

Therapeutic Effectiveness of Instrument Assisted Soft Tissue Mobilization (IASTM) and Kinesio Taping (KT) in Addressing Pain and Knee Function Among Patients with Patellofemoral Pain Syndrome (PFPS)

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Abstract

Therapeutic Efficacy of Soft Tissue Mobilization using Instrument Assistance (IASTM) and Kinesio Taping (KT) in addressing the Pain and Knee Function Among Patellofemoral Pain Syndrome (PFPS) patients.

Objective: Study to find out the efficacy and dominance of soft tissue mobilization by instrument assistance over kinesio-taping in the Management of Pain and Knee Function Among patients with Patellofemoral Pain Syndrome.

Design: pre and post experimental study design is adopted.

Setting: The study was conducted in RVS College of physiotherapy, Sulur, Coimbatore and Yasodha Physiotherapy Centre, Coimbatore. Participants: Two groups comprising of 15 participants each carefully subjected to proper selection criteria addressed as group A (with IASTM involvement) and group B (with KT involvement). Experimental Group A: instrument assisted soft tissue mobilization (IASTM) with exercises. Experimental Group B: Kinesio taping (KT) with exercises.

Main outcome measures: Pain using visual analogue scale and knee function score using Anterior knee pain Scale

Results: When comparing the mean values of Group, A (IASTM) and B (KT), Group A subjects treated with instrument assisted soft tissue mobilization along with hip and knee strengthening exercise showed more difference than Group B treated with kinesio-taping.

Conclusions: It is concluded that instrument assisted soft tissue mobilization (IASTM) more effective than kinesio taping (KT) in pain reduction and knee function progress among athletes with Patello femoral pain syndrome (PFPS).

Keywords: Patellofemoral Pain Syndrome (PFPS); Instrument Assisted Soft Tissue Mobilization (IASTM); Kinesio Taping (KT)

Introduction

Patellofemoral pain syndrome (PFPS), one of the most common causes of Knee pain, is defined as anterior knee pain involving the knee cap patella and support soft tissue structure retinaculum that excludes other articular joint pathology and pathology of peripatellar structures [13]. Patellofemoral pain syndrome (PFPS) is most of the times an overuse damage characterized by pain in the peripatellar area, where physical activities can exacerbate involving knee bending like climbing stairs, squats, jumps, running and/or by sitting knees flexed for prolonged hours. Since the patellofemoral joint is affected by multiple forces it increases the difficulty in assessing and treating the pain syndrome pertaining this joint. Combination of several factors, viz atypical lower limb biomechanics (malalignment, excessive Q angle, patellar maltracking), weakness in muscle, tightness in soft tissue, and disproportionate amount of exercise may develop an augmented stress in cartilage

and subchondral bone and subsequent PFPS [19]. The patella component is an inverted triangle shaped flat bone with an inferiorly directed apex and posterior area partitioned by a vertical ridge and masked by articulating cartilage. This is the largest sesamoid bone in the body. It's function primarily as an anatomical pulley for the quadriceps muscle. The movements of the patella are patellar flexion and extension and patellar tilt [17,18]. There consensus statement on the aetiology of patellofemoral pain syndrome (PFPS) is patellar tendinitis, quadriceps rupture, patellar instability (lateral compartment syndrome, chronic subluxation, recurrent dislocation of patella, fracture of the patella, sindig-larson-johansson's disease, Osgood-Schlatter's disease [8]. PFPS is extremely common, occurring in majority of school population and a big chunk of knee injuries in a sporting population [19]. Various Symptoms of patella femoral knee pain are diffuse ache and pain, pain on stairs, pain on squatting, pain on sitting (moviegoer's knee), crepitus, pseudo

