ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2020; 6(2): 91-99
www.allresearchjournal.com
Received: 11-12-2019
Accepted: 15-01-2020

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Immediate effect of patellar kinesio taping versus mcconnell taping on pain and hop function in patellofemoral pain syndrome

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Abstract
Background and Objective: Patellar Kinesio-Taping (KT) and McConnell taping (MT) both techniques have been individually advocated for reducing the pain and support to the knee joint as well as improved 'Hop' function activity in anterior knee pain or patello-femoral pain syndrome (PFPS) but comparison of both these techniques have not been explored in studies. The purpose of the study was to find immediate effect of Patellar Kinesio-Taping vs McConnell Taping on pain and 'Hop' function in subjects with patella-femoral pain syndrome.
Material and Method: A pre and post comparative study was done on 40 subjects mean age group of 16-30 years were included in the study. KT and MT both groups received Patellar Kinesio-taping and Patellar McConnell taping for single time respectively. VAS scale and Hop test (single leg triple jump) were taken before and after intervention. The intervention was given once in a day, in one week and each session lasts for 15-30 minutes. Data was analyzed by Paired and Unpaired t test, Pearson Chi-Square test, Wilcoxon signed rank test and Mann Whitney U test.
Results: There was very statistical significant difference ($P<0.0001$) within the groups and no statistical significant difference between the groups in VAS score (during rest, step up, squatting, step down) and hop test (single leg triple jump test) after intervention.
Conclusion: The present study concludes that both kinesio taping and McConnell taping techniques are effective on reducing pain in functional activity step up, step down, squatting and also improving hop function activity in patellofemoral pain syndrome.

Keywords: Kinesio tape, McConnell tape, hop test (single leg triple jump test), VAS score, patello-femoral pain syndrome (PFPS)

Introduction
Patellofemoral joint pain well defined as retro- patellar, peri-patellar or patellofemoral pain syndrome (PFPS) causing from physical and biochemical changes [1]. Usually, patients complaint pain at anterior aspect of knee joint or behind the patella (retro-patellar pain) [2]. The incidence in the general population is 25% in adolescents and adults [3]. In highly active population and general practice incidence rate varies from 22 and 5 to 6 new cases per 1000/year respectively [3].

Females due to their increased "Q" angle are more prominent as compared to males [1, 4, 5]. This predisposes females more to patella maltraking. Pain commonly occurs during squatting, running, prolonged sitting, stair climbing and kneeling. In the patellofemoral joint, the patella serves as a link to converge the fibers of the quadriceps femoris muscle group to increase its lever arm and maximize its mechanical advantage. To ensure this functional efficacy, maintaining the patellar alignment in the trochlear groove of the femur is necessary. Malalignment of the patella, or altered patellar tracking, may be a predisposing factor for patellofemoral pain, chondromalacia, and articular cartilage degeneration [2]. Those patients typically complain of pain in the anterior region of the knee referred to as "runner's knee" or patellofemoral pain syndrome. A trigger of increased pain is normally due to increased activity or prolonged sitting subject who have patellofemoral pain syndrome often experience pain while descending stairs or steep declines. In acute condition it is normally resolves in 6-8 weeks if given sufficient rest from prolonged running, walking, jumping, and

other aggravating activities [7] but chronic pain (cases in which athletes continue to push through the pain with symptoms lasting longer than 6-8 weeks) can take 6 months or longer to heal [6].

It is a problem commonly faced by physicians who provides medical care for competitive or recreational athletes. Other names for this entity are retro-patellar pain syndrome, patellofemoral arthralgia, extensor mechanism disorder, lateral patellar compression syndrome, patellalgia and patellofemoral dysfunction. Chondromalacia patella, which involves degeneration of the cartilage on the articular surface of the patella, has been inappropriately included with the patellofemoral disorders. Mostly there is no damage occurs in articular cartilage of all patellofemoral disorders. Furthermore, there is little epidemiologic evidence that patellofemoral pain syndrome, if untreated, leads to chondromalacia [7]. This problem may develop if mild malalignment of the extensor mechanism is present or through overuse when anatomy and alignment are normal.

Functional Anatomy

The patellofemoral joint is a most incongruent diarthrodial plane synovial joint includes the trochlear surface of the distal anterior femur and the posterior surface of the patella. The patella is a largest sesamoid bone in the body. Geometrically, the patella is shaped like an upside down triangle with inferior surface is stated to as the apex and the superior patella is the base [8, 9]. It composed of a trabecular core with a thin cortical shell. The anterior surface of patella is convex in medio-latral and antero-posterior planes and the posterior surface is divided into a variety of facets. The posterior surface is covered by a thick articular cartilage and divided by centrally situated vertical ridge in two half medial and lateral half. The two halves can be further divided into seven convex facets, three horizontal pairs; proximal, middle and distally and an odd facet that is located on the far medial, posterior aspect of the patella [10, 11]. The distal femur forms into an inverted U-shaped intercondylar (trochlear sulcus) with concave lateral and medial facets covered by a thin layer of articular cartilage. As with the patella, the lateral facet of the femur is extends more proximally.[10] Stability of the patellofemoral joint is depends on static and dynamic soft tissue structure [9]. patellar tendon, joint capsule and ligaments provides static stability. The medial structures, medial patellofemoral ligament (MPFL) and medial mensico-patellar ligament both are acts as a primary and secondary restraint to minimize lateral translation [9, 12]. lateral side of the patellofemoral joint following structures provide stability: lateral patellofemoral ligament, joint capsule, iliotibial band (ITB) and lateral retinaculum [13]. Contractile structure of the quadriceps, pes anserine muscle group, and biceps femoris muscle help to maintain patellar alignment in dynamic conditions [13, 14]. The more oblique alignment (as compared to the vastus medialis longus) and attachment of VMO to the mid-portion of patella, the MPFL and adductor magnus tendon provides mechanical advantage to promote medial stabilizing force to the patella [15, 16]. The rectus femoris inserts on the anterior portion of superior aspect of patella and the vastus intermedius inserts posteriorly at the base of patella [16] and the vastus lateralis provides lateral dynamic reinforcement in conjunction with the ITB and the superficial oblique retinaculum [17]. Inferiorly, the patella is secured via the patellar tendon and its attachment to the tibial tubercle tightness in the ITB can cause the patella to glide and/or tilt laterally [18].

