ORIGINAL ARTICLE

Effects of tibiofemoral mobilization in patients of Patellofemoral pain syndrome

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Abstract

Objective: To determine the effects of tibiofemoral joint mobilisation on pain and range of motion in patients with patellofemoral pain syndrome.

Methods: The randomised control trial was conducted at the Lady Reading Hospital and Hayatabad Medical Complex, Peshawar, Pakistan, from July to December 2019, and comprised patellofemoral pain syndrome patients of either gender aged 25-35 years with anterior knee pain for at least one month. The subjects were randomly allocated control group A and experimental group B. Group A received 6 stretching and strengthening exercises of hip and knee muscles with hot pack, while group B additionally received tibiofemoral joint mobilisation. There were 3 sessions per week over 4 weeks for both the groups. Numeric pain rating scale, Kujala scale, algometer and goniometer were used to assess pain and range of motion at baseline and at the end of the last session. Data was analysed using SPSS 20.

Results: Of the 60 individuals initially assessed, 52(86.6%) were enrolled; 26(50%) in each of the two groups. The overall mean age of the sample was 29.63±3.25 years. The experimental group B showed significant improvement in pain, range of motion and pressure pain threshold ($p<0.05$) compared to the control group A. Group B also showed significant improvement in terms of functional activities ($p<0.05$). Except patellar instability and weight-bearing activities, the groups showed no significant difference ($p>0.05$).

Conclusion: Tibiofemoral joint mobilisations with hip and knee stretching and strengthening exercises were found to be more effective in reducing pain, and increasing range of motion as well as pressure pain threshold.

Clinical Trial Number: Identifier: **NCT04225000:https://clinicaltrials.gov/ct2/show/NCT04225000**

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Introduction

Patellofemoral pain syndrome (PFPS) is a common condition associated with overuse injuries of the lower extremity. It is characterised by anterior knee pain (AKP) which tends to worsen with activity of daily living (ADLs), like prolonged sitting with knee-bend, walking, squatting, running and jumping.[1-4] It is caused by abnormal biomechanics and abnormal arrangement of patella.[5] Abnormal biomechanics lead to muscle imbalance among vastus medialis oblique (VMO) and vastus lateralis (VL). The VMO muscle works relative to the VL muscle. When it does not work properly, like delayed recruitment of VMO relative to VL, it leads to patellar maltracking.[6]

PFPS is highly difficult to treat.[4] Physical therapy (PT) is the first-line treatment programme as non-operative management.[7] PT treatment of PFPS for pain reduction and restoration of muscle balance include manual techniques, therapeutic modalities, exercise therapy and techniques of knee-taping and re-establishment of functional activities.[8]

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Exercise therapy of PFPS include muscle strengthening, stretching, isometric and resisted exercises.[9] Mobilisation is low-amplitude passive movements that produce traction and gliding at the joint surface, i.e. joint play movements.[10] The therapeutic purpose of this technique is improving range of motion (ROM), pain relief, reduction of muscle guarding, and effusion reduction.[11] According to a study, afferent inputs from the surrounding tissues alter motor regulation at joint dysfunction which can be responsible for the weakness of the muscle.[12] Mobilisation of dysfunctional and restricted joint generates arthrokinetic reflex which removes the inhibition and improves the strength of the muscle.[13] As such, joint mobilisation and manipulation reduce pain and activate the weak muscle in PFPS patients by stimulating sensory receptors within and around the joint.[14]

There is limited literature on the effects of tibiofemoral joint (TFJ) mobilisation in patients with PFPS. A search on PubMed, PEDro, Cochrane library and Google Scholar databases revealed no randomised controlled trial (RCT) determining the effects of TFJ mobilisation in PFPS.

The current study was planned to determine the effects of TFJ mobilisation on pain and ROM in PFPS patients.