locking, swelling [38]. Five clinically tests comprising Vastus medialis coordination test, Patellar apprehension test, Patellofemoral grinding test (Clarke's test), Eccentric step test and Waldrone's test are usually used in the diagnosis of PFPS. Researcher reported an increase in probability of PFPS corelated with the sure outcome on any of the following tests: the patellar apprehension test, the vastus medialis coordination test and the eccentric step test [17]. Kinesiotape (KT), created by Kenzo Kase in 1996, is a thin, cotton fabric with adhesive that is latex-free and nonmedicated. It results in multidirectional pulling of the skin allowing a fractional to complete movement of the underlying muscles [1]. Hypothesis proposed that the tapes lift the skin and increase the spaces between the skin and muscle, hence reduce the localized pressure and help to increase and aid circulation and lymphatic drainage that results in reduced pain, swelling and muscle spasm [2]. Anatomy Trains is a modern descriptive term for the whole schema of pathways, stations, switches and so on is used.

A myofascial meridian is nothing but a single Anatomy train. A bundle of intimate muscle tissue along with its connective tissue web is represented as myofascial. The postural knee extension is maintained by the Superficial front line (SFL) myofascial. The functional movement of SFL creates knee extension, trunk and hip flexion and foot dorsiflexion [37]. A systematic procedure either involving a relatively low repetition cycles or a short period of time concentrating on a specific muscle or group of muscles in lifting, lowering or offering resistance to heavy loads is addressed as strengthening exercise [9].

Methodology

Study setting

The study setting was conducted in Yasodha physiotherapy center Coimbatore and RVS college of physiotherapy -out patient department.

Independent t-test performance Stanley and Campbell notation for the study design is

O A O

O B O

- O- Observation
- A-group treated with instrument assisted soft tissue mobilization followed by corrective exercise
- B-group treated with kinesio taping followed by exercise
- Paired t- test is done for experimental group A and experimental group B
- Unpaired t-test is done to find the significance of experimental group A over experimental group B

Study design and Study duration

The study design was a pre and post experimental study conducted over a period of 4 weeks.

Inclusion criteria

- Clinically diagnosed patellofemoral pain syndrome patient
- Age group 17-35 years
- Excessive lateral compression syndrome
- Unilateral side affected.
- Positive patellar grind test
- Giving way of the knee during one/any activity average pain.
- Restriction of superficial front line anatomy trains subjects are included.

Exclusion criteria

- Recent surgery
- Open wounds
- Hypersensitive subjects
- Infants
- Carcinoma
- Chronic pain greater than 4years
- Pregnancy
- Corticosteroid injection of the knee joints within the past 3month
- Severe tibio-femoral arthritis, patellofemoral arthritis
- Medial joint line tenderness
- Rheumatologic conditions
- Diabetic, hypertensive subjects, gout
- Any history of lower limb trauma and surgery
- contusions

Orientation to the subjects and procedure

Prior to data collection the purpose of the study was elaborated to the subjects. A detailed orientation of the test procedures involved in the present study such as pain measurement by visual analog scale and range of motion to record the knee function was explained by the investigator. The compliance and full support of every participant was sought after the description of the condition and illustration of the involved procedure. Totally 30 patients with Anterior knee pain, divided into two groups were subjected to study.

GROUP A (instrument assisted soft tissue mobilization (IASTM), hip and knee strengthening exercises) and GROUP B (Kinesio taping, Hip and knee strengthening exercises). Pre -treatment assessment was done. Both groups of patients recorded their pain on VAS and anterior knee pain scale on the base line and the treatment was given for both groups for 4 weeks. Both groups are received hip and knee strengthening exercises before applying taping and IASTM.

Hip and knee strengthening exercises

Strengthening exercises used body weight and progresses from 3 sets of 10 repetitions over a course of 4-week program applied before taping (alternative days).

- Isometric quadriceps
- High sitting with knee extension
- SLR in supine lying with Resistance band.
- SLR in prone lying with Resistance band
- CLAM SHELL inside lying.

Data Analysed and Results

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre- test	7.8	4	0.73	18.9*
Post- test	3.8			

Table 1: Shows mean value, mean difference, standard deviation, and paired 't' value between pre- test and post-test scores of pain among group A (Instrument Assisted Soft Tissue Mobilization).