Pathomechanics

Patella serve as a mechanical pulley throughout knee range of motion during contraction of quadriceps muscle [19]. At full knee extension and between 90 and 120 degrees of flexion the patella provides 31% and 13% of total knee extension torque respectively. Due to its interposed position between the quadriceps tendon and femur it prevents excessive friction between the quadriceps tendon and the femoral condyles [20, 21]. Patellofemoral joint stability is based on the interplay among bony geometry, ligamentous retinacular restraints and muscles [21]. The static alignment of patella depends on the height of the lateral femoral condyle wall, depth of the femoral sulcus and the shape of patella [18]. In the frontal plane with full extension of the knee patella typically sits midway between the two condyles or a slight laterally deviated [22]. The patella is most mobile because its position superior to the trochlea and minimal contact exists between the patella and femur. The Q-angle commonly used clinically to identify the angle of quadriceps muscle pull. Normally, it is 10-13 and 15-17 degrees for male and females respectively. An increased Q-angle is thought to create excessive lateral forces on the patella through a bowstring effect [23]. Recently, studies have shown no association between the static Q-angle and patellofemoral kinematics or pain [24, 25]. Knee in slight flexion in sagittal plane, the apex of the patella rest just at or slightly proximal to the joint line. The length of the patellar tendon and the length of the patella approximately in 1:1 ratio is referred to as the Insall Salvati index. It is commonly used to measure patellar position in sagittal plane [26, 27]. A ratio of around 1.0 is considered normal. A ratio less than 0.80 and greater than 1.2 is suggestive of an inferior patella or “patellar baja” that may be due to a shortened patellar tendon and “patella alta” respectively [27]. If any deviation from normal of any surface of the patella either anterior or posterior is present, this is termed “tilt”. In the sagittal plane, location of the inferior pole of the patella in either a depressed (inferior tilt) or elevated (superior tilt) position. Pinch or irritate the patellar fat pad that lay underneath the patellar due to inferiorly tilted patella.[18] The patella should be lie horizontally in transverse plane such that the medial and lateral borders are equidistant from the femur. A lateral tilt, when the medial border is higher than the lateral border, can lead to lateral patellofemoral compression syndrome [28]. Rotation (medial/lateral) of the patella about an anteroposterior axis is referenced by the movements of the distal apex of the patella [29].

The dynamic movements patella tilts, patella shifts and rotation and accessory movements slide, spine and roll occurs in multiple axis and plan [29, 18]. During the OCC and CCC (Open and close kinematic Chain) movements, contact point between two surfaces and joint reaction forces changes with the flexion and extension. The stability of the patellofemoral joint depends on the three main elements bony geometry, ligamentous-retinacula restraints and muscles [30]. To optimal functions of the PFJ must able to control forces in sagittal and frontal planes. Hip and foot must control transverse plane forces through the PFJ. The quadriceps force of contraction, the sagittal plane angle of knee and the contact area between the patella and femur these three factors play important role in the sagittal plane

mechanics. The interaction between the force of the quadriceps muscle contraction and knee angle determines the compressive force between the patella and femur. It is known as patellofemoral joint reaction force [30, 31] increasing the quadriceps force of contraction and knee joint angle increases the PFJR force [30, 32]. The frontal plane forces that must be balanced by the extensor mechanism also originate from forces developed by the quadriceps muscle. During contraction of the quadriceps patella has the tendency to shift laterally. This lateralization is maintained by the (VMO) vastus medialis oblique muscle and static restraints of the medial portion of the extensor retinaculum [33-35]. The mechanism of PFPS is complex and varies on individual to individual. Several predisposing factors anatomic anomalies (e.g. hypoplasia of the medial patellar facet, patella alta), malalignment (hip abnormality, Q angle, pes planus, or subtalar pronation, ankle dorsiflexion, genu varum, and forefoot varus), muscle dysfunction (e.g. weakness in quadriceps or improper firing pattern), hypermobility of patellar, due to poor quadriceps, hamstring or iliotibial band flexibility, previous surgery, tight lateral structures (i.e. iliotibial band or lateral retinaculum), training errors or overuse, trauma and appear to development PFPS via alterations (biomechanics of the lower extremity static or dynamic), patellar tracking, increased patellofemoral joint forces, or combinations of these biomechanical features neurophysiological sources of pain in patients with PFP Psychological factors [36-38]. Causes of the PFPS with or without instability are idiopathic, congenital abnormality, inflammatory, neoplastic, degenerative, tight structure, overuse, traumatic, soft tissue dysfunction [39].

Sign and symptoms

The Patients with PFPS typically describe gradual onset, “achy,” but it can be sharp at times pain “behind,” “underneath,” or “around” the patella. Stiffness and pain both are the common symptoms on prolong siting with knee flexed referred as “theater sign” and pain also present with activities that load the patellofemoral joint, such as squatting, descending stairs, climbing or running. A “popping” or “catching” sensation may be described. Locking of the joint and swelling are not a symptoms it suggest other pathology of PFPS, although patients may report a sensation of stiffness, while knee is flexed [40]. Clinical methods of evaluation of PFPS are primarily based on symptom assessment, physical examination with functional tests, and then investigations like radiographs, arthroscopy, MRI etc. A primary goal of diagnosis is to match the patient's clinical presentation and determination of appropriate physical therapy management [39, 40]. The examiner in clinical evaluation of the presenting condition has to suspect that involvement of psychological, neurological factor, biomechanical dysfunction, compression issues, muscular dysfunction, overuse injury, trauma, soft tissue injury, malalignments syndrome, hip and foot disorder. Medical history is cornerstone of any examination and the knowledge about the mechanism of injury, symptoms’ onset, location, character or description, severity under different conditions, and any aggravating or alleviating factors will help with the diagnosis. To perfect diagnosis of PFPS, the examiner should need to proper clinical observation, examination includes inspection, palpation and special test of the normal and affected knee joint. The radiological examination consider the test for conformation of suspected information [41, 42].

