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Efficacy of mobilization of talonavicular joint and intrinsic foot muscle strengthening in management of patellofemoral pain - an experimental study

Abstract

An experimental study on the efficacy of mobilization of talonavicular joint and intrinsic foot muscle strengthening in management of patellofemoral pain.

Objective: A study to find out the efficacy of mobilization of talonavicular joint and intrinsic foot muscle strengthening on pain, knee function and foot posture in management of patellofemoral pain.

Design: Pre and post experimental study design is adopted.

Setting: The study was carried out at RVS college of physiotherapy. The review board of RVS college of physiotherapy approved the study and an informed consent was obtained prior to the study from the subjects. Twenty subjects who fulfilled the inclusion and exclusion criteria were selected for this study. The subjects were treated by talonavicular joint mobilization and intrinsic foot muscle strengthening and treated for a period of four weeks. Main outcome measures: Pain measured by numerical pain rating scale, knee function measured by kujala scale and foot posture measured by foot posture index scale.

Result: When analysing the mean values, it showed that subjects treated with talonavicular joint mobilization and intrinsic foot muscle strengthening were effective.

Conclusion: It concluded that application of talonavicular joint mobilization and intrinsic foot muscle strengthening reduced pain and improved knee function and foot posture in patients with patellofemoral pain.

Keywords: patellofemoral pain, talonavicular joint mobilization, intrinsic foot muscle strengthening, numerical pain rating scale, kujala scale, foot posture index scale

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Introduction

Patellofemoral pain is characterized by pain around the patella due to activities such as squats, running, climbing steps, etc., that load the patellofemoral joint without causing any pathological changes.[1] Patellofemoral pain is a condition characterized by insidious onset of anterior knee pain that is increased due to compressive forces to the patellofemoral joint.[2] Patellofemoral pain is a common problem reported in young adults with an annual prevalence of 22.7 and 28.9% in the general population of young adults.[3]

Patella is the largest sesamoid bone that functions to improve efficiency of knee flexion and to protect the tibiofemoral joint. The combined action of the quadriceps tendon, lateral retinaculum, medial retinaculum and the patellar tendon helps in stabilization of patella. Instability and the potential for subluxation or dislocation injury increases, if patellar stabilizers are weak or mal-aligned as the patella is not completely engaged in the patellar groove during the first 0-30 degrees of knee flexion. The arterial supply to the patella arises from circumpatellar anastomosis. The pathology of patellofemoral pain may be related to decrease in pulsatile blood flow in young adults. The patellofemoral joint contains a variety of sensory receptors and also includes bare nerve endings, Pacinian corpuscles, Ruffini endings, Golgi receptors and muscle spindles.[4]

Patellofemoral pain is one of the commonest and challenging knee pathologies seen in most physiotherapy clinics among young adults that is higher for women than for men. The most typical symptom of patellofemoral pain is diffuse peripatellar and retropatellar pain, typically elicited by ascending or descending stairs, squatting, cycling and sitting with flexed knees for prolonged time. The cause of patellofemoral pain is still unknown but has been proposed to be multifaceted. The commonly accepted cause of patellofemoral pain is change in patellar tracking that increases patellofemoral joint stress and causes subsequent wear and tear on the articular cartilage.[5]

The patella is an essential part of the knee because it increases the mechanical advantage of the quadriceps muscle action. Other functions include protection of articular cartilage of the trochlea and femoral condyles, and loads the tensile forces of the quadriceps muscle to the patellar tendon. The function of the patellofemoral joint is dependent on balancing of the active and passive stabilizers. The primary active stabilizers are the quadriceps muscles. Passive stabilizers include the bony and cartilaginous articulating surfaces of the patellofemoral joint and the patellar tendon.[6]

The primary intrinsic foot muscles are abductor hallucis, flexor digitorum brevis and quadratus plantae to provide foot stability and flexibility for shock absorption and improve dynamic alignment along with maintenance of the foot arches and activating proprioceptors on the sole of the feet. These are also resulted to be active part in the foot core system and play an important role in static posture and dynamic activities.[7] The Talonavicular joint contributes only 5° of plantar flexion while 30° of plantar flexion of the ankle joint and

also functions as subtalar joint by means of supination and pronation movement, which occur with abduction, adduction, eversion and inversion. Because of these characteristics of the talonavicular joint, it looks like a subtalar joint.[8]