*0.005 level of significance.

In Group A for pain the calculated paired 't' value is 18.9 and 't' table value is 2.977 at 0.005 level. Since the calculated 't' value is more than 't' table value, it shows that there is significant difference in pain following Instrument Assisted Soft Tissue Manipulation therapy along with hip and knee strengthening exercise in Patello Femoral Pain

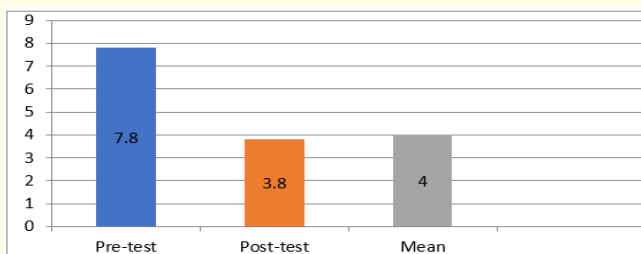


Figure 1: Shows graphical representation of pre and post-test mean values of pain among Group A (Instrument Assisted Soft Tissue Mobilization).

In Group B for pain the calculated paired 't' value is 11.06 and 't' table value is 2.977 at 0.005 level. Since the calculated 't' value is more than 't' table value, it shows that there is significant difference in pain following Kinesio taping along with hip and knee strengthening exercise in Patello Femoral Pain.

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre- test	7.6	2.2	0.77	11.06*
Post- test	5.4			

Table 2: The table shows mean value, mean difference, standard deviation, and paired 't' value between pre- test and post-test scores of pains among group B (Kinesiotaping).

*0.005 level of significance.

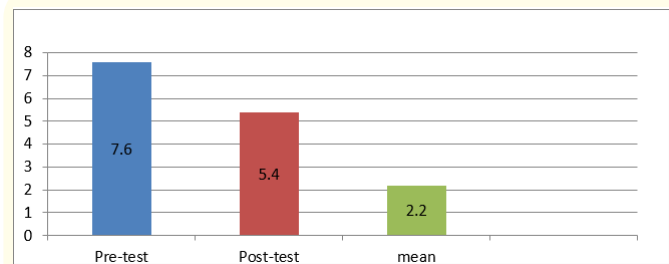


Figure 2: Shows graphical representation of pre and post- test mean values of pain among Group B (kinesiotaping).

Groups	Improvement		Standard deviation	Unpaired 't' Test
	Mean	Mean Difference		
Group A Group B	4 2.2	1.8	0.14	27.3*

Table 3: The table shows mean value, mean difference, standard deviation, and unpaired 't' value of pain between group A (Instrument Assisted Soft Tissue Mobilization) and B (kinesiotaping).

*0.005 level of significance.

In Group A and Group B for pain the calculated unpaired 't' value is 27.3 and 't' table value is 2.763 at 0.005 level. since the calculated 't' value is more than 't' table value, it shows that there is significant difference between Instrument Assisted Soft Tissue Manipulation and kinesio-taping along with hip and knee strengthening exercise in patients with Patello Femoral Pain Syndrome.

In Group A for Knee functions the calculated paired 't' value is 14.98 and 't' table value is 2.977 at 0.005 level. Since the calculated 't' value is more than 't' table value, it shows that there is significant difference in knee function following Instrument Assisted Soft Tis-

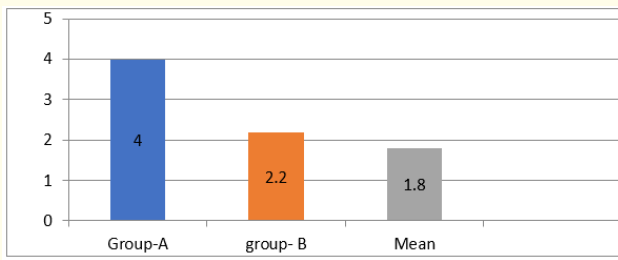


Figure 3: Shows graphical representation of un-paired 't' value of pain between Group A (Instrument Assisted Soft Tissue Mobilization) and Group B (kinesiotaping).