Patients and Methods

The RCT was conducted at the Lady Reading Hospital and Hayatabad Medical Complex, Peshawar, Pakistan, from July to December 2019. After approval from the ethics review committee of Riphah College of Rehabilitation Sciences, Rawalpindi, the sample size was calculated using OpenEpi version 3.01[15] by applying a two-group means comparison, post t-test values of control and treatment groups while keeping power at 0.90 or 90%, mean difference of Numeric pain rating scale (NPRS) ascending stairs 2±0.8 and level of significance 0.05.[16] The study trial was registered at www.ClinicalTrails.gov with registry number NCT04225000 .The sample was raised using non-probability purposive sampling technique from among PFPS patients of either gender aged 25-35 years with AKP intensity level of 3≥ on NPRS during stepping up and down a 25-cm height for at least one month Reported knee pain had to be on anterior peripatellar or retropatellar site during at least two of the following activities: stairs climbing, kneeling, prolonged sitting, running, squatting and jumping. Patients with spinal referred pain, history of medication, or those who had undergone any PT or acupuncture treatment for the knee joint within the preceding 30 days were excluded, and so were those with history of knee surgery, arthritis, patellar subluxation or dislocation, malalignment, ligament laxity, or other irregularities, such as leg length discrepancy 2 cm.

For clinical assessment, the following criteria was used: pain during patellar compression test, apprehension test and crepitation on compression test.[3,16,17]

After taking written informed consent, the patients were randomised into control group A and experimental group B using sequence generation through opaque sealed envelope as allocation concealment.

Patient in group A received 3 sessions per week over 4 weeks. Each session consisted of hip and knee stretching and strengthening exercises along with hot-pack. Exercises included semi-squatting, straight leg raise (SLR) and hamstring stretch, quadriceps isometrics, terminal knee extension with elastic band, adductor squeeze and hip abduction in standing position with elastic band. Each set consisted of 15 repetitions of stretching and strengthening exercises with 10 sec hold three times a day.[17,18] Each session lasted approximately 25-30 minutes.

Patient in group B also received the same number of sessions over the same duration. The treatment consisted of of TFJ mobilisation through anterior-posterior (AP) glide, which is the Kaltenborn technique, along with exercises and hot-pack provided to the other group.[18]

According to concave on convex rule, grade II or III AP tibial glide was performed. TFJ mobilisation was performed in supine position with knee flexion in approximately 45º or 90º according to patient comfort. Knee was mobilised at 45º with limited knee flexion when <100º and the knee was mobilised at 90º in patients with knee flexion >100º.[9,19]

The primary outcome variables were changes in pain intensity and ROM of the knee joint. For pain intensity, 11-item NPRS scale ranging 0-10 was used; 0 = the least pain, and 10 = extreme pain.[20] Algometer was used to determine the pressure-pain threshold (PPT).[21]

Universal goniometer was used to measure ROM of the knee joint extension. It is a universal tool and is most commonly used for evaluating ROM in hospitals and clinics.[22]

As a secondary outcome measurement, the 13-item Kujala questionnaire with 3-5 options[22] for pain severity, symptoms and specific activities was used. The scale was used to determine the functional activity level of patients at baseline and at the end of the last session. The total sum of the scale ranges 0-100; 0 = greatest limitation of the knee