The altered motion of the talonavicular joint due to navicular drop is an indicator of the function of the foot.[9] The rehabilitation of patellofemoral pain includes conservative treatment for symptoms such as muscle strengthening exercises, flexibility exercises and foot orthoses to reduce pronated foot, patellofemoral joint taping and braces.[10] Some studies have shown a pronated foot as an intrinsic risk factor for patellofemoral pain suggesting that it may be a solution to the underlying problem.[11] A pronated foot is referred as the reduced or loss of the medial longitudinal arch (MLA).[12] Any changes in the lower extremity can cause calcaneal eversion, tibial internal rotation, valgum of knee, and femoral internal rotation in the normal structure. These changes alters the angle of muscle contraction of the quadriceps causing the patella to track towards lateral, resulting in lower extremity dysfunction.[13]

The assessment tool in the study for patellofemoral pain is the numerical pain rating scale to establish the subject's pain level after each functional test. It is an 11-point scale that ranges from 0 as no pain to 10 as worsening imaginable pain.[14] The knee function assessed by Kujala scale, is a well-recognized tool used in the orthopedic field and sports medicine. It is a 13-questionnaire scale to assess patellofemoral pain in young adults.[15,16] The foot posture index scale is a assessment tool for foot posture comprising six subsets such as talar head palpation, curves above and below the lateral malleoli, calcaneal angle, talonavicular bulge, medial longitudinal arch, and forefoot to rear foot alignment with each item scored from − 2 to + 2 points with − 12 as highly supinated and + 12 as highly pronated.[17]

In this study, the mobilization of talonavicular joint was performed to control the hyper mobility of the talonavicular joint at the pronated foot and intrinsic foot muscle strengthening was performed to maintain foot posture. This study aims to investigate the effect of mobilization of talonavicular joint and intrinsic foot muscle strengthening on patellofemoral pain.

Methodology

Study setting

The study was conducted in RVS college of physiotherapy - out patient department

Study design and study duration

The study was pre and post experimental study conducted for a period of four weeks.

Inclusion criteria

a. Patient with anterior or posterior knee pain for more than 12 weeks

b. Patient with more calcaneal eversion measured at 6° in the relaxed posture

c. Patient with positive indication for at least two of the following four tests (isometric contraction during slight flexion of knee, knee joint line palpation, compression of the knee against the femur, and actively limited knee extension)

d. Patients experiencing pain score 5 and above points on the Numerical Pain Rating Scale during last week's activities of daily living.

Exclusion criteria

a. Patient with a history of meniscus or knee joint injury

b. Patient suffering from cruciate or collateral ligament instability or tenderness

c. Patient experiencing patellar tendon, iliotibial band, or pes anserine tenderness

d. Presence of patellar apprehension test positivity

e. Patient diagnosed with osteochondrosis and traces of effusion

f. Presence of pain referring to hip or back areas

g. Patient with history of recurrent knee joint subluxation or dislocation.

Orientation to the subject and procedure

Prior to data collection the purpose of the study was elobarated to the subjects. A detailed orientation of the test procedure involved in the present study such as pain measured by numerical pain rating scale, knee function measured by kujala scale and foot posture measured by foot posture index was explained by the invigilator. The compliance and full support of every participant was sought after the description of the condition and illustration of the involved procedure. Totally 20 patients with patellofemoral pain were subjected to study. The subjects were treated with talonavicular joint mobilization and intrinsic foot muscle strengthening. Pre - treatment assessment was done. The patients recorded their pain on numerical pain rating scale, knee function on kujala scale and foot posture on foot posture index and the treatment was given for four weeks.

Mobilization of Talonavicular joint

Patient position: Prone lying with foot supported with towel

Therapist position: Walk standing at the foot end of the couch

Procedure: The therapist's one hand wraps the calcaneus while grasping the talus bone, and stabilizes the foot. The other hand holds the navicular and glides in the dorsal direction.

Mobilization of talonavicular joint of grade III Maitland technique was applied with a high amplitude from the end range with 1 second of vibration in the middle range of the joint through a linear motion to where tissue resistance is felt. Two sets of 5 minutes totally for 4 weeks (Figure 1).[6,18,19]

Figure 1 Talonavicular joint mobilization.