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre- test	60.6	10.0	2.6	14.98*
Post- test	70.6			

Table 4: Shows mean value, mean difference, standard deviation, and paired 't' value between pre- test and post-test scores of knee function in group A (Instrument Assisted Soft Tissue Mobilization). *0.005 level significance.

sue Manipulation therapy along with hip and knee strengthening exercise in Patello Femoral Pain Syndrome.

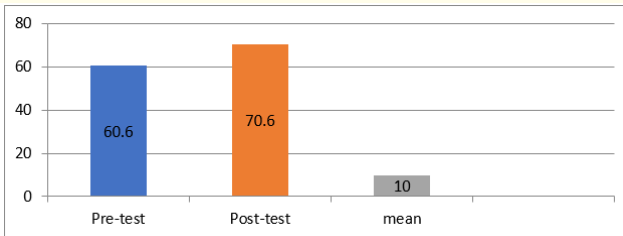


Figure 4: Shows graphical representation of pre and post- test mean values of knee function among Group A (Instrument Assisted Soft Tissue Mobilization).

Measurement	Mean	Mean difference	Standard deviation	Paired 't' value
Pre- test	56.1	4.3	1.22	13.33*
Post- test	60.4			

Table 5: The table shows mean value, mean difference, standard deviation, and paired' value between pre- test and post-test scores of knee function of group B (kinesiotaping). *0.005 level of significance.

In Group B for knee function the calculated paired 't' value is 13.33 and 't' table value is 2.977 at 0.005 level. Since the calculated 't' value is more than 't' table value, it shows that there is significant difference in knee function following kinesio-taping along with hip and knee strengthening exercise in Patello Femoral Pain Syndrome.

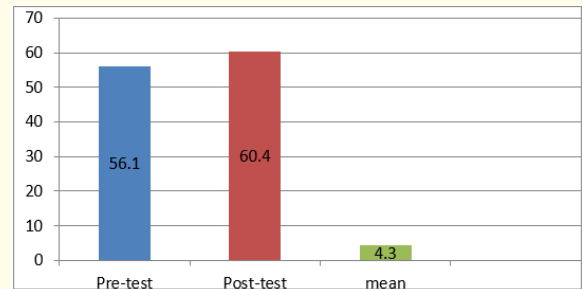


Figure 5: Shows graphical representation of pre and post- test mean values of knee function among Group B (kinesiotaping).

Groups	Improvement		Standard deviation	Un paired 't' Test
	Mean	Mean difference		
Group-A	10.0	5.7	1.69	6.19*
Group-B	4.3			

Table 6: Shows mean value, mean difference, standard deviation, and unpaired 't' value of knee performance between Group A (Instrument Assisted Soft Tissue Mobilization) and Group B (kinesiotaping). *0.005*0.005 level of significance.

In Group A and Group B for Knee function the calculated un-paired 't' value is 6.19 and 't' table value is 2.763 at 0.005 level. since the calculated 't' value is more than 't' table value, it shows that there is significant difference between Instrument Assisted Soft Tissue Manipulation therapy and Kinesio taping along with hip and knee strengthening exercise in Patello Femoral Pain Syndrome.

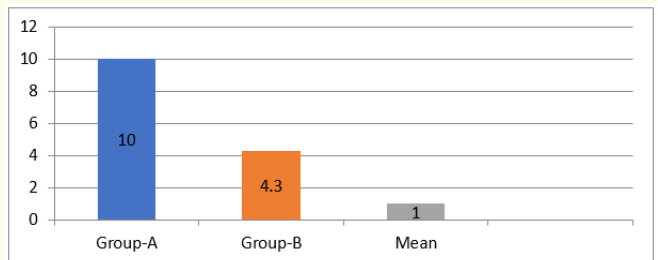


Figure 6: Shows graphical representation of un-paired 't' value of knee function between Group A (Instrument Assisted Soft Tissue Mobilization) and Group B(kinesiotaping).

