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EFFECTS OF KINESIO TAPING WITH CONVENTIONAL PHYSIOTHERAPY ON PATELLOFEMORAL PAIN SYNDROME AMONG UNIVERSITY FOOTBALL PLAYERS

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Abstract

Introduction. Patellofemoral pain syndrome (PFPS) is a common musculoskeletal condition among sports players, often resulting in anterior knee pain and functional limitations. While conventional physiotherapy remains a cornerstone of treatment, Kinesio Taping (KT) has emerged as a complementary approach aimed at enhancing rehabilitation outcomes. The present study aimed to investigate the effect of KT combined with conventional physiotherapy versus conventional physiotherapy alone in improving pain and performance measures in football players with PFPS. ***Material and Methods.*** The present quasi experimental study included 52 football players aged 18-25 years with PFPS. They were divided into two groups (n = 26 each). KT group received KT with conventional physiotherapy, while conventional group received physiotherapy alone. The intervention was administered three times a week for four weeks. Outcome measures included pain, speed, agility, vertical jump height, dynamic balance and Kujala Anterior Knee Pain Scale (KAKPS) score. ***Results.*** KT group exhibited significant improvements in all variables ($p < 0.05$) at a confidence interval of 95%. VAS improved from 6.15 ± 1.04 to 2.23 ± 0.95, speed improved from 4.73 ± 0.31 to 4.65. There was also an improvement in agility (12.18 ± 0.62 to 12.07 ± 0.64), vertical jump height (43.17 ± 6.20 to 46.82 ± 6.68), Y balance score (77.44 ± 2.36 to 84.61 ± 3.55) and Kujala score (61.08 ± 3.97 to 91.27 ± 4.41). Conventional group also showed statistically significant differences in all variables except agility. On comparison, KT group showed statistically superior outcomes ($p < 0.05$) in pain intensity, speed, balance and Kujala score (effect size: 1.22, 0.82,1.24 and 0.62, respectively) relative to conventional group. ***Conclusions.*** Kinesio Taping, when combined with conventional physiotherapy, significantly improved pain reduction, speed, balance and Kujala score compared to conventional physiotherapy alone.

Keywords: Patellofemoral pain syndrome, Kinesio Taping, VAS, Kujala, speed, balance, agility, vertical jump height

Introduction

Patellofemoral pain syndrome (PFPS) is defined as an anterior knee pain originating from the patellofemoral joint, often exacerbated by activities that increase stress on the knee such as squatting, stair climbing, or prolonged sitting. It is characterized by pain around or behind the patella, typically without structural damage to the joint [1]. PFPS stands out as a frequently diagnosed condition among adolescents and adults presenting with knee concerns, constituting around 25% of knee disorders identified in sports medicine clinics [2]. As a result, physical therapy, incorporating exercises to strengthen and stretch the hip and quadriceps muscles, has become an essential component in the management of PFPS [2].

Various causes have been proposed for the development of patellofemoral pain syndrome (PFPS) that include a combination of overuse, imbalances in musculoskeletal strength, and anatomical variations that result in patellar maltracking and increased forces on the knee [3]. The Vastus Medialis Oblique (VMO) acts as a dynamic medial stabilizer of the patella, helping to alleviate symptoms of PFPS. In other words, lateralization of the patella, or "patella maltracking," can result from insufficient and delayed VMO activation, which subsequently impairs the knee joint function [2]. The malalignment of the patella disrupts the biomechanics of the extensor mechanism, thus contributing to abnormal movement patterns [3]. Development of PFPS can also be attributed to stimulation of nerve endings within the retinacula, infrapatellar fat pad, and peripatellar synovium [4]. Thus, leading causes of PFPS include altered biomechanics of lower limbs due to muscular imbalance, patellar malpositioning, impairment of proprioception, and inflammation of soft tissues [5, 6, 7].

As PFPS is complex, its treatment can be clinically challenging. Numerous therapeutic approaches, such as electrotherapy modalities, stretching and strengthening exercise, balance training, patellar bracing, patellar mobilization, biofeedback training, etc., have been used to treat PFPS. Athletes, however, typically favor therapy approaches that do not interfere with their participation in sports [8].

