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IMMEDIATE EFFECT OF KINESIO VERSUS MCCONNELL TAPING ON PATELLOFEMORAL PAIN SYNDROME DURING FUNCTIONAL ACTIVITIES- A COMPARATIVE STUDY

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ABSTRACT

Background: Patellofemoral pain syndrome (PFPS) is a condition presenting with anterior knee pain or pain behind the patella (retro-patellar pain). The purpose of the study is to find the immediate effect of Kinesio taping versus McConnell taping in patellofemoral pain syndrome subjects during functional activities- stair ascent, stair descent and squat lift.

Methods: An experimental study design with three groups, 45 subjects with patellofemoral pain syndrome was randomized. 15 subjects into each Kinesiotaping group, McConnell group and Sham group. Kinesiotaping group received patellofemoral kinesio taping technique, McConnell group received McConnell taping technique and Sham group received sham taping technique. Outcome measure pain was measured using visual analogue scale during pre and post taping pain levels that were measured during three functional activities: stair ascent, stair descent and squat lift.

Results: When analysed within the group using paired 't' test and wilcoxon signed rank test, there is statistically significant improvement in post pain levels in KT, MT and Sham group during stair climbing, stair descent and squat lift. When compared measuring of pre and post pain levels between three groups, there is no significant change in pain level between Kinesio taping and McConnell taping as also compared to sham taping.

Conclusion: The study concluded that Kinesio taping, McConnell taping and sham taping shown immediate effect on reducing pain during functional activities such as stair climbing, stair descent and squat lift with greater percentage of pain reduction was found following Kinesiotaping and McConnell taping.

Keywords: patellofemoral pain syndrome, Kinesio taping, McConnell technique, sham technique, Visual Analogue scale.

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INTRODUCTION

Patellofemoral pain syndrome (PFPS) is a condition presenting with anterior knee pain or pain behind the patella (retro-patellar pain).¹ The incidence in the general population is 25% in adolescents and adults.² Incidence rates vary from 22 new cases per 1000 persons/year in highly active populations to 5 to 6 new cases per 1000 in general practice.³

Taping is frequently used in the field of rehabilitation as a means of treatment for knee pain. Taping techniques commonly used for anterior knee pain in the clinical setting include McConnell Taping (MT), Kinesio Taping (KT), Athletic Taping and Mulligan Taping.⁴

McConnell introduced a rehabilitation program that incorporates patellar taping techniques to improve patellar tracking within the patellofemoral groove, as well as lateral knee structure stretching, VMO strengthening, and closed kinematic chain training. The McConnell patellar taping (MT) is intended to correct patellar tracking by medialising the patella, allowing patients to engage in pain-free physical therapy exercises.⁴ The approach is based largely on the premise that patellar malalignment and a poorly tracking patella can lead to patellofemoral pain. The aim of patellar taping is to create a mechanical shift of the patella, thereby purportedly centering the patella within the trochlear groove and improving patellar tracking.³ The underlying concept is that most patients with PFPS would benefit from medialisation of the patella, which theoretically would off-load the compressive forces at the lateral patellofemoral joint.^{1,4}

Kinesio tape (KT) as an alternative taping technique theorized to be an effective treatment to improve physiological problems based on functions of the tape.^{2,6} It was hypothesized that KT has multiple functions: improvement of muscle function, gathering fascia to align tissue in the desired position, activation of the circulation (blood and lymph) by lifting the skin over areas of inflammation, reducing pain and edema, deactivation of the pain system by stimulating cutaneous mechanoreceptors, supporting the function of the joints by stimulating proprioceptors, correcting the direction of movement and increasing stability and segmental influences.^{5,7}

Studies have been found comparing the effectiveness of Kinesio taping and McConnell taping versus no tape in subjects with anterior knee pain during functional activity and shown that both KT and MT were effective in reducing pain during

functional activities.⁴ There is a need to know the effect of these taping technique in other functional activities like squat lift, stair ascending and stair descending. Therefore, the present study with research question, Whether there is any difference in immediate effect between kinesio taping versus McConnell taping on pain level during stair ascent, stair descent and squat lift functional activity in subjects with Patellofemoral Pain syndrome (PFPS)? Hence, the purpose of this study is to compare the immediate effect of KT versus MT on pain levels during stair ascent, stair descent and squat lift functional activity in subjects with patellofemoral pain syndrome. It was null hypothesized that there will be no significant difference between Kinesio taping versus McConnell taping on immediate effect on pain level during stair ascent, stair descent and squat lift functional activities for subjects with patellofemoral pain syndrome.