A total of 30 chronic Anterior knee pain subjects were selected for the study. The subjects were randomly divided into two groups. Group A was treated with Instrument Assisted Soft Tissue Mobilization therapy along with hip and knee strengthening exercise. Group B was subjected to Kinesio taping accompanied by strengthening exercises pertaining to hip and knee. The patient was treated for one session a day like alternative days that 4 week. Prior to treatment, pain and knee function were assessed by VAS and Kujala scale respectively.

- **Dependent Variable pain analysis in Group A:** The paired 't' value is calculated to be 18.9 and the table value is 2.977 at 0.005 level of significance. This confirms a substantial pain transformation by adopting Soft Tissue Mobilization therapy with Instrument Assistance accompanied by strengthening exercise pertaining to hip and knee in Patello Femoral Pain Syndrome.
- **Dependent Variable pain analysis in Group B:** The paired 't' value is calculated to be 11.2 and the table value is 2.977 at 0.005 level of significance. This confirms a substantial pain transformation by adopting Kinesio taping accompanied by strengthening exercise pertaining to hip and knee in Patello Femoral Pain Syndrome.
- **Dependent Variable pain involving Group A and Group B:** The paired 't' value is calculated to be 27.3 and table value is 2.763 at 0.005 level of significance. The calculated 't' value is observed to be greater than the table 't' value. Hence there is a substantial variation between Soft Tissue Mobilization therapy with Instrument Assistance and kinesio taping accompanied by strengthening exercise pertaining to hip and knee in Patello Femoral Pain Syndrome.

Upon comparing the results from two groups, Group A subjects treated with Soft Tissue Mobilization therapy with Instrument Assistance accompanied by strengthening exercise pertaining to hip and knee showed more positive response than Group B subjects treated by Kinesio taping. Hence it is concluded that instrument assisted soft tissue mobilization therapy is more effective than kinesio taping in reducing pain and improving knee function among Patello Femoral Pain Syndrome.

- **Dependent variable analysis based on knee function in Group A:** The paired 't' value is calculated to be 14.9 and the paired table 't' value is 2.977 at 0.005 level. The calculated 't' value is observed to be greater than the table 't' value. A noteworthy difference is observed for subjects following Soft Tissue Mobilization therapy by instrument assistance accompanied by strengthening exercise pertaining to hip and knee in Patello Femoral Pain Syndrome.

- **Dependent variable analysis based on knee function in Group B:** The paired 't' value is calculated to be 13.3 and the paired table 't' value is 2.977 at 0.005 level. The calculated 't' value is observed to be greater than the table 't' value. A noteworthy difference is observed for subjects adopting Kinesio taping accompanied by strengthening exercise pertaining to hip and knee in Patello Femoral Pain Syndrome.
- **Dependent variable knee function involving Group A and Group B:** The unpaired 't' value determined is 6.19 and the unpaired table 't' value is 2.763 at 0.005 level of significance. Hence, the calculated 't' value is significant difference between Instrument Assisted Soft Tissue Mobilization therapy and kinesio taping along with hip and knee strengthening exercise in Patello Femoral Pain Syndrome.

Upon comparing the results from two groups, Group A subjects treated with Soft Tissue Mobilization therapy with Instrument Assistance accompanied by strengthening exercise pertaining to hip and knee showed more positive response than Group B subjects treated by Kinesiotaping. Hence it is concluded that instrument assisted soft tissue mobilization therapy is more effective than kinesio taping in reducing pain and improving knee function among Patello Femoral Pain Syndrome.

The study was conducted to compare the effectiveness of Instrument Assisted Soft Tissue Mobilization therapy and Kinesio taping along with hip and knee strengthening exercise in Anterior knee pain syndrome patients.