Conventional physiotherapy is extensively utilized for the management of PFPS due to its ability to address both the biomechanical and neuromuscular contributors to the condition. This multifaceted approach typically includes a combination of strengthening exercises, stretching routines, manual therapy, proprioceptive training, and patient education. These components work synergistically to improve muscle balance, enhance joint stability, restore normal movement patterns, and ultimately alleviate patellofemoral joint stress [9].

Over the years, the application of taping is extensively used for injury prevention in athletes. Evidence suggests that Kinesio Taping (KT) contributes to pain reduction, improved muscle strength, and an increased pain-free range of motion [10]. Notably, knee pain is the reason why about 25% of recreational athletes with PFPS stop participating in sports [11]. However, only

a few studies have examined KT in athletic populations especially where a combination of KT with conventional physiotherapy is used. This study addresses that gap. KT may serve as a valuable adjunct to conventional physiotherapy, complementing exercise-based interventions to enhance pain relief in individuals with PFPS. Exercise treatment may help people with PFPS with their discomfort and activity limitations, according to a number of studies [12].

This study hypothesized that Kinesio Taping in conjunction with conventional physiotherapy would result in greater improvement in pain, function, and performance outcomes compared to conventional physiotherapy alone in football players with patellofemoral pain syndrome.

Material and Methods

The present quasi experimental study was conducted at a private university. Fifty-two football players aged 18-25 years were recruited for the study. Sample size was calculated using G power software. The subjects were chosen as per the selection criteria given below:

Inclusion Criteria [13]

1. Diagnosed cases of PFPS with Kujala score between 50-70
2. Amateur football players participating in game at least 3 times/week
3. Football players aged 18-25 years
4. Football players with BMI of 18.5-24.9 kg/m²

Exclusion criteria [13]

1. Football players undergoing higher level sports training
2. A previous history of knee injuries
3. Infectious disease of the knee joint
4. Presence of systemic diseases
5. Acute injuries of lower limb

Before starting with the interventions, the entire procedure was explained to all the participants and an informed written consent was obtained from them. The study was approved by the institutional ethics committee (Ref. No. SU/SMS&R/76--A/2024/296) and it was undertaken in compliance with the Helsinki Declaration. All the participants underwent a general training programme twice a week, consisting of a combination of aerobic, resistance, flexibility and agility exercises. The participants were instructed to avoid any vigorous exercise for at least 48 hours and not to eat a heavy meal prior to fitness testing. All the participants performed a general warm-up of 5 minutes (jogging and stretching), after which the following outcome measures were recorded:

1. **Pain:** It was measured using visual analog scale [14] at rest prior to a warm-up. The participant marked a point on a 10 cm (100 mm) line representing the pain intensity, with "no pain" at one end and "worst possible pain" at the other. Then the distance in millimeters from the "no pain" end to the participant‘s mark was measured to obtain a score. Scores were interpreted as follows: 0-4 mm (or 0-4) is no pain, 5-44 mm (1-4) is mild pain, 45-74 mm (5-6) is moderate pain, and 75-100 mm (7-10) is severe pain. The maximum value of pain reported by the participant was noted.
2. **Vertical Jump Height:** Countermovement jump method was used for the estimation of vertical jump height. To measure this, the participants stood with their feet flat on the floor while standing and positioning themselves on the free wall's side. Then they were asked to extend the dominant hand to the maximum reachable height which was recorded as the standing reach height. The participants were then instructed to move away from the free wall and leap as high as they could while using both hands and legs to help drive their bodies forward. The difference between the standing reach and jump height (in centimeters) was used to record the outcome height in centimeters [15].
3. **Speed:** It was measured using 30 m sprint test. To perform this test, cones were set up at the 30-meter starting and finish line. The participant was instructed to complete the 30 m sprint in the shortest possible time. Using a stopwatch, the time was recorded in seconds [16]. Speed test is known to have good test-retest reliability. Studies have shown high ICC values (e.g., 0.83-0.94), further supporting the reliability of the test [17, 18].
4. **Balance:** It was measured using the Y-Balance Test. The test required a flat, non-slip surface, a measurement tape or built-in rulers. The participants were instructed to maintain a single-leg posture with hands on hips, while reaching in three different directions (anterior, posteromedial, and posterolateral) with the opposite leg in order to evaluate dynamic postural control. If the participants lost the balance, they were unable to get back to the starting position, or touched down with the reaching foot for support, the test was considered invalid. Three attempts were given in each direction, the reach distances were noted in cm, and the average was used. Leg length was used to standardize distances and calculate percentages [19]. The Y-Balance Test proved to have good relative and absolute reliability with intraclass correlation coefficient (ICC) ranging from 0.79-0.86 [20].
5. **Agility:** It was measured using the T-test. Before the test, the participants warmed up for five minutes. They were asked to sprint 9.14 meters from the start line to the first cone and touch the tip with their right hand. Then they shuffled 4.57 meters to the left to the second cone and touched it with their left hand. They were then instructed to shuffle 9.14 meters to the right to the third cone and touch it with their right hand. Finally, they were instructed to back pedal to the start line. The entire amount of time spent was noted using a hand-held stopwatch [21]. Paule et. al. found T-test to be highly reliable [21].
6. **Kujala Score:** It was measured using the Kujala Anterior Knee Pain Scale (KAKPS) to assess the subjective symptoms and functional limits of people with patellofemoral pain syndrome (PFPS). It is a self-reported questionnaire consisting of thirteen questions related to everyday activities and athletic activities that may exacerbate anterior knee discomfort [22]. The scoring is done on a scale of 0 to 100, with 100 being the highest possible score. Lower scores reflect greater pain and disability. KAKPS is known to be a reliable and valid scale for PFPS [23].