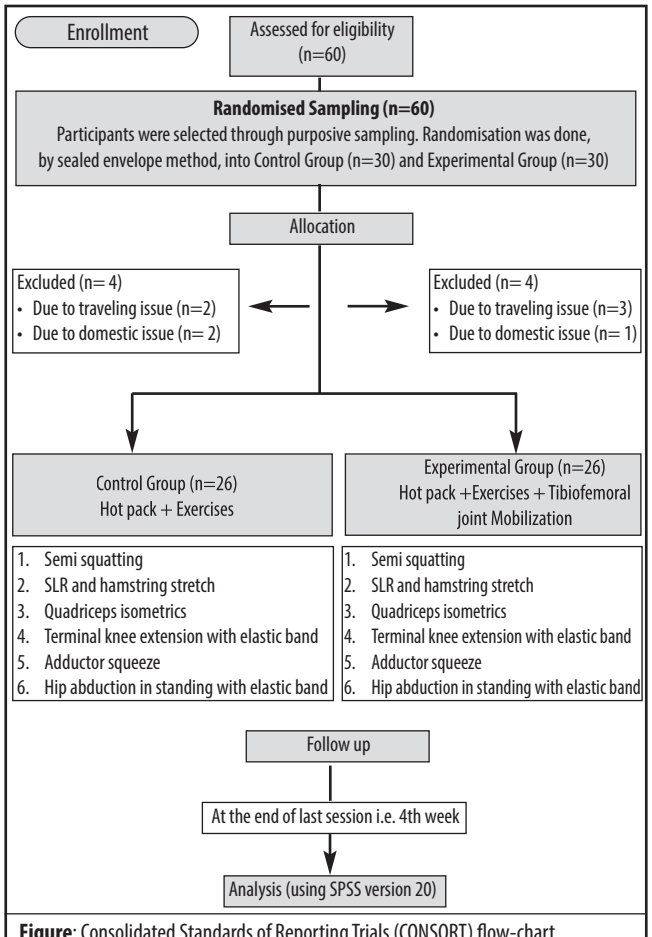

Figure: Consolidated Standards of Reporting Trials (CONSORT) flow-chart.

function, and 100 = the greatest ability to perform most knee functions.[23]

Data was analysed using SPSS 20. Kolmogorov was used to check data normality. For non-normally distributed data, non-parametric Mann Whitney U (two-related-sample) test was used to check the intergroup significance, and Wilcoxon signed rank test for intragroup analysis. Median and inter-quartile range (IQR) values was used to express the data that was ordinal-ranked, like limping, walking, stair climbing, squatting, weight-bearing, running, jumping, and sitting with prolonged knee-bend. Parametric independent-sample t test for intergroup and paired-sample t test for intragroup analyses were used for normally-distributed variables. P<0.05 was considered statistically significant.

Results

Of the 60 individuals initially assessed, 52(86.6%) were enrolled; 26(50%) in each of the two groups. The overall mean age of the sample was 29.63±3.25 years, and there were 39(75%) females and 13(25%) males. Further, 41(78.8%) patients reported pain in the right knee, and 28(53.8%) had pain in the anterior location (Table 1).

There was significant improvement in terms of NPRS score, PPT, ROM Kujala score in group B compared to group A (p<0.05) (Table 2).

Table-1: Baseline characteristics.

Characteristics		Control (n=26)	Experimental (n= 26)
Mean Age (years)		29.38±3.45)	29.88±3.06
Mean Duration of PFPS, (months)		3.65±1.91	4.00±2.31
Gender, n (%)	Male	7 (13)	6 (11.5)
	Female	19 (36)	20 (38)
Affected knee, n (%)	Right	21 (40)	20 (38)
	Left	5 (9.6)	6 (11.4)
Location of pain, n (%)	Anterior	13 (25)	15 (29)
	Anterior-Lateral	7 (13)	8 (15)
	Anterior-Medial	6 (12)	3 (6)

Table-2: Inter-group comparison from baseline to 4-week management of patellofemoral pain syndrome (PFPS).

Variables	Baseline (pre)			Week 4(post)		
	Control Mean±SD	Experimental Mean±SD	*p*- value	Control Mean±SD	Experimental Mean±SD	*p*- value
NPRS	7.07±1.01	8.08±1.24	0.78	4.26±0.96	3.53±1.30	0.02*
PPT	1.24±0.22	1.41±0.34	0.58	1.90±0.36	2.35±0.69	0.02*
ROM	113.2±18.70	116.6±16.60	0.20	125.23±12.46	132.88±4.59	0.001*
Kujala Score	58.53±16.58	56.84±12.9	0.00	85.07±6.65	89.69±6.27	0.00*

NPRS: Numerical pain rating scale, PPT: Pressure pain threshold, ROM: Range of motion, Control: Control group, Experimental: Experimental group, SD: Standard deviation.

Table-3: Inter-group effect on Kujala Anterior Knee Pain Scale (AKPS) questionnaire (functional activities).