A total of 30 subjects, randomly divided into two different groups were included in this study. The group A was treated with Instrument Assisted Soft Tissue Mobilization therapy along with hip and knee strengthening exercise and group B treated with kinesio-taping technique along with hip and knee strengthening exercise.

The results show a prominent difference in pain reduction and increased performance of knee in both the groups, whereas upon comparison it is found out that the group A treated Instrument Assisted Soft Tissue Mobilization therapy along with hip and knee strengthening exercise is more effective than kinesio-taping technique along with hip and knee strengthening exercise for Anterior knee pain syndrome.

Discussion

Totally 30 subjects were chosen for the study. The subjects were divided into two groups; group A and group B of 15 subjects in each

group. Group A received instrument assisted soft tissue mobilization along with hip and knee strengthening exercises and group B received kinesio-taping along with hip and knee strengthening exercises.

The study aimed on comparing the effectiveness of instrument assisted soft tissue mobilization and kinesio taping on patients with Anterior knee pain subjects.

According to the earlier experiments by physical therapists, soft tissue mobilization by instrument assistance is an effective therapy. Whereas in patients with patellofemoral pain syndrome kinesio taping has been reported to be effective in reducing the anterior knee pain [1].

Aminaka N, Gribble PA. A2005).

Soft tissue mobilization with instrument assistance enhances the blood circulation and removes the body toxins and wastes. This could be achieved by improved microcirculation, accelerating granulation and angiogenesis in the regional tissues, fostering capillary endothelial repair, which in turn supports pain reduction due to the transformations of the skin's biomechanical properties. This has been explained by Diffuse Noxious Inhibitory Controls" (DNICs), "Pain-Gate Theory" (PGT) and "Reflex Zone Theory" (ZRT). The "Nitric Oxide Theory" explains the relaxation of muscle, unambiguous structural changes in local tissue and an increased blood circulation.

According to the "Activation of Immune System Theory" (AIST), soft tissue mobilization by instrument assistance aids the immunomodulatory effects. Whereas "Blood Detoxification Theory" (29) features the removal of heavy metals and waste and toxin release. A

The taping application to block nociceptive input and cause neural inhibition via large afferent fiber, there by pain is reduced [40].

Kinesio tape is proposed to lift the skin and increase space between the skin and muscles, and thus provide the central nervous system with a large influx of afferent sensory input via mechanoreceptor [39]. Wu, W. T., Hong, C. Z., and Chou, L. W. (2015).

The tape is to improve proprioception by providing constant cutaneous stimulation, by the way of this mechanism the tape leads to an increase in muscle activation (Halseth., *et al.* (2004).) a decrease in pain through neurological suppression it allows the full range of motion of knee joint for the applied muscles and joints with different pulling forces to the skin. It is anticipated that the tapes lift the skin and increases the space between them which in turn reduces

the localized pressure and hence the reduction in intra-articular friction [26]. There won't be any restriction to perform activities like squatting, running, jumping after the application of taping [14,15].

Dr. Kensokase and colleagues in Japan has been suggested for the treatment of patellofemoral pain syndrome provides additional benefits of improved circulation and reduced inflammation when compared to the other types of tape [31]. The recoiling nature of Kinesio tape aids in partial to full range motion, without affecting the circulation as there is no wrapping. Therefore, kinesio taping enables to maintain the bones and muscles in stable position during athletic activity since there is no inhibition of blood flow [42].

The group treated with Instrument assisted soft tissue mobilization found more effective than group Treated with kinesiotaping.

Conclusion

The study was conducted to compare the effectiveness of instrument assisted soft tissue mobilization and Kinesio taping along with hip and knee strengthening exercise in Anterior knee pain cricketers.

A total of 30 subjects divided into two separate groups were considered for this study.

The results of the present study confirm a substantial improvement in pain reduction and an active knee performance in either of the groups, whereas upon comparing the mean value, it is found out that the group A treated instrument assisted soft tissue mobilization (IASTM)along with hip and knee strengthening exercise is more effective than kinesio-taping technique (KT)along with hip and knee strengthening exercise for Anterior knee pain cricketers.