Management

The management of PFPS is includes conservative, surgical and physiotherapy rehabilitation program depends on pathology and diagnosis of the PFPS. Reduction of load to Patellofemoral joint, cessation of specific strengthening exercises (squat, lunge) those produce repetitive injury should be avoided through the treatment. Application of the ice and other cold method may further reduce the symptoms but heat is generally not recommended [42]. Although commonly prescribed medicine are nonsteroidal anti-inflammatory drugs (NSAIDs) for patients with PFPS but evidence supporting their effectiveness is very less [43, 44]. It have been treated by various variety of sleeves, braces and straps. Although bracing alone may provide some symptomatic relief, three prospective randomized studies found no significant benefit when bracing was used in addition to physical therapy [45, 46]. To treat PFPS with improving alignment and quadriceps function patellar taping has been suggested as a best method. Although the results of some randomized clinical trials studies have not been consistent found no improvement when patellar taping was used as a program of physical therapy [47, 48].

Several studies have shown physical therapy effective to treating the PFPS [49]. The rehabilitation program is focus to correct the patella maltraking either the abnormality of tightness of soft tissues structure or quadriceps weakness with proper flexibility or strengthening program respectively [49, 50]. Some studies found that foot orthosis is also helpful for PFPS in malalignments and lower injury athletes [51]. Surgery is rarely indicated in PFPS to correct the malalignment. The following procedure performed arthroscopically: resection of the medial plicae, debridement of chondral lesions, partial synovectomy, and lateral release [52].

Taping is a frequently used treatment method for athletes with PFPS [53, 54]. Two taping techniques commonly used for anterior knee pain in the clinical setting include McConnell Taping (MT) and Kinsio-taping (KT) [55]. McConnell taping is a taping technique designed by an Australian PT by the name of Jenny McConnell in 1984 [56]. Utilized two types of tape. It correct the abnormal tilt and position of the patella. Laterally tracking patella are assisted to shift medially. McConnell Taping decreases pain during physical activity, correct patella alignment, improve activation of VMO (Vastus Medialis Oblique) and allow earlier return to activity [55, 56]. The MT is structurally supportive and uses a tape that is rigid, highly adhesive, and can be worn for up to 18 hours. It has been described in some studies to regulate the mediolateral pulling force of the patella, reduce anterior knee pain, improve joint alignment and facilitate the vastus medialis oblique (VMO) activity relative to vastus lateralis. These results indicates taping techniques biomechanical effects and neuromotor effects [57]. Although it has been reported to reduce pain and improve function in people with patellofemoral pain syndrome during activities of daily living [55].

Kinesio-tape (KT), created by Kenzo Kase in 1996, is thin, cotton, porous fabric with acrylic adhesive that is non-mediated and latex-free. The method incorporates special tape product plus different techniques for various conditions. The elastic tape KT is unique in that it can

stretch to 130-140% of its static length; theoretically allowing full range of motion while the muscle is placed on gentle functional stretch during the application. It can be applied for 3-5 days [55].

Systemic review and Meta-analysis has shown Kinesio taping increases muscle flexibility, improves motor function, moderate effect on muscle activity and a small effect on pain reduction [53, 58]. It gathers fascia to align tissue in the desired position, activation of the circulation (blood / lymph) by lifting the skin over areas of inflammation, pain and edema, deactivation of the pain system by stimulating cutaneous mechano receptors, supporting the function of the joints by stimulating proprioceptors, connecting the direction of movement and increasing stability and segmental influences [59].

Hop test (Single leg Triple Jump)- Hop function test is consists of single leg triple jump test, single leg 6m timed hop, triple hop for distance, cross over hop for distance. It is a valid and reliable tool [60] commonly used clinically as a functional test to determine an individual's readiness to return to play after injury, illness or postoperative knee patients [61, 62] It require minimal equipment, time and allow one to use the contra lateral limb as a references for comparison in sport rehabilitation to predict the lower extremity functional performance strength, power, balance and coordination of the injured athletes [62-64]. In healthy populations, functional tests can be used to detect abnormal limb symmetry or weakness [65]. In this test standard cloth tape measure to the ground, perpendicular to a starting line participants stand on the designated testing leg, with the great toe on the starting line then perform three consecutive hops forward on the same limb with arm swing allow. Then measure the distance hop from the starting line to the point where the heel struck the ground upon completing the third hop. The athlete's should be warm properly and athlete's practice for three trial before the hop test. If the athlete's unable to complete a triple hop without losing balance and contacting the ground with the opposite leg the trial is repeats. After third trial maximum distance measure in centimeter and used for analysis [66].

VAS scale (Visual analog scale)-It is more reliable, valid, responsive and commonly used to measure intensity of pain in clinical practice compare to other score numerical rating scale, verbal rating scale [67]. It includes a bidirectional 10 cm straight line with two labels, that is, "no pain" and "worst possible pain", located at either end of the line. According to patients vertical mark on the line indicating decides the intensity of the pain [68].

Although taping techniques are used in clinical practice, there is limited scientific evidence evaluating the effectiveness of the KT and MT in pain and hop function activity in patellofemoral pain syndrome subjects. Therefore the purpose of this study is compare the Immediate effect of patellar Kinesio taping versus McConnell taping on pain and hop function activity in subject with patellofemoral pain syndrome.