Variable	level	Control Group		Experimental Group		p-value
		Median(IQR)	Mean rank	Median (IQR)	Mean Rank	
Limp	Pre	3(3)	26.9	3(3)	26	0.80
	Post	5(2)	22.5	5(0)	30.5	0.002*
Weight Bearing	Pre	5(2)	28.2	3(2)	24.7	0.35
	Post	5(0)	25.5	5(0)	27.5	0.34
Walking	Pre	2(3)	28.3	2(1)	24.6	0.34
	Post	5(2)	23.5	5(0)	29.5	0.05*
Stairs climbing	Pre	3(4)	30.3	3(1)	22.6	0.34
	Post	10(3)	22.5	10(0)	30.5	0.01*
Squatting	Pre	3(3)	26.2	3(3)	26.7	0.88
	Post	4(2)	19.9	5(1)	33.3	0.00*
Running	Pre	3(6)	29.9	0(3)	23.0	0.07
	Post	8(0)	20.4	8(2)	32.6	0.001*
Sitting	Pre	4(2)	27.6	4(1)	25.4	0.57
	Post	8(2)	21.3	10(2)	31.6	0.005*
Jumping	Pre	0(.7)	24.7	0(3)	28.2	0.29
	Post	7(0)	21.3	7(3)	31.6	0.00*
Patellar Instability	Pre	6(5)	23.9	10(4)	29.2	0.19
	Post	10(4)	23.5	10(0)	29.5	0.20

IQR: Interquartile range. Level of significance ≤0.05*.

Group B also showed significant improvement in functional activities, like limping, walking, squatting, prolonged sitting with flex knee, walking, stairs climbing, running and jumping (p<0.05), while no significant difference was observed in terms of weight-bearing and patellar instability across the 4 weeks of intervention (p>0.05) (Table 3).

Discussion

PFPS is a common knee joint problem associated with AKP and limited ROM. Patellar maltracking is a major feature due to weak adjunct hip and knee muscle strength. The PFPS syndrome restricts the functional activities of patients.[24] Different PT treatment approaches have been reported to be effective in the PRFPS management, but no one technique has been proven to be superior over the rest.[25]

In the current study, TFJ mobilisation produced great improvement through significant reduction in pain, enhancement in PPT and knee-joint ROM and restoration in functional activities except weight-bearing and patellar instability.

The current study showed that females were more affected with PFPS than males, which is in line with literature.[26,27] One study concluded that females are at high incidence of developing PFPS due to difference in anatomical and biomechanical factors, like q angle (increased static measure in females), lower extremity muscle strength (weaker in females, i.e. quadriceps, hip external rotators,

hip extensors and hip abductors) and dynamic frontal plan alignment (increased knee valgus angle, valgus movement, hip internal rotation angle and decreased knee flexion angle).[28]

The repetitive passive joint gliding movement improves nutrition, blood flow, and joint lubrication further restores mobility. It also helps to normalise the joint kinematic, gliding and rolling movement.[29]

Studies concluded that both six-week exercise programmes focussing on the hip and the knee were equally effective to improve functional activities and muscle strength, and in reducing pain of PFPS patients.[1,30] The current study found remarkable improvement in pain, ROM and functional activities within 4 weeks of TFJ mobilisation along with exercises which is in accordance with literature.[1] A case of PFPS patient managed with TFJ mobilisation (AP glide III) with home plan exercises increased PPT due to decreased active nociceptive pathways and eliminated central sensitisation of pain.[19] These findings are in support of the results of the current study.

One study compared knee manipulation with the patellar medial glide with local lateral retinacular massage, and concluded that knee mobilisation indicated remarkable improvement in pain and ROM compared to patellar medial glide with lateral retinacular massage treatment.[17]

The current study has limitations as it had a short duration which was not enough to rule out long-term effects of the intervention. Also, the study did not assess the physical activity level of the patients that might have indicated the association between physical activity and PFPS development. Further studies should focus on long-term effects of TFJ mobilisation (Kaltenborn) along with strengthening and stretching exercises and its effects on physical activity levels in patients with and without PFPS.

Conclusion

TFJ mobilisation with hip and knee stretching and strengthening exercises effectively reduced pain intensity, improved ROM with improvement in PPT in PSPF patients compared to conventional PT. TFJ mobilisation with hip and knee joint exercises were also effective in improving functional activities except weight-bearing and patellar instability.

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