Study Limitations

- Relatively smaller number of subjects
- Disregarded Psychological factors
- Brief study time

Recommendations

- Improvement in sample size
- Involvement of different age group subjects
- Scope for Long-term study period.

Bibliography

1. Aminaka N and Gribble PA. "A systematic review of the effects of therapeutic taping on patellofemoral pain syndrome". *Journal of Athletic Training* 40.4 (2005): 341-351.
2. Alrawaili SM. "Investigating the Clinical Effect of Kinesio Tape on Muscle Performance in Healthy Young Soccer Players - A Prospective Cohort Study". *Clinics (Sao Paulo)* 74 (2019): e1158.
3. Akbas., et al. "The effects of additional kinesio taping over exercise in the treatment of patellofemoral pain syndrome". *Department of Orthopaedics and Traumatology, Faculty of Medicine, Hacettepe University, Ankara, Turkey* (2011).
4. Alicia M Montalvo., et al. "Efficacy of kinesiotaping for improving pain and quadriceps performance in physically active patellofemoral pain syndrome patients". *International Journals of Physiotherapy* 3.3 (2013): 1-6.
5. Amira Hussein Draz. "Carryover effect of hip and knee exercise program on individuals with PFPS". *The Journal of Physical Therapy Science* (2017).
6. Anil T John., et al. "The effect of patellar taping versus therapeutic ultrasound on pain and Q-angle in subjects with patellofemoral pain syndrome". *International Journal of Development Research* 5.12 (2015): 6282-6286.
7. Boonstra., et al. "A study to determine the reliability and concurrent validity of a visual analogue scale for disability as a single item instrument measuring disability". *International Journal of Rehabilitation Research* 31.2 (2004): 165-169.
8. Bump JM and Lewis L. "Patellofemoral Syndrome". In: *StatPearls*. Treasure Island (FL): StatPearls Publishing (2022).
9. Carolyn kisner. "Therapeutic exercises, foundations and techniques". 6th edition 772 to 773 (2012): 159.
10. Caylor Janice. "Clinical mechanics and Kinesiology". 5th edition (1993): 290.
11. Cynthiya Norkin., et al. "Joint structure and function". 5th edition (2012): 434.
12. David Magee., et al. "Orthopaedic physical assessment". 5th edition (2011): 727.
13. Dixit S., et al. "Management of patellofemoral pain syndrome". *American Family Physician* 75.2 (2007): 194-202.
14. Chang ryeol lee., et al. "The effects of kinesio taping on VMO and VL EMG activities during stairs ascent and descent by persons with PFPS". *Journal of Physiotherapy in Science* 24.2 (2012): 153-156.
15. Carl Clarkson and Dana Murray. "Effects of moving cupping therapy on hip and knee range of movement and knee flexion power". *Journal of Manual and Manipulative Therapy* 27.5 (2019).
16. Clemow chris., et al. "Which strengthening/stretching exercises are most effective at relieving the pain of patellofemoral pain syndrome". a peer reviewed publication of the family physicians' inquiries network 14.5 (2011): 1-15.
17. Cowan., et al. "Therapeutic patellar taping changes the timing of vasti muscle activation in people with patellofemoral pain syndrome". *Sports Medicine* 12.6 (2002): 2.
18. Cynthia., et al. "Did a study to determine the test-retest reliability and responsiveness of anterior knee pain scale and lower extremity functional scale in patients with anterior knee pain". *Journal of Orthopaedic Sports Physical Therapy* 35.3 (2005): 136-146.
19. Farzin., et al. "Patellofemoral Pain Syndrome and Modifiable Intrinsic Risk Factors How to Assess and Address". *Asian Journal of Sports Medicine* 4.2 (2013): 85-100.
20. Halabchi F., et al. "Patellofemoral pain in athletes: clinical perspectives". *Open Access Journal of Sports Medicine* 8 (2017): 189-203.
21. Halseth T., et al. "The effects of kinesio™ taping on proprioception at the ankle". *Journal of Sports Science and Medicine* 3.1 (2004): 1-7.
22. Herrington., et al. "Strap taping for sports and rehabilitation" (2007): 95.
23. Hee-Joong Kim., et al. "Effect of Cupping Therapy on Range of Motion, Pain Threshold, and Muscle Activity of the Hamstring Muscle Compared to Passive Stretching". *Department of Physical Therapy, The Graduate School of Sahmyook University, Seoul, Korea* (2017).
24. Ilkay zihni chirali. "Traditional Chinese medicine cupping therapy". 3rd edition (2014).
25. kujala., et al. "A pain sub scale score of the anterior knee pain scale showed significantly better result for the patients managed with the patellofemoral pain syndrome". *Journal of Orthopaedic Sports Physical Therapy* 9.2 (1993): 159-163.