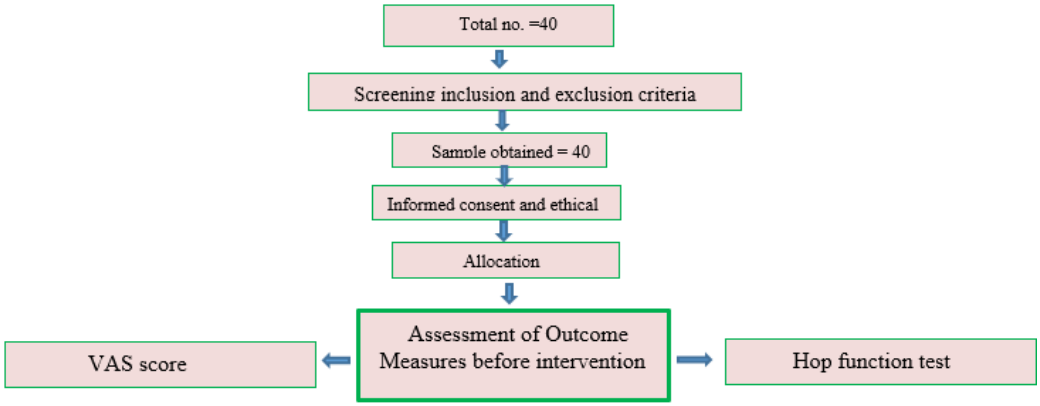
Methods

A pre and post comparative study of 40 subjects (both male and female) using convenient sampling and allocation with chit method was done. Subjects which were suffered from patella femoral pain syndrome aged between 16-30 years included according to inclusion and exclusion criteria. The intervention both Kinesio taping and McConnell taping were implemented once. Pain status was checked with VAS score in subjects before and immediately after intervention at rest and along with three functional activity (step up, squatting, step down), associated with PFPS and functional performance measured with Hop test (single leg triple jump test). The inclusion criteria for this study were both male and female suffered from patellofemoral pain syndrome age between 16-30 years and BMI<30, who those willing to participate in this study, anterior knee pain in one or both knees lasting past greater than 4 weeks, additional inclusion requirement included 2 or more of the following pain complaints; (Ascending/Descending stairs, squatting, sitting with knee bent greater than 15 minute, running, jumping or hopping), [69] subjects not undergone any other form of physical therapy or on analgesics in past 2 weeks [55]. and exclusion criteria for this study who were previous patellar subluxation or dislocation, patellar fracture, knee surgery within the past 2 years, systemic disease, adhesive allergies, diagnosed soft tissue disorder, pregnancy, neurological impairment that impede physical activity, patellar tendonitis. Epiphyseal stress syndrome of knee, internal derangement or ligamentous injury of knee and any infection.

Outcome Measures

VAS-Visual analog scale (universal pain rating scale, 10 point) used to measure pain because of its sensitivity and specificity [67, 68].

Hop function test (Single leg triple jump test)-It is a reliable tool commonly used in sport rehabilitation to measure the performance of the athlete's [60]. As the study includes human subjects ethical clearance is received from Institutional Ethical Committee of K.T.G. College of physiotherapy and K.T.G. Hospital Bangalore. As per the ethical guidelines for Bio-medical research on human subjects, 2000 ICMR, New Delhi.



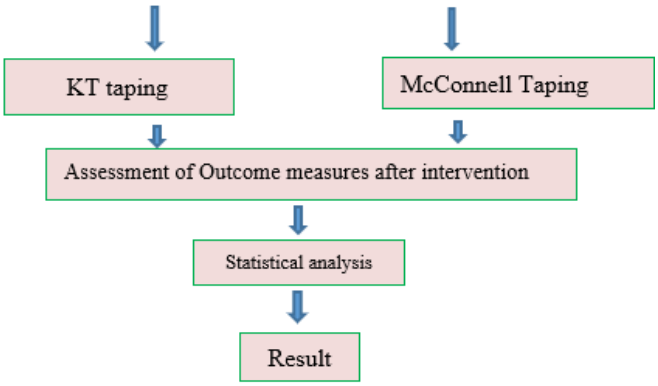


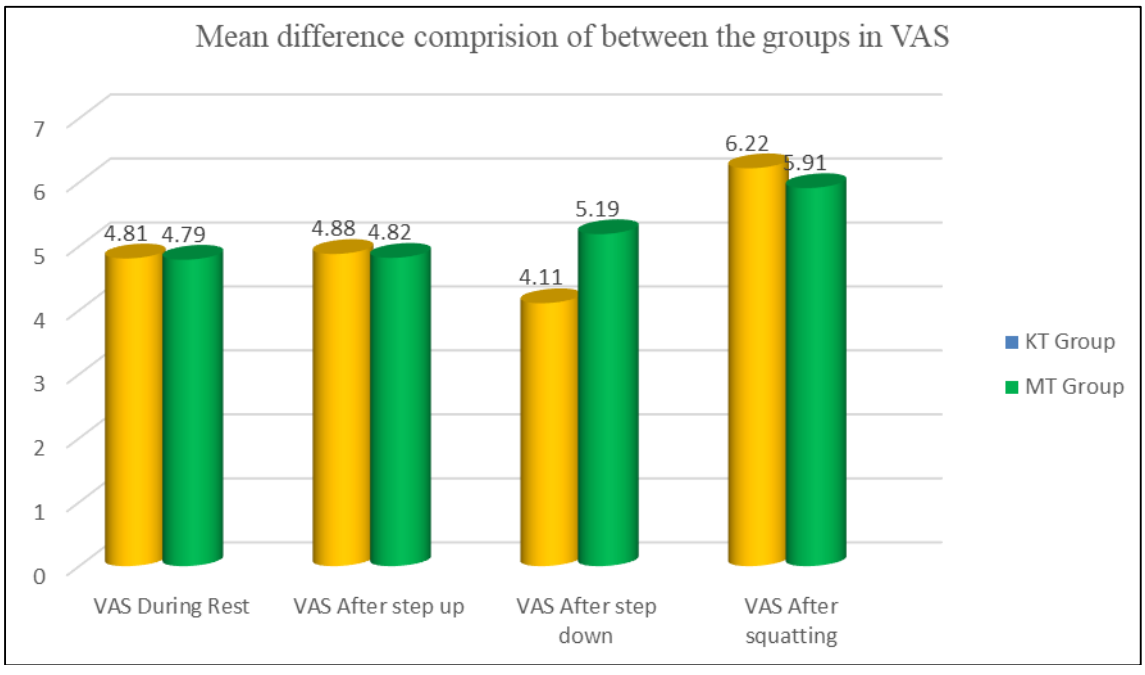
Fig 1: Flow chart representing the procedure of selection of patients

