation: Al-Nazir physiotherapy clinic

Maira Gilani
Email Id: mairagilani3@gmail.com
Designation: Clinical Physiotherapist
Affiliation: Physiodoc Clinic

Nadia Ali
Email Id: drnadia.ali0045@gmail.com
Designation: consultant physiotherapist
Affiliation: University of Lahore

Raheel Munawar
Email Id: Raheelmunawar6113@gmail.com
Designation: Clinical Physiotherapist
Affiliation: Johar Pain Relief Center, Lahore

Aqsa Akram
Email Id: aqsachaudhary52@gmail.com
Designation: Consultant Physiotherapist (MSOMPT)
Affiliation: Ammar Healthcare Centre

Sumbal Salik
Email Id: Sumbalsalik1@gmail.com
Designation: Clinical Physiotherapist
Affiliation: DHQ Hospital, Okara

Sania Maqbool
Email Id: saniamaqbool28@gmail.com
Designation: Clinical Physiotherapist
Affiliation: Saadan Hospital Lahore

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Abstract: *Patellofemoral pain syndrome significantly impacts daily activities in adults. Physical therapy, including targeted exercises and both patellofemoral and tibiofemoral mobilization techniques, is a primary treatment approach for managing this condition.This study aimed to compare the effects of tibiofemoral and patellofemoral mobilization on pain, range of motion (ROM), and functional disability in patients with patellofemoral pain syndrome.A randomized controlled trial was conducted on 68 participants (n=34) at the Physiotherapy Department of Doctors Clinic, Samnabad, Lahore. The patients were randomly assigned into two groups: Group A received conventional treatment along with patellofemoral mobilization, while Group B received conventional treatment combined with tibiofemoral mobilization. The study spanned six months, with assessments conducted prior to treatment and weekly thereafter. Numeric Pain Rating Scale (NPRS) for pain, a goniometer for knee range of motion, and the Kujala scoring system for functional status used for assessment. The study results demonstrated significant improvements in NPRS scores, range of motion, and Kujala scores in both groups, with a p-value of 0.000. However, a comparison between the groups confirmed that conventional physiotherapy combined with patellofemoral mobilization yielded superior outcomes in reducing pain, improving range of motion, and enhancing functional status compared to tibiofemoral mobilization, with a p-value of <0.05.The study concluded that patellofemoral mobilization, when combined with conventional physiotherapy, is an effective approach for reducing pain, improving range of motion, and enhancing functional status in individuals with patellofemoral pain syndrome*.

Keywords: conventional physiotherapy, patellofemoral mobilization, tibiofemoral mobilization, patellofemoral pain syndrome.

INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a common condition of anterior knee pain significantly impact a patient's functional ability by developing multiple inter-leg asymmetries especially in adolescents and adults younger than 60 years (1). Being Jumper 's or Runner 's knee, it is highly prevalent among young athletes, trainers and active person along with females are twice likely to develop PFPS as compared to males (2). Hypotrophy of the vast medial muscle or an alteration of the muscular balance of the lower limb, anatomical changes, overuse of the lateral structures, and inappropriate physical activities with increased foot pronation, increase Q-angle and radiologically patellar lateral tilting, internal rotation of the tibia, and valgus stress (3). However, the major cause of PFPS is the malalignment of lower extremity along with hypoplasia of trochlear grove. This instability ultimately alter patellofemoral joint geometry and constrained the soft tissues around patella leads to development of PFPS (4).

The over activity of knee muscles and immediate acceleration activity affects joint

biomechanics and induce greater compression and lateral force that induce further tracking of patella and cause bilateral severe pain at anterior potion of knee joint (5). Intermittent peripatellar or retro patellar; stabbing pain, without irradiation that worsening in squatting movements, complain of giving away or slipping of patella during climbing and descending stairs, and after long sitting periods are major complaints (6).