Procedure

Based on the inclusion and exclusion criteria, participants were randomly allocated to 2 groups using the odd even method.

KT group received Kinesio Taping with conventional physiotherapy and conventional group received conventional physiotherapy only. Both groups received three sessions per week for four weeks.

KT group: Kinesio tape (Boldfit kinesio tape) of 5 cm width and 0.5 mm thickness was applied (Fig. 1) following the procedure given by Lee et al. [2]. A physical therapist with an experience of two years and certified in KT applied the tape. The tape was applied at 50% stretch with its base at zero tension. KT was applied 3 times a week for 4 weeks along with conventional physiotherapy, and the tape was removed before coming to the next

session. The participants were asked to report if they felt any skin irritation after tape application.

In addition to KT, conventional physiotherapy [24] was also given, as explained in Table 1.

Conventional group received conventional physiotherapy similar to KT group. Three sessions were given per week for 4 weeks. All participants adhered well to the prescribed exercise program, with consistently full attendance and compliance rates during the intervention phase. There were no recorded dropouts.

Figure 1. Application of KT

Table 1. Conventional physiotherapy

Week 1	Repetitions	Week 2	Repetitions	Weeks 3 and 4	Repetitions
Static Quadriceps	10	Static Quadriceps	15	Static Quadriceps	10
Static Hamstrings	10	Static Hamstrings	15	Static Hamstrings	10
VMO Strengthening	10	VMO Strengthening	15	VMO Strengthening	10
Dynamic quadriceps	10	Dynamic quadriceps	15	Dynamic quadriceps	10
Hamstring stretch	10	Hamstring stretch	15	Hamstring stretch	10
				Mini squats up to 40 degrees	10
				Lunges	10

Statistical Analysis

The data were analysed using SPSS 24 version. Descriptive statistics were expressed as mean and ± standard deviation. Paired t-test was used to compare the differences within the groups and unpaired t-test was used for comparisons between the groups. The p value was set at $p < 0.05$. The confidence interval was set at 95%. Effect size was also calculated using the Cohen's d.

Results

Table 2 shows the comparison of demographic and baseline characteristics between KT and conventional groups. There were no statistically significant differences between the groups for all the variables.

Table 3 represents the pre and post intervention comparison of pain intensity, speed, agility, vertical jump height, balance and Kujala score between football players in KT group. The intervention resulted in statistically significant improvement in all outcome measures after four weeks of the intervention.

Table 4 represents the pre and post intervention comparison of pain intensity, speed, agility, vertical jump height, balance and Kujala score between football players in conventional group. The intervention resulted in statistically significant improvement ($p<0.001$) in all outcome measures after four weeks of the intervention except agility, for which results were not significant.

Table 5 shows the post-intervention comparison between KT group and conventional group. It was found that KT group had a statistically significant improvement in VAS, speed, balance and Kujala score compared to conventional group.