Results

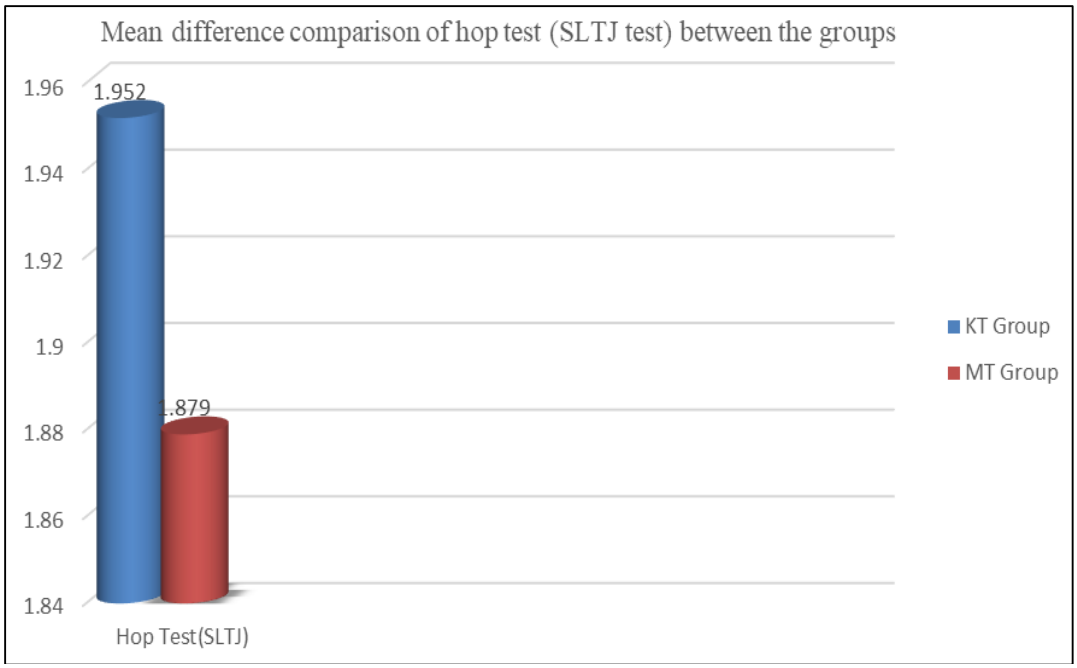
Data was analyzed by Paired and Unpaired t test. Pearson Chi-Square test, Wilcoxon signed rank test, Mann Whitney U test. All statistical analysis was done with utilizing SPSS-18.20 software, excel sheet and $p<0.05$ is considered as level of significance. VAS during rest: The mean difference in KT-group and MT-group after intervention was 4.81±0.9 4.79±1.161 respectively. VAS After step up: The mean difference in KT-group and MT-group after intervention was 4.88±0.84 and 4.82±1.109 respectively. VAS After step down: The mean difference in KT-group and MT-group after intervention was 4.11±0.69 and 5.19±1.147 respectively. VAS After squatting: The mean difference in KT-group and MT-group after intervention was 6.31±0.89 and 5.91±0.924 respectively. Hop Test: The mean difference in KT-group and MT-group after intervention was 1.96±18.9 and 1.88±24.05 respectively.

Table 1: Mean difference comparison of VAS score during rest, after step up, after step down, squatting and hop test (single leg triple jump test) in both groups.

Outcome Measure	Groups	Pre	Post	MD (Mean Difference)	Z value and p-value	t-value
VAS During Rest	KT Group	4.81±0.9	3.81±0.83	4.81±0.9	-3.938 P <0.000	22.049
	MT Group	4.79±1.161	3.82±1.19	4.79±1.161	-3.938 P <0.000	18.524
VAS After step up	KT Group	4.88±0.84	3.79±0.82	4.88±0.84	-3.938 P <0.000	15.759
	MT Group	4.82±1.109	3.60±1.29	4.82±1.109	-3.938 P <0.000	5.635
VAS After step down	KT Group	4.11±0.69	3.78±0.80	4.11±0.69	-3.938 P <0.000	4.173
	MT Group	5.19±1.147	3.91±1.21	5.19±1.147	-3.938 P <0.000	14.308
VAS After Squatting	KT Group	6.215±0.89	4.430±0.668	6.31±0.89	-3.938 P <0.000	10.615
	MT Group	5.91±.924	4.31±1.18	5.91±.924	-3.938 P <0.000	12.691
Hop test (SLTJ)	KT Group	1.95±18.88	2.11±15.27	1.96±18.9	-3.938 P <0.000	-8.501
	MT Group	1.879±24.05	2.092±22.035	1.88±24.05	-3.938 P <0.000	-14.547



Graph 1: Mean difference comparison of VAS score between the groups.



Graph 1: Mean difference comparison of hop test (SLTJ test) between the groups.

Discussion

The results of this study indicates that, there was no statistically significant difference between KT group and MT group after intervention to reducing pain and increasing hop function activity in patellofemoral pain syndrome (PFPS). However there was a significant difference to reduce the pain within the group. VAS during rest: Values in KT-group mean difference after intervention was 4.81±0.9 and MT-group mean difference after intervention was 4.79±1.161. VAS After step up: Values in KT-group mean difference after intervention was 4.88±0.84 and MT-group mean difference after intervention was 4.82±1.109. VAS After step down: Values in KT-group mean difference after intervention was 4.11±0.69 and MT-group mean difference after intervention was 5.19±1.147. VAS After squatting: Values in KT-group mean difference after intervention was 6.31±0.89 and MT-group mean difference after intervention was 5.91±0.924. Hop test (SLTJ test): Values in KT-group mean difference after intervention was 1.952±18.9 and MT-group mean difference after intervention was 1.879±24.05. Marc Campolo *et al.* compared the effects of KT and McConnell taping in squatting, stair ascent, descent and found that both may be effective in reducing pain during stair climbing activities. A study have been found that decreased pain from pre-treatment measures during most functional activities for both KT and placebo effect, which showed useful in reducing knee pain. Lee. *et al.*, found the KT application in physically active PFPS patients useful in decreasing pain and increasing knee extensor strength and endurance in the short term during the execution of functional performance tasks [55, 70].

In kinesio taping group, the immediate effects of KT tape can be due to needed mechanical support to the medial ligaments of the patellofemoral joint. It lifts the skin and increase the space between the skin and muscle, due to reduce the pressure under KT strip promotes circulation and lymphatic drainage.

As a result, it reduces pain, swelling and muscle spasm. It also reduces pain through neurological suppression. Pain modulation via the gate control is one of the proposed theories as it stimulates neuromuscular pathways via increased afferent feedback. It provides immediate sensorimotor feedback, and patients often report symptom relief, improved comfort level or stability of the involved joint. Thus, It has been theorized to be an effective treatment to restore muscle function and decrease pain in PFPS subjects [70].