There is also a locking or catching sensation is observed after prolonged seating named as movie theatre of Theatre sign (7). Additionally, squinting of patella, knee valgus, pes planus and excessive external rotation of tibia further confirm the condition enhanced Q-angel that is even > 14* in males and >17* in females during PFPS. (8, 9) AP and lateral view X-Ray describe tibiofemoral joint alignment, patellar alta, lateromedially subluxation, patellar height, Insall-Salvati ratio (ISR) and Blackburne-Peel ratio (10). Axial X-ray provide further information about patellar translation, axial rotation and trochlear morphology (11). Cross-sectional knowledge, cartilage pathology, anterior patellar enthesopathy, tendinopathy and integrity and friction of fat pad at patella are in detailed examined though CT and MRI (10).

Quadriceps strengthening program is a common rehabilitation technique, which attempts to strengthen the knee extension weakness and has consistently been shown to aid in improvement. The vastus medialis, particularly obliquus, draws a lot of attention due to its role in the medial stabilization of the patella (10). Additionally, Tibiofemoral and Patellofemoral mobilization helps in improving joint play, strengthening and correction of kinematics, particularly to reduce hip adduction and internal rotation in PFP patients (12). Khan et al (2024) supported combination of Taping and Patellar mobilization are effective in managing pain among PFPS patients (13). Similarly, Alarab et al (2019) reported isometric exercises and patellar mobilization improve pain, ROM and functional status within total eight sessions (14). Additionally, Shabiethaa et al (2024) and Kumar et al (2022) reported TF mobilization with normal and traditional physical therapy techniques helps to reduce pain and improving ROM along with quality of life within 6 weeks (15, 16).

Patellofemoral pain syndrome (PFP) is increasing steadily and has become a major problem because it affects basic movements like walking, climbing stairs, and sitting and is characterized by severe pain and tenderness. Thus, chronic PFP can also result in knee and foot muscular spasms as well as muscular imbalances making it difficult to address it. The standard and joint mobilization techniques are applied for PFP; however, evidence-based research is lacking to determine which clinical approach offers maximal treatment outcomes for pain relief and function restoration. The purpose of this study should be to assess and contrast the outcomes related to reciprocal tibiofemoral and patellofemoral joint mobilization on pain, ROM, and functional disability in participants with PFP. It is expected that the outcomes derived from this comparative study will provide substantial information regarding the efficacy of the above-mentioned interventions, for facilitating clinicians to decide the most appropriate blend of the interventions, thereby aiming at providing high-standard rehabilitation solutions to the patients suffering from PFP.

MATERIAL AND METHODS

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The single blinded randomized clinical trial conducted after receiving an ethical permission from the Ethical Committee of University of Lahore. The study included sample size of Sixty eight calculated by Open Epi tool of Version 3 form the Knee pain variable with M1 52.7± 62.5, M II 34±29.1, d= 18.7, CI 95% and Power 80% (17). The patients were selected by convenience sampling technique from Physiotherapy department of Doctors Clinic, Samnabad, Lahore. Male and female patients of 30-50 years having mild to moderate pain more than 2 months in Unilateral knee affecting physical activity for more than 2 months i.e walking, skipping, stair climbing and jumping (18, 19), having pronated foot (20) and positive Patellar tilt test (21) were included in study. Exclusion criteria was having history of Hip surgery, knee injury / surgery (18), Infrapatellar bursitis, Collateral ligamentous injuries, fracture (19), Meniscal injury, Effusion of knee joint Patellar Apprehension (22) and any psychological disorder i.e. anxiety, depression, posttraumatic stress disorder (23).

Informed written and verbal consent was then sought from all participants and participants were randomly allocated into Group A or Group B based on simple random sampling using the computer generated list. Patellofemoral mobilization was done on group A with hot pack application of 5-10 minutes at first. In a supine position with a slightly flexed knee, the therapist manually mobilized the patella in four directions: superior, inferior, medial, and lateral For inferior movement facilitation, the therapist used the index finger and thumb to apply the downward pressure to the superior surface of the patella; for the superior displacement the upward force was applied at the inferior margin. Specifically, medial and lateral glides were done by stabilizing the femur and applying gross manual contacts in a specific direction (24). For each glide, the patient did 10 sets of active knee extension and flexion in three sets in the same glide with one minutes rest between sets(25). After the mobilization, participants performed initial standard PTA exercises where the stretches of the hamstrings, quadriceps, and iliotibial band were applied, straight leg raises, (26) quadriceps isometrics, and hip isometric adduction for 5 seconds over 25 reps across 4 sets (27).