Table 2. Demographic details and baseline data of participants

Variables	KT group (n = 26)		Conventional group (n = 26)		p
	Mean	± SD	Mean	± SD	
Age (Years)	22.38	± 1.60	22.54	± 2.26	0.769
Height (cm)	169.77	± 8.43	169.69	± 7.58	0.080
Weight (kg)	63.73	± 7.92	64.90	± 8.13	0.710
VAS	6.15	± 1.04	6.04	± 1.11	0.713
Speed (sec)	4.73	± 0.31	5.06	± 0.39	0.142
Agility (sec)	12.18	± 0.62	12.35	± 0.83	0.4067
Vertical Jump Height (cm)	43.17	± 6.20	41.45	± 6.50	0.334
Y-Balance	77.44	± 2.36	77.08	± 2.97	0.637
Kujala score	61.08	± 3.97	61.50	± 4.06	0.706

Data expressed as mean ± SD. Confidence interval of 95%.

Table 3. Pre and post intervention comparison of variables in KT group

Variables	Pre Intervention		Post Intervention		95% Confidence Interval		p
	Mean	± SD	Mean	± SD	Lower	Upper	
VAS	6.15	±1.04	2.23	±0.95,	3.581	4.264	<0.001*
Speed (sec)	4.73	±0.31	4.65	±0.35	0.030	0.119	0.002*
Agility (sec)	12.18	±0.62	12.07	±0.64	0.055	0.163	<0.001*
Vertical Jump Height (cm)	43.17	±6.20	46.82	±6.68	-4.299	-3.000	<0.001*
Y-Balance	77.44	±2.36	84.61	±3.55	-8.156	-6.182	<0.001*
Kujala score	61.08	±3.97	91.27	±4.41	-31.418	-28.967	<0.001*

Data expressed as mean ± SD; * – statistically significant at $p < 0.05$.

Table 4. Pre and post intervention comparison of variables in conventional group

Variables	Pre Intervention		Post Intervention		95% Confidence Interval		p
	Mean	± SD	Mean	± SD	Lower	Upper	
VAS	6.04	±1.11	3.54	±1.17	2.117	2.883	<0.001*
Speed (sec)	5.06	±0.39	4.99	±0.47	0.178	0.116	<0.001*
Agility (sec)	12.35	±0.83	12.33	±0.88	-0.455	0.082	0.558
Vertical Jump Height (cm)	41.45	±6.50	43.58	±6.96	-2.681	-1.572	<0.001*
Y-Balance	77.08	±2.97	80.43	±3.13	-3.664	-3.020	<0.001*
Kujala score	61.50	±4.06	88.62	±4.060	-28.571	-25.660	<0.001*

Data expressed as mean ± SD; * – statistically significant at $p < 0.05$.

Table 5. Post intervention comparison of variables between KT group and conventional group

Variables	KT Group		Conventional Group		Effect Size	95% Confidence Interval		p
	Mean	± SD	Mean	± SD		Lower	Upper	
VAS	2.23	±0.95	3.54	±1.17	1.22	-0.486	0.717	<0.001*
Speed (sec)	4.65	±0.35	4.99	±0.47	0.82	-0.527	-0.126	0.006*
Agility (sec)	12.07	±0.64	12.33	±0.88	0.33	-0.583	0.234	0.222
Vertical Jump Height (cm)	46.82	±6.68	43.58	±6.96	0.47	-1.822	5.261	0.093
Y-Balance	84.61	±3.55	80.43	±3.13	1.24	-1.141	1.849	<0.001*
Kujala score	91.27	±4.41	88.62	±4.06	0.62	-2.66	1.817	0.028*

Data expressed as mean ± SD; * – statistically significant at $p < 0.05$.

Discussion

This study assessed the effectiveness of combining Kinesio Taping (KT) with conventional physiotherapy, compared to conventional physiotherapy alone, in the management of PFPS among football players. When compared with the conventional group, the results indicated a significant improvement in all variables except vertical jump height and agility in the group that received KT along with conventional therapy, aligning with the findings from recent literature [2, 8]. KT has gained popularity for its non-invasive approach, particularly among athletes seeking minimal disruption to training schedules. The results of the present study align with existing literature, indicating that KT contributes to significant pain reduction and functional improvement [8]. The mechanism through which KT contributes to symptom relief may include enhanced proprioception, patellar realignment, and neuromuscular facilitation, particularly of the vastus medialis obliquus (VMO), which plays a critical role in patellar tracking [3].