Although our study does not provide information about the mechanism of action or change, it does suggest that patellar KT technique can significantly reducing pain in VAS during rest, step up, step down, squatting and increase hop function activity (single leg triple jump test) in subjects with patella femoral pain syndrome.

MT group showed that there was statistically significant negative percentage of changes were found in VAS score during rest, step up, step down, squatting and positive percent of changes in hop test (single leg triple jump test) respectively. There is a clinical significant effect with large effect size in squatting and medium effect size in VAS in rest, step up, step down, and hop test.

Immediate post VAS scores improvement in VAS score and hop test can be due to medial glide technique that is proposed to have three effects: patellar glide, patellar tilt, and patellar rotation. In PFPS patients, the femur tends to adduct relative to a stable patella during movement. Inferiorly shifting the patella within the femoral groove decreases the patellofemoral contact area which decreases contact stress at the patellofemoral joint by spreading out the load over a wider area. Therefore, similar improvements from McConnell taping that obtained in the present study, also relates to finding of previous studies [70].

Bockrath *et al.* stated that patellar tape may elicit neural inhibition by facilitating large afferent fiber input. Herrington proposed that patellar taping may lead to altered large fiber afferent input to the dorsal horn, decreasing the perceived pain that may be contributing to quadriceps inhibition. Additionally, cutaneous stimulation from the patellar tape may change the order and timing of motor unit recruitment. The earlier activation of the VMO allows for a

more optimal positioning of the patella into the trochlea which may help to improve the timing of force distribution and decrease the pressure placed on a particular portion of the articular cartilage [70, 71].

This study found that the groups showing no significant difference between the groups. One reason for no significant difference in patellar kinesio taping and patellar McConnell taping was both give support to knee joint. KT tape can give due to needed mechanical support to the medial ligaments of the patellofemoral joint. The tape lifts the skin and increases the spaces between the skin and muscle, hence reducing the pressure under KT strip and promoting circulation and lymphatic drainage. As a result, it reduces pain, swelling and muscle spasm. And McConnell taping immediate post VAS scores improvement can be due to medial glide technique that is proposed to have three effects: patellar glide, patellar tilt, and patellar rotation. In PFPS patients, the femur tends to adduct relative to a stable patella during movement. Inferiorly shifting the patella within the femoral groove decreases the patellofemoral contact area which decreases contact stress at the patellofemoral joint by spreading out the load over a wider area [16, 70].

Hence based on the analysis and findings, the present study found that patellar Kinesio taping technique and patellar McConnell taping technique found statistically no significant difference on pain VAS during rest, step up, step down, squatting and hop function (single leg triple jump test) in subject on patella femoral pain syndrome (PFPF). Therefore the study accepts null hypothesis.

Limitations of the study

- Subjects with 16-30 years of age were considered for study thus results cannot be generalized to all age group.
- No follow-up was done after one week of intervention that would have helped to find the maintenance of the improved outcome measures.
- It is difficult to determine the long term effect of kinesio taping and McConnell taping because only the immediate effects were observed.
- This study not shown mechanics of action or action of patella kinesio taping and McConnell taping technique perfectly.

Recommendation for future research

- Further study is recommended to find long term effects of patellar Kinesio taping versus McConnell taping on pain and hop function activity on subjects with patellofemoral pain syndrome.
- Further study on other techniques needed to find the effect for individual with patello femoral pain syndrome.
- Further study on long term effect of both techniques in individual with patella femoral pain syndrome.
- A larger sample size should be used to see the actual effects of taping on PFPS. Effects of these techniques are need to be find out using objective and functional outcome measures.
- Further study should needed measuring effect on other outcome measurements.

Conclusion

The present study concludes that both kinesio taping and McConnell taping techniques are effective on reducing pain in functional activity during rest, step up, step down squatting and also improving hop function activity in patellofemoral pain syndrome.

Competing interests: None

References

1. Juhn M *et al.* Patellofemoral pain syndrome: A Review and guidelines for treatment. American family physician. 1999; 60(7):2012-2018.
2. Naoko Aminaka, Phillips A *et al.*; Systemic review of the effects of therapeutic taping on patellofemoral pain syndrome. Journal of athletic training. 2005; 40(4):341-351.
3. Robbart Van Linschoten, Marienke Van Middlekoop, Edith M Heintjes *et al.* Exercise therapy for patellofemoral pain syndrome. Br J Sports Med. 2011, 9.
4. Dutton M. Orthopedics for the Physical Therapist Assistant. Jones and Bartlett Learning, Mississiauga, Canada 2012, 540-542.
5. Dixit S, Difiori John *et al.*; management of patellofemoral pain syndrome: American family physician. 2007; 75(2):194-202.
6. Marsha Rutland, Jean-michel Brismée, Gail Apte, Janelle O'connell *et al.* Clinical commentary evidence–supported rehabilitation of patellar tendinopathy: North American journal of sports physical therapy. 2010; 5(3):166.
7. Kent Davidson *et al.*; Patellofemoral pain syndrome. American family physician. 1993; 48:7.
8. Tria AJ, Palumbo RC, Alicea JA *et al.*; Conservative care for patellofemoral pain: Orthop Clin North Am. 1992; 23(4):545-554.
9. Reider B, Marshall JL, Koslin B, Ring B, Girgis FG *et al.*; The anterior aspect of the knee joint; J Bone Joint Surg Am. 1981; 63(3):351-356.
10. Grelsamer RP, Klein JR. The biomechanics of the patellofemoral joint: J Orthop Sports Phys Ther. 1998; 28(5):286-298.
11. Kwak SD, Colman WW, Ateshian GA, *et al.*: anatomy of human patellofemoral joint articular cartilage surface curvature analysis; J Orthop Res. 1997; 15:468.
12. Desio SM, Burks RT, Bachus KN *et al.*: Soft tissue restraints to lateral patellar translation in the human knee; Am J Sports Med. 1998; 26(1):59-65.
13. Powers CM, Landel R, Perry J *et al.*; Timing and intensity of vastus muscle activity during functional activities in subjects with and without patellofemoral pain; Phys Ther; 1996; 76(9):946-955, 956-967.
14. Lack S, Barton C, Vicenzino B, Morrissey D *et al.*: Outcome predictors for conservative patellofemoral pain management: a systematic review and meta-analysis. Sports Med Auckl NZ. 2014; 44(12):1703-1716.
15. Goh JC, Lee PY, Bose K. A cadaver study of the function of the oblique part of vastus medialis; J Bone Joint Surg Br. 1995; 77(2):225-231.
16. Lieb FJ, Perry J. Quadriceps function. An anatomical and mechanical study using amputated limbs. J Bone Joint Surg Am. 1968; 50(8):1535-1548.
17. Terry GC, Hughston JC, Norwood LA. The anatomy of the iliopatellar band and iliotibial tract. Am J Sports Med. 1986; 14(1):39-45