Participants in group B received actual treatment as tibiofemoral mobilization preceded by hot pack on the affected area for 5-10 min. The patient was placed in the supine posture with the affected knee straight and the therapist maintained medial stabilization on the distal femur while applying posterior glide on the proximal tibia with the help of a firm belt. In the glide, the patient did ten active knee extension exercises, completing three sets with one minute of rest between each set (25). Immediately after mobilization, participants were instructed to perform a set of four standardized exercises – passive stretching: straight leg raises: 2 sets of 25 isometric quadriceps contraction and 2 sets of 25 isometric hip adduction (26), three sets per week for four weeks. In the primary study, pain, range of motion and functional status were measured at the time of baseline, at second week and fourth week (27).

Pain, ROM and functional status were the outcome variables assessed through NPRS, Goniometer and KUJALA scoring. Numeric Pain Rating scale (NPRS) is a numeric version scale helps in assessing the intensity of pain among patellofemoral pain syndrome. The scale is ranked from 1 to 10 in which 1 means no pain while 10 means sever pain. the patient is asked to ranked the intensity of pain on scale. (28) Goniometry is the universal device that consists on fulcrum (Body) attached with fixed or immovable arm and moveable arm that helps in

analyzing the ranges of dferent joints of body. (28) It is highly reliable tool in assessing passive and active ranges of joints including knee joint with ICCs of 0.99-1.00 (29). KUJALA score is self-reported questionnaire designed with total thirteen questions for diagnosing PFPS and assessing its severity, symptoms, limitation of activities and disability (30). It is highly sensitive and valid tool for PFPS having 80% sensitivity, 90% specificity, test-retest reliability of 0.81-0.996, internal consistency of 0.74 (30, 31).

Statistical procedure:

Data were analyzed by using SPSS 26.0,. The quantitative data were described as mean and standard deviation using while the qualitative data including gender was described as frequency and percentages in tabular and pie chart forms. Data normality was done by Shapiro Wilk test while within group and between group analysis were done by paired T test and independent T test respectively at a significance level of p value < 0.05.

RESULT:

The results of the study was described in the tabulated form. Table 1 displays a comparative analysis of age between the two groups. The mean age of patients in the Patellofemoral (PF) group was 33.29±8.31 years, while the mean age in the Tibiofemoral (TF) group was 34.12±9.67 years. Similarly, the distribution of gender mention in Table 1 showed among the 68 patients. In the Patellofemoral (PF) group, there were 10 males (29.4%) and 24 females (70.6%). In the Tibiofemoral (TF) group, 15 patients (44.1%) were male, while 19 patients (55.9%) were female. Table 1 outlines the distribution of affected knees among the 68 patients. In the Patellofemoral (PF) group, 17 patients (50%) had the right knee affected, and 17 (50%) had the left knee affected. In the Tibiofemoral (TF) group, 21 patients (61.8%) had the right knee affected, while 13 patients (38.2%) had the left knee affected.

Table 2 presents the within-group analysis of NPRS, KUJALA & Knee ROM for Patellofemoral (PF) and Tibiofemoral (TF) groups showed marked improvement from pre-treatment to post treatment having p-value <0.05 showed Patellofemoral mobilization and Tibiofemoral mobilization were effective in reducing pain in patellofemoral pain syndrome patients (p-value < 0.05). While the across group analysis mentioned in Table 3 showed NPRS score in the PF group was 2.17±1.05, compared to 2.23±1.49 in the TF group (p=0.016), KUJALA score in the PF group was 63.21±10.46, compared to 57.03±10.45 in the TF group (p=0.018), PF knee flexion was 88.15±9.33, compared to TF 86.03±9.35 (p=0.002) and PF knee extension was 68.56±9.57 while 77.15±9.96 in the TF group (p= 0.001) indicates that Patellofemoral mobilization was significantly more effective in improving PFPS symptoms in patients (p-value < 0.05).