METHODOLOGY

An Experimental study design with three groups- Kinesiotaping group (KT group), McConnell taping (MT group) and Sham group. As this study involved human subjects the Ethical Clearance was obtained from the Ethical Committee of KTG College of Physiotherapy and K.T.G. Hospital, Bangalore as per the ethical guidelines of Bio-medical research on human subjects. This study was registered under Rajiv Gandhi University of Health Sciences for subject for registration for dissertation with registration number 09_T031_4712. The study was done on total of 45 subjects. 15 in each KT group, MT group and Sham respectively. Subjects who meet inclusion criteria were informed about the study and a written informed consent was taken. Subjects included in the study were both male and female, BMI < 30, age group- 30 to 50 years,⁴ Subjects diagnosed with patellofemoral joint, anterior- or retro-patellar knee pain aggravated by at least two activities that load the PFJ (e.g. stair ascends and descends, squatting and/or rising from sitting),⁵ Symptoms for at least 3 months,⁵ VAS scale during stair ascends and descends and squat lift greater than 30mm,⁵ Subjects who have never received patellar taping (McConnell, Kinesio and Sham) before this study, Subjects not undergone any other form of Physiotherapy treatment or are on pain killer drugs in past 2 weeks,⁸ Subjects who are willing to participate and give consent. Subjects were excluded with any recent injury (<1 year) around the knee joint,⁸ Chronic knee pain greater than 4 years,⁸ Corticosteroid injections of knee joints within the past 3 months,⁸ presence of severe graded knee osteoarthritis based on radiographic evidence,⁸

presence of any other non-orthopedic diseases that may affect the knees,⁸ pregnancy or possibility of pregnancy,⁵ referred pain from spine,⁵ Allergic reactions to taping (kinesio and McConnell).⁶ Subjects were recruited and study was conducted at KTG Hospital, Bangalore between June 2014 to December 2014. Subjects who meet inclusion criteria were recruited by Simple random sampling method using closed envelopes, randomly allocated subjects into three groups. Total duration of intervention per subject is only one time.

Procedure of intervention for Kinesiotaping Group:⁴

In this group, subjects were applied kinesiotaping. The K-tape was applied from origin to insertion of quadriceps muscle. Superior 'Y' technique was applied. The subject was sitting at the edge of the plinth with the thigh little flexed (small roll of towel under the knees) position and the part taped was exposed. The application of tape began with the kinesio "Y" strip approximately from the insertion of quadriceps. It was applied light (25% of available stretch) or paper off tension until "Y" in kinesio strip reaches the superior pole of patella. Tape activation was done prior to any further subject movement. Then the subject was instructed to flex the knees to maximum flexion. The tails of kinesio strip were then applied around the medial and lateral border of patella. The tails were applied with light (25 % of available stretch) or paper off tension. The tip of the tail ended with no tension on tibial tuberosity. Tape activation was done prior to any further movement. Tape was removed immediately after the outcome measures and if they feel itching, heat, redness or discomfort.

Procedure of intervention for McConnell Taping Group:⁴

In this group, subjects were applied McConnell taping. Two pieces of rigid tape (VPK Pvt. Ltd) were applied, a medial patellar glide and corrected lateral and AP tilt. Two further pieces of tape applied distal to the patella, unloaded the infrapatellar fat pad. Hypoallergenic undertape was applied beneath the rigid tape to prevent skin irritation. Next, a medial glide of patella was obtained by manually pushing the patella medially to its end range of motion. Rigid strapping tape then was used to maintain glide of patella by pulling the skin and patella medially. Tape was removed immediately after the outcome measures and if they feel itching, heat, redness or discomfort.

Procedure of intervention for Sham Group:^{6,7}

In this group, subjects were applied sham taping consists of non-elastic taping (placebo effect). Non-rigid hypoallergenic tape was placed on the skin in a vertical direction from the center of the patella to

5 cm proximal to the patella while the participant was sitting (with the knee flexed). The alignment of the patella was not visibly altered, nor was knee motion restricted.



Figure-1: Application of taping



Figure-2: Functional activity with Kinesio taping.



Figure-3: Functional activity with McConnell taping.

Outcome Measurements:

An outcome measurement such as Pain was measured by using 100 mm Visual Analogue Scale before applying taping and after applying taping. A VAS is usually a horizontal line, 100 mm in length, anchored by word descriptors at each end. The patient is asked to mark on the line the point that they feel represents their perception of their current state. The VAS score is determined by measuring in millimeters from the left hand end of the line to the point that the subject marks. Reliability of VAS for measurement for acute pain measured by the Interclass Co-efficient (ICC) appears to be high. This suggests VAS is sufficiently reliable to be used to assess pain.⁹

Statistical Methods

Descriptive statistical analysis was carried out in the present study. Out Come measurements analyzed are presented as mean \pm SD. Significance is assessed at 5 % level of significance with p value was set at 0.05 less than this is considered as statistically significant difference. Paired 't' test as a parametric and Wilcoxon signed rank test as a non-parametric test have been used to analysis the variables pre-intervention to post-intervention

with calculation of percentage of change. One-way ANOVA -Tukey HD post-hoc test with pair wise comparison and Kruskal-Wallis Test have been used to compare the means of variables between the three groups with calculation of percentage of difference between the means. The Statistical software namely SPSS 16.0, Stata 8.0, MedCalc 9.0.1 and Systat 11.0 were used for the analysis of the data and Microsoft word and Excel have been used to generate graphs, tables etc.

RESULTS

The study was conducted on total of 45 subjects (table-1) in Kinesiotaping Group there were 15 subjects with mean age 37.07 years and in Mc Connell Taping Group there were 15 subjects with mean age 35.27 years and in Sham Taping Group there were 15 subjects with mean age 36.33 years. There is no statistically significant difference in mean ages between the groups.

Analysis within the groups (table-2) shows that there is a statistically significant change in means of VAS during stair climbing, stair descent, squat

lift when means were analyzed from pre taping to post taping within the Kinesiotaping group, Mc