18. Loudon Janice K. Biomechanics and pathomechanics of the patellofemoral joint; The International Journal of Sports Physical Therapy. 2016; 11:6 820.
19. Huberti HH, Hayes WC. Patellofemoral contact pressures. The influence of q-angle and tendofemoral contact; J Bone Joint Surg Am. 1984; 66(5):715-724.
20. Steinkamp LA, Dillingham MF, Markel MD, Hill JA, Kaufman KR *et al.*: Biomechanical considerations in patellofemoral joint rehabilitation. Am J Sports Med. 1993; 21(3):438-444.
21. Hungerford DS, Barry M. Biomechanics of the patellofemoral joint. Clin Orthop. 1979; (144):9-15.
22. Powers CM, Ward SR, Fredericson M, Guillet M, Shellock FG *et al.* Patellofemoral kinematics during weight-bearing and non-weight-bearing knee extension in persons with lateral subluxation of the patella: a preliminary study; J Orthop Sports Phys Ther. 2003; 33(11):677-685.
23. Witvrouw E, Lysens R, Bellemans J, Cambier D, Vanderstraeten G *et al.* Intrinsic risk factors for the development of anterior knee pain in an athletic population. A two-year prospective study; Am J Sports Med. 2000; 28(4):480-489.
24. Freedman BR, Brindle TJ, Sheehan FT. Re-evaluating the functional implications of the Q-angle and its relationship to in-vivo patellofemoral kinematics; Clin Biomech Bristol Avon. 2014; 29(10):1139-1145.
25. Silva D de O, Briani RV, Pazzinatto MF. Q-angle static or dynamic measurements, which is the best choice for patellofemoral pain? Clin Biomech Bristol Avon. 2015; 30(10):1083-1087.
26. Schlenzka D, Schwesinger G. The hight of the patella: An anatomical study; Eur J Radiol. 1990; 11:19.
27. Insall J, Salvati E. Patella position in the normal knee joint. Radiology. 1971; 101(1):101-104.
28. Zhang D, Wu Z, Zuo X, Li J, Huang C *et al.* Diagnosis and treatment of excessive lateral pressure syndrome of the patellofemoral joint caused by military training; Orthop Surg. 2011; 3(1):35-39.
29. Bull AM, Katchburian MV, Shih YF *et al.* standardization of the description of patellofemoral motion and comparison between different techniques; Knee surg sports Tramatol Arthosec. 2002; 10:184.
30. Pamela K levangie, Cynthia C Norkin. The knee in; Erin hartigan, Michael lewek and lynn Snyder Mackler; Joint structure and function; 5th edition A comprehensive analysis, 2012, 426-427.
31. Hungerford DS, Barry M. Biomechanics of the patellofemoral joint. Clin. Orthop. Relat. Res. 1979; 144:9-15.
32. Steinkamp LA, Dillingham MF, Markel MD *et al.* Biomechanical considerations in patellofemoral joint rehabilitation. Am. J Sports Med. 1993; 21:438-444.
33. Reilly DT, Martens M. Experimental analysis of the quadriceps muscle force and patellofemoral joint reaction force for various activities. Acta Orthop. Scand. 1972; 43:126-137.
34. Fulkerson JP, Hungerford DS. Biomechanics of the patellofemoral joint. In: Disorders of the Patellofemoral Joint, 2nd ed. Baltimore, Williams & Wilkins. 1990, 25-39.
35. Goh JC, Lee PYC, Bose K. A cadaver study of the function of the oblique part of vastus medialis. J. Bone Joint Surg. Br. 1995; 77:225-231.
36. Lieb FJ, Perry J. Quadriceps function: An anatomical and mechanical study using amputated limbs. J. Bone Joint Surg. Am. 1968; 50:1535-1548
37. Cutbill JW, Ladly KO, Bray RC, Thorne P, Verhoef M *et al.* Anterior knee pain: a review. Clin J Sport Med. 1997; 7:40-5.
38. Lun V, Meeuwisse WH, Stergiou P, Stefanyshyn D *et al.* Relation between running injury and static lower limb alignment in recreational runners.Br J Sports Med 2004; 38:576-80
39. Witvrouw E, Lysens R, Bellemans J, Cambier D, Vanderstraeten G *et al.* Intrinsic risk factors for the development of anterior knee pain in an athletic population. A two-year prospective study. Am J Sports Med. 2000; 28:480-9.
40. Brukner P, Khan K, McConnell J, Cook J. Anterior knee pain. In: Brukner P, Khan K. Clinical Sports Medicine. 2nd ed. New York, N.Y.: Mc Graw Hill, 2002, 464-93.
41. Post WR. Clinical evaluation of patients with patellofemoral disorders. Arthroscopy 1999; 15:841
42. Robert C Manske, George J Davies. Clinical Commentary Examination Of The Patellofemoral Joint The International Journal of Sports Physical Therapy; December 2016; 11(6):831.
43. Sameer Dixit, John P Difiori, Monique Burton. Brandon mines: Management of Patellofemoral Pain Syndrome; American Family Physician. 2007; 75:2.
44. Heintjes E, Berger MY, Bierma-Zeinstra SM, Bernsen RM, Verhaar JA, Koes BW. Pharmacotherapy for patellofemoral pain syndrome. Cochrane Database Syst Rev. 2004; (3):CD003470.
45. Petersen W, Ellermann A, Gösele-Koppenburg A *et al.* Patellofemoral pain syndrome. Knee Surg Sports Traumatol Arthrosc. 2014; 22(10):2264-2274.
46. Finestone A, Radin EL, Lev B, Shlamkovitch N, Wiener M, Milgrom C. Treatment of overuse patellofemoral pain. Prospective randomized controlled clinical trial in a military setting. Clin Orthop Relat Res. 1993; 293:208-10.
47. Lun VM, Wiley JP, Meeuwisse WH, Yanagawa TL *et al.* Effectiveness of patellar bracing for treatment of patellofemoral pain syndrome. Clin J Sport Med. 2005; 15:235-40.
48. Clark DI, Downing N, Mitchell J, Coulson L, Syzpryt EP, Doherty M *et al.* Physiotherapy for anterior knee pain: a randomised controlled trial. Ann Rheum Dis 2000; 59:700-4.
49. Whittingham M, Palmer S, Macmillan F *et al.* Effects of taping on pain and function in patellofemoral pain syndrome: a randomized controlled trial. J Orthop Sports Phys Ther. 2004; 34:504-10.
50. Natri A, Kannus P, Jarvinen M. Which factors predict the long-term outcome in chronic patellofemoral pain syndrome? A 7-yr prospective follow-up study. Med Sci Sports Exerc. 1998; 30:1572-7.
51. Witvrouw E, Danneels L, Van Tiggelen D, Willems TM, Cambier D. Open versus closed kinetic chain exercises in patellofemoral pain: a 5-year prospective randomized study. Am J Sports Med. 2004; 32:1122-30.
52. Kannus P, Niittymaki S. Which factors predict outcome in the nonoperative treatment of patellofemoral pain