Table 1: Demographics of patients:

Variable	PF Group (n=34)	TF Group (n=34)

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		Mean± S.D	Mean± S.D
Age		33.29±8.31	34.12±9.67
Gender	**Male**	10 (29.4%)	15 (44.1%)
	Female	24 (70.6%)	19 (55.9%)
Affected Knee	**Right**	17 (50%)	21 (61.8%)
	Left	17 (50%)	13 (38.2%)

Table 2: Within group Analysis of NPRS, KUJALA & Knee ROM:

Variable	PF Group (n=34)				TF Group (n=34)			
	Pre Mean± S.D	Post Mean± S.D	Mean difference	p	Pre Mean± S.D	Post Mean± S.D	Mean difference	p
NPRS	6.56±1.31	2.17±1.05	**4.38**	**0.00**	6.85±1.35	2.23±1.49	**4.62**	**0.00**
KUJALA	41.58±12.95	63.21±10.46	**-21.62**	**0.00**	39.05±13.41	57.03±10.45	**-17.97**	**0.00**
Flexion	78.88±9.22	88.15±9.33	**-9.26**	**0.00**	81.65±9.19	86.03±9.35	**-4.38**	**0.00**
Extension	77.56±9.56	68.56±9.57	**9.00**	**0.00**	80.67±9.63	77.15±9.96	**3.53**	**0.00**

Table 3: Between Group Analysis of NPRS, KUJALA & Knee ROM:

Variable		PF Group (n=34)	TF Group (n=34)	Mean difference	p-value
NPRS	**Pre treatment**	6.56±1.31	6.85±1.35	**-0.29**	**0.365**
	Post Treatment	2.17±1.05	2.23±1.49	**-0.058**	**0.016**
KUJALA	**Pre treatment**	41.58±12.95	39.05±13.41	**2.53**	**0.432**
	Post Treatment	63.21±10.46	57.03±10.45	**6.17**	**0.018**
Flexion ROM	**Pre treatment**	78.88±9.22	81.65±9.19	**-2.76**	**0.220**
	Post Treatment	88.15±9.33	86.03±9.35	**2.12**	**0.002**
Extension ROM	**Pre treatment**	77.56±9.56	80.67±9.63	**-3.12**	**0.185**
	Post Treatment	68.56±9.57	77.15±9.96	**-8.58**	**0.001**

DISCUSSION:

The study aimed to compare the effects of patellofemoral (PF) mobilization and tibiofemoral (TF) mobilization in managing pain, knee range of motion (ROM), and functional status among patients with patellofemoral pain syndrome (PFPS). The findings demonstrated that PF mobilization produced clinically and statistically significant improvements in reducing pain, enhancing knee ROM, and improving functional status, with a p-value < 0.05. The study concluded that PF mobilization was more effective than TF mobilization in managing PFPS.

Pain intensity and functional status were measured using the Numeric Pain Rating Scale (NPRS) and the KUJALA score. PF mobilization led to an improvement in NPRS (2.17±1.05) and KUJALA scores (63.21±10.46), compared to the TF mobilization group's NPRS (2.23±1.49) and KUJALA scores (57.03±10.45), with p-values of 0.016 and 0.018, respectively. These results indicate that PF mobilization was significantly more effective in improving pain and functional outcomes in PFPS patients. Supporting evidence from Alsulaimani et al. (2019) demonstrated a significant reduction in pain and marked improvement in functional status in PFPS patients following PF mobilization within just one to three sessions. Alsulaimani's findings on the improvement of joint play and restoration of joint mobility and flexibility (32) align with the current study's results, which showed significant post-treatment improvements in NPRS and Kujala scores following PF mobilization. However, a limitation of the present study was the lack of multiple readings, which represents a study gap.