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Intrinsic foot muscle strengthening

Patient position: Sitting for 1,2 weeks and then standing for next 3,4 weeks

Therapist position: Walk standing beside the patient

Procedure: Intrinsic foot muscle strengthening is an exercise that mobilizes the abductor hallucis thus, preventing excessive pronation of the medial longitudinal arch. Intrinsic foot muscle strengthening is done by isometric contraction of pulling the metatarsal head towards the heel using intrinsic foot muscle for 5 seconds. Two sets of 5 minutes, totally for 4 weeks (Figure 2&3, Table 1).[18,20]

Figure 2 Isometric contraction of foot in a chair sitting.

Figure 3 Isometric contraction of foot in standing position.

Table 1 Shows mean value, mean difference, standard deviation and paired 't' value between pre-test and post-test scores of pain

Data analysed and results

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre-test	7.1			
Post-test	4.1	3	0.725	18.496

*0.005 level of significance

The calculated paired 't' value is 18.496 and the 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is more than 't' value shows that there is significant difference in pain severity following mobilization of talonavicular joint and intrinsic foot muscle strengthening in patient with patellofemoral pain (Figure 4, Table 2). The calculated paired 't' value is 18.925 and the 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is more than 't' value shows that there is significant difference in knee function following mobilization of talonavicular joint and intrinsic foot muscle strengthening in patients with patellofemoral pain (Figure 5, Table 3). The calculated paired 't' value is 12.963 and the 't' table value is 2.861 at 0.005 level. Since the calculated 't' value is more than 't' value shows that there is significant difference in foot posture following mobilization of talonavicular joint and intrinsic foot muscle strengthening in patients with patellofemoral pain (Figure 6).

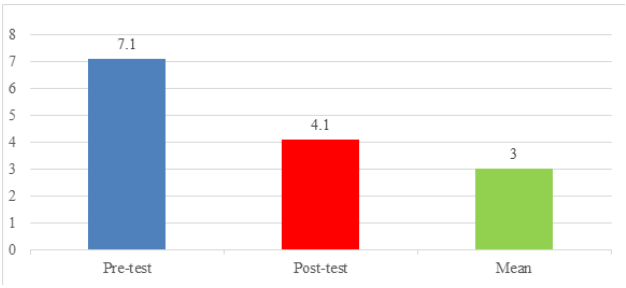

Figure 4 Shows graphical representation of pre and post-test mean values of pain.

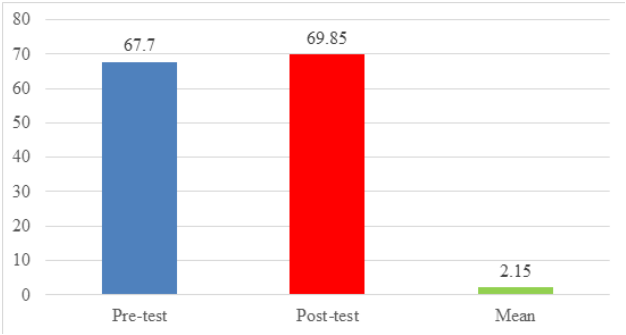

Figure 5 Shows graphical representation of pre and post-test mean values of knee function.

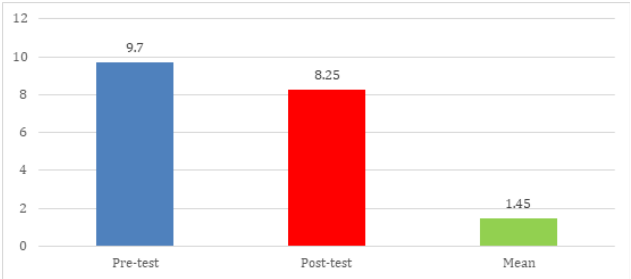

Figure 6 Shows graphical representation of pre and post-test mean values of foot posture.

Table 2 Shows mean value, mean difference, standard deviation and paired 't' value between pre-test and post-test scores of knee function

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre-test	67.7			
Post-test	69.85	2.15	0.744	18.925

*0.005 level of significance

Table 3 Shows mean value, mean difference, standard deviation and paired 't' value between pre-test and post-test scores of foot posture

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre-test	9.7			
Post-test	8.25	1.45	0.5099	12.963

***0.005 level of significance**

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Twenty subjects with patellofemoral pain were selected for the study and treated with mobilization of talonavicular joint and intrinsic foot muscles strengthening. The subjects were treated one session a day for four weeks. Prior to treatment, pain, knee function and foot posture were assessed by NPRS, Kujala scale and foot posture index respectively.

Analysis of dependent variable pain: The calculated paired 't' value is 18.496 and the table 't' value is 2.861 at 0.005 level of significance. Since, the calculated 't' value is greater than the table 't' value, this shows significant difference in pain following mobilization of talonavicular joint and intrinsic foot muscle strengthening in subjects with patellofemoral pain.