Notably, the Kujala Anterior Knee Pain Scale (KAKPS) scores improved significantly in KT group, suggesting that KT may positively influence long-term functional recovery. This is consistent with the work of Aghapour et al. and Ebrahimian et al., who demonstrated that KT not only alleviates pain but also facilitates neuromuscular performance [25, 26]. On the contrary, Guna et al. reported no effect on pain and Kujala score following the application of KT [27].

Also, a systematic review and meta-analysis by Jiao et al. supports the finding of KT reducing pain in PFPS patients [28]. Various mechanisms have been proposed for the action of KT on pain, especially the pain gate theory, which is thought to reduce pain by stimulating the low-threshold cutaneous mechanoreceptors [29, 30, 31]. Another possible mechanism is the movement of patella along the correct pathway as maltracking of patella is one of the major causes of pain in PFPS patients [32, 33]. Previous studies have also shown that KT would shift the patella posteriorly [34].

The improvements in performance-based outcomes such as the 30 m sprint and Y-balance tests in KT group may reflect both the mechanical support provided by the tape and its proprioceptive stimulation, which potentially enhances movement control and athletic performance [35]. Moreover, Motealleh et al. found that incorporating core neuromuscular training into regular physical therapy exercises can effectively reduce pain, enhance function, and improve balance in patients with PFPS [36]. Aktas et al. observed that in healthy subjects, the quadriceps facilitation approach of KT treatment and patellar correction enhanced eccentric muscular strength in healthy adults as well as hop distance and isokinetic knee extension peak torque [37]. Quadriceps strengthening enhanced pain-free eccentric knee control, isokinetic strength, and pain measurements, indicating that weak quadriceps may be a contributing factor to or effect of PFPS in the majority of participants [38]. The improvement in agility is similar to that recorded by Kargin et al. and Guven et al., who found a statistically significant effect on balance, agility, and vertical jump performances in tennis and badminton players [39, 40].

Strength training, combined with hamstring and flexibility exercises, has been proven to alleviate knee pain and improve functional performance in patients with PFPS [41, 42]. Similarly, Rasti et al. observed that a 4-week exercise therapy program can enhance the functional performance of athletes with PFPS [43].

Although both groups showed improvements, the superior results in KT group reinforced the utility of KT as an effective adjunct to exercise therapy. This is supported by the findings of Kakar et al., who noted that combining KT with physical therapy yields better results than either intervention alone [44].

A marked decrease in VAS scores post-intervention indicates a significant reduction in perceived pain. This aligns with previous studies suggesting that KT can effectively reduce anterior knee pain by altering muscle activation and joint alignment, thereby decreasing stress on the patellofemoral joint [30, 45]. The neurophysiological actions of KT, which activate cutaneous mechanoreceptors and alter nociceptive input, may potentially be responsible for the decrease in pain [46].

Improvements in the 30 m sprint and T-test reflect enhanced lower limb function and agility, which are critical for sports performance. The support provided by KT possibly contributed to more stable and efficient movement patterns, reducing compensatory mechanisms often seen in PFPS patients [9]. Moreover, the vertical jump test results revealed a significant increase in jump height, suggesting that the intervention not only addressed pain but also facilitated muscle performance potentially through better patellar tracking and enhanced proprioceptive feedback [47]. Improvement in agility in KT group is similar to that reported by Hanayoğlu and Can, who found increased agility among soccer players [48].

Most notably, the Kujala Anterior Knee Pain Scale (KAKPS) score showed a substantial improvement, indicating an overall enhancement in knee function. The combination of KT and conventional physiotherapy, which likely included strengthening, stretching, and manual therapy, appears to have a synergistic effect on restoring functional capability. This supports existing literature, emphasizing the importance of multimodal approaches in managing PFPS [1].

Overall, the results suggest that adding KT to conventional physiotherapy significantly enhances pain relief, speed, and muscle strength in sports players with patellofemoral pain syndrome, though its impact on agility and overall knee function was not significantly greater than physiotherapy alone.

Conclusions

Kinesio Taping, when used in conjunction with conventional physiotherapy, provides significant benefits in managing patellofemoral pain syndrome among football players. KT group was better in terms of all variables than conventional group except agility and vertical jump height.

Limitations

The study has several limitations that should be acknowledged. The present study focused only on amateur football players and only a limited number of performance variables were assessed. Also, there was no follow-up done to reassess the variables. The use of t tests for statistical analysis can also be considered a limitation. ANCOVA could have provided better control for baseline differences as well as less risk of statistical errors. Future research should address these points.

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