Jayaseelan et al. (2020) further supported the role of PF mobilization, noting its impact on improving knee joint congruency, which led to reduced pain and enhanced knee function. This ultimately improved the functional status and range of motion in PFPS patients (33). Similarly, Sit et al. (2018) found significant improvements in pain, stiffness, and quality of life after 24 weeks of PF mobilization (34). Former studies highly concurrent with current study results as NPRS and KUJALA scoring improved comparatively better in the PF group. However, Sit et al. (2018) focused on knee osteoarthritis patients (34), which slightly differs from the current study's focus on PFPS patients, potentially influencing the comparative results

In terms of knee ROM, assessed via goniometry, PF mobilization led to improvements in flexion and extension compared to TF mobilization, with a p-value < 0.05. Jayaseelan et al. (2018) also found patellar mobilization to be effective in managing knee pain and functional outcomes within three months (35), further supporting the results of this study, which observed significant improvements within four weeks. Contrarily, Kumar et al. (2022) found TF mobilization to be effective in managing pain, functional status, and knee ROM by the fourth week, although it was considered equally effective compared to other mobilization techniques (36). This finding aligns partially with the current study, as TF mobilization produced beneficial results, but PF mobilization was superior in effect within the same timeframe. Similarly, Lantz et al (2016) reported a case study of 28 female patient and concluded TFM is the successful therapeutic technique for correcting biomechanical irritation and kinematics of patellar motions. Significant reduction in pain with improvement in knee ROM highly

supported current study results still the comparative PF produced beneficial results in managing PFPS (37).

Anum et al. (2024) conducted a study involving 50 patients with patellofemoral pain syndrome (PFPS), concluding that patellar femoral mobilization (PFM), when combined with conventional physiotherapy, significantly alleviates pain within six weeks of treatment (38). This aligns with the current study's findings, where patients demonstrated notable improvement within just four weeks. Further supporting evidence from Alarab et al. (2019) revealed that combining PFM with conventional isometric exercises led to significant reductions in pain intensity, increased range of motion (ROM), and enhanced muscle strength after 35–45-minute sessions over a three-week period. (39). These earlier studies corroborate the present findings, highlighting that the integration of PFM with strengthening exercises, even during shorter 20–35-minute sessions, yields clinical improvements in pain (NPRS) and knee ROM, compared to tibiofemoral mobilization in PFPS patients.

However, Shabiethaa et al. (2024) reported that TF mobilization was statistically effective in improving NPRS, KUJALA scores, and knee ROM after six weeks. While this study supports the improvement seen with TF mobilization, it contrasts with the current study, which found PF mobilization to be more effective in producing improvement in NPRS, Knee ranges ad KUJALA scoring with p-value =0.00 (16). Similarly, Fatimah et al. (2024) conducted a randomized trial involving 60 patients and concluded that combining TF mobilization with hip and knee strengthening exercises significantly reduced pain and improved pressure thresholds and ROM in PFPS patients, except for those with patellar instability, with a p-value of <0.05 (40). This further supports the current study's results, which showed that PF mobilization led to superior improvements in ROM and KUJALA scores ($p<0.05$), indicating better patellar stability compared to the TF mobilization group.

This paper has few limitations that limit its ability to consider treatment effectiveness as comprehensively as possible. Firstly, there is poor follow up data and this precludes an evaluation of the duration of the effects of treatment, an important criterion for evaluation of efficacy interventions. However, the study blinding was done only for patients which makes it susceptible to certain type of bias which are although of the blinding Were the blinding done up to double or triple level then their results might be wrongly influenced. Another weakness in this study is that outcome variables where only assessed at the pre and post stages of the treatment. This approach omitted an ability to know whether early mobilisation brought improved symptom relief as other intermediate assessments could provide better understanding of any progression and timing of such improvements.

Therefore the future study should have longer follow-up time which in its turn will provide a better picture of treatment outcome specificity as well as of its stability. The authors suggest that more rigorous blinding of the studies could be made, using at least double, if not triple blinding to minimise bias and improve the validity of the results. Moreover, instead of obtaining two readings only, one could take three or four measurements to gain a clearer and highly detailed picture of the treatment's benefits for both the short-term and for an extended period to make sure that the improvements made are recorded well and continued.

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CONCLUSION

Therefore the study concluded Patellofemoral mobilization has demonstrated superior efficacy compared to tibiofemoral mobilization in alleviating pain, enhancing knee range of motion, and improving functional status in patients with patellofemoral pain syndrome. The significant reduction in pain and disability scores underscores the potential of patellofemoral mobilization as a highly effective treatment approach.

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