syndrome? A prospective follow-up study. Med Sci Sports Exerc. 1994; 26:289-96.
53. Kettunen JA, Harilainen A, Sandelin J *et al*. Knee arthroscopy and exercise versus exercise only for chronic patellofemoral pain syndrome: a randomized controlled trial. BMC Med. 2007; 5:38-45.
54. Chang WD, Chen FC, Lee CL, Lin HY, Lai PT. Effects of Kinesio Taping versus McConnell Taping for patellofemoral pain syndrome: a systematic review and meta-analysis. Evid Based Complement Alternat Med. 2015; 2015:471208.
55. Barton C, Balachandar V, Lack S, Morrissey D. Patellar taping for patellofemoral pain: a systematic review and meta-analysis to evaluate clinical outcomes and biomechanical mechanisms. Br J Sports Med. 2014; 48(6):417-424.
56. Marc Campolo, Jenie Babu. A comparison of two taping techniques kinesio and McConnell and their effort on anterior knee pain during functional activities. The international journal of sports physical therapy. 2013; 8(2):105.
57. Callaghan MJ, Selfe J. Patellar taping for patellofemoral pain syndrome in adults. Cochrane Database Syst Rev. 2012; 4:CD006717.
58. Barton C, Balachandar V, Lack S, Morrissey D. Patellar taping for patellofemoral pain: a systematic review and meta-analysis to evaluate clinical outcomes and biomechanical mechanisms. Br J Sports Med. 2014; 48(6):417-424.
59. Osorio JA, Vairo GL, Rozea DG *et al*. The effects of two therapeutic patellofemoral taping techniques on strength, endurance, and pain responses. Phys Ther Sport. 2013; 14(4):199-206.
60. Fahad Albahel, Ashraf Ramadan Hafez. Kinesio taping for treatment of mechanichal low back pain. world Applied science Journal. 2013; 22(1):78-84.
61. Andrea Reid, Trevor B Birmingham, Paul W Stratford, Greg K Alcock. J Robert Giffin: Hop Testing Provides a Reliable and Valid Outcome Measure During Rehabilitation After Anterior Cruciate Ligament Reconstruction Physical Therapy. 2007; 87(3):337-349.
62. Daniel DM, Malcolm L, Stone ML, Perth H, Morgan J, Riehl B. Quantification of knee stability and function. Contemp Orthop. 1982; 5(1):83-91.
63. Daniel DM, Stone ML, Riehl B, Moore MR *et al*. A measurement of lower limb function: the one-leg hop for distance. Am J Knee Surg. 1988; 1(4):212-214.
64. Noyes FR, Barber SD, Mangine RE. Abnormal lower limb symmetry determined by function hop tests after anterior cruciate ligament rupture. Am J Sports Med. 1991; 19(5):513-518.
65. Ross MD, Langford B, Whelan PJ. Test-retest reliability of 4 single leg horizontal hop tests. J Strength Cond Res. 2002; 16(4):617-622.
66. Ostenberg A, Roos E, Ekdahl C, Roos H. Isokinetic knee extensor strength and functional performance in healthy female soccer players. Scand J Med Sci Sports. 1998; 8(5, pt.1):257-264.
67. Bolgla LA, Keskula DR. Reliability of lower extremity functional performance tests. J Orthop Sports Phys Ther. 1997; 26(3):138-142.
68. Ahmad H Alghadir, Shahnawaz Anwer, Amir iqbal Zaheen, Ahmed Iqba *et al*. Test–retest reliability, validity, and minimum detectable change of visual analog, numerical rating, and verbal rating scales for measurement of osteoarthritic knee pain; Journal of Pain Research. 2018; 11:851-856.
69. Hjermstad MJ, Fayers PM, Haugen DF *et al*. Studies comparing numerical rating scales, verbal rating scales, and visual analogue scales for assessment of pain intensity in adults: a systematic literature review. J Pain Symptom Manage. 2011; 41(6):1073-1093.
70. Scott R Freedman, Lori Thein Brody, Michael Rosenthal, Justin C. Wise: Short-Term Effects of Patellar Kinesio-Taping on Pain and Hop Function in Patients With Patellofemoral Pain Syndrome; sports physical therapy, 2014.
71. Sai Kumar N, Vinod Babu KVR, Ayyappan Stuti Ragesh Shah. Immediate effect of kinesio v/s Mc Connell taping on patellofemoral pain syndrome during functional activity Acomparative study Int. J Physiother. 2015 2(6):1077-1084.
72. Kelly Bockrath, Cindi Wollen, Teddy Worell. Effect of Patellofemoral taping on patella position and perceived pain. Med. Sci. Sports Exerc. 1993; 25(9):989-992.