Analysis of dependent variable knee function: The calculated paired 't' value is 18.925 and the table 't' value is 2.861 at 0.005 level of significance. Since, the calculated 't' value is greater than the table 't' value, this shows significant difference in knee function following mobilization of talonavicular joint and intrinsic foot muscle strengthening in subjects with patellofemoral pain.

Analysis of dependent variable foot posture: The calculated paired 't' value is 12.963 and the table 't' value is 2.861 at 0.005 level of significance. Since, the calculated 't' value is greater than the table 't' value, this shows significant difference in foot posture following mobilization of talonavicular joint and intrinsic foot muscle strengthening in subjects with patellofemoral pain.

Upon analysing the results, subjects treated with talonavicular joint mobilization and intrinsic foot muscle strengthening showed effective in the management of patellofemoral pain. The study was conducted to find out the efficacy of mobilization of talonavicular joint and intrinsic foot muscle strengthening on pain, knee function and foot posture in management of patellofemoral pain. A total of 20 subjects, were included in this study. The subjects were treated with talonavicular joint mobilization and intrinsic foot muscle strengthening exercises. The results show a prominent difference in pain reduction, increase in knee function and foot posture correction in patients with patellofemoral pain.

Discussion

The study was conducted on 20 clinically diagnosed subjects with patellofemoral pain. The group was treated with mobilization of talonavicular joint and intrinsic foot muscle strengthening for a period of 4 weeks. The study aimed at showing the effect of mobilization of talonavicular joint and intrinsic foot muscle strengthening in subjects with patellofemoral pain.

According to the earlier experiments by physical therapists, talonavicular joint mobilization and intrinsic foot muscle strengthening is an effective management for treating patellofemoral pain.The effectiveness of talonavicular joint mobilization and intrinsic foot muscle strengthening was earlier experimented by various physical therapists. They proved that talonavicular joint mobilization and intrinsic foot muscle strengthening is more effective in control of patellofemoral pain, knee function and foot posture in patients with patellofemoral pain.[18]

The effect of the mobilization of talonavicular joint and intrinsic foot muscle strengthening on pain, functional performance and foot posture in patients with patellofemoral pain syndrome (Kim, *et al.,* 2022). The participants were randomly assigned to three groups and received 12 sessions of mobilization of talonavicular joint and intrinsic foot muscle strengthening and blended interference at university laboratory for 4 weeks. The primary outcome was pain, along with the secondary outcomes of lower extremity function, valgus knee, foot posture, and muscle activity ratio measured. It was concluded that foot intervention of mobilization of talonavicular joint and intrinsic foot muscle strengthening was effective for pain reduction and improvement of function of knee among individuals with patellofemoral pain.[18] The effectiveness of ankle and midfoot mobilization on pain and functional performance. This study showed physiological evidence of improvement in the movement of the navicular to the dorsally towards in the pronated foot. This study concluded that mobilization at the talonavicular joint can help in activating the muscles around the joints by stimulating mechanoreceptors of the joint and muscles.[19]

The effects of the blended talonavicular joint mobilization and foot core strengthening interference were significantly greater than those of other groups for 4 weeks post-interference. Many studies have shown that foot core strengthening, a typical therapeutic exercise for the pronated foot, can improve the performance of the foot intrinsic muscles to improve arch that was supported when joint mobilization and exercise are performed in combination for better results.[20] Hence, applying all the above concepts and support, it can be justified that mobilization of talonavicular joint and intrinsic foot muscle strengthening make a difference in the reduction of pain and improvement of functional performance and foot posture among patients with patellofemoral pain.

Conclusion

The study was conducted to find out the effectiveness of talonavicular joint mobilization and foot muscle strengthening in the management of patellofemoral pain. A total of 20 subjects were considered for this study. According to the statistical results, the present study confirm a substantial improvement in pain reduction, functional performance and foot posture among patients with patellofemoral pain.

Study limitations

a. The sample size of the study was small.

b. This study was limited to assessing only the pain intensity, functional performance and foot posture.

c. Psychological factors of the patient were not considered

d. Short term study duration

Recommendations

a. Similar studies can be done with large sample size

b. Similar studies can be undertaken with different outcome measures.

c. Long term study can also be done

Acknowledgments

None.

Conflicts of interest

The authors declare no conflicts of interest.

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