26. K Ullah., *et al.* "An investigation into the effect of Cupping Therapy as a treatment for Anterior Knee Pain and its potential role in Health Promotion". *The Internet Journal of Alternative Medicine* 4.1 (2007).
27. Kuru T., *et al.* "The comparison of efficiency of kinesio taping and electrical stimulation in patients with patellofemoral pain syndrome". *Journal of Acta Orthopaedica ET Traumatologica Turcica* 46.5 (2012): 385-392.
28. Laura Kookiker., *et al.* "The Effects of Physical Therapist-Guided Quadriceps-Strengthening Exercises for the Treatment of patellofemoral pain syndrome". *Journal of Orthopaedic and Sports Physical Therapy* 44.6 (2014): 391-404.
29. Maria zuluaga. "Sports physiotherapy applied science and practise". 1st edition (1995): 594.
30. Naseem., *et al.* "The medical perspective of cupping therapy effects and mechanism of action". *Journal of Traditional and Complementary Medicine* (2018).
31. Osorio Javier., *et al.* "The effects of two therapeutic patellofemoral taping techniques on strength, endurance, and pain responses". *Physical Therapy in Sport* (2012).
32. PL Chen., *et al.* "Biomechanics effects of kinesio taping for persons with patellofemoral pain syndrome during stair climbing". 4th Kuala Lumpur International Conference on Biomedical Engineering 21.1 (2008): 395-397.
33. Ricardo., *et al.* "Hip and knee strengthening is more effective than knee strengthening alone for reducing pain and improving activity in individual with PFP". *Journal of Orthopaedic and Sports Physical Therapy* 48.1 (2018).
34. Susan Sullivan. "Physical rehabilitation". 6th edition (2014): 318.
35. Smith., *et al.* "Addition of hip exercise to treatment of PFPS: A meta-analysis". *World Journal of Meta-Analysis* 3 (2015).
36. Stedje HL., *et al.* "Kinesio taping and the circulation and endurance ratio of the gastrocnemius muscle". *Journal of Athletic Training* 47.6 (2012): 635-642.
37. Tamer Shaban. "Cupping therapy encyclopedia" (2014): 43.
38. Thomas W Myers. "Anatomy trains". 2nd edition 4 (2004): 97.
39. Waryasz GR and McDermott AY. "Patellofemoral pain syndrome (PFPS): a systematic review of anatomy and potential risk factors". *DynMed* 7 (2008): 9.
40. Wu WT., *et al.* "The Kinesio Taping Method for Myofascial Pain Control". *Evidence-Based Complementary and Alternative Medicine: eCAM* (2015): 950519.
41. Williams S., *et al.* "Kinesio taping in treatment and prevention of sports injuries: a meta-analysis of the evidence for its effectiveness". *Sports Medicine (Auckland, N.Z.)* 42.2 (2012): 153-164.
42. Wen-Chi Chen., *et al.* "Effects of kinesio taping on the timing and ratio of vastus medialis obliquus and vastus lateralis muscle for person with patellofemoral pain". *Journal of Biomechanics* 40.2 (2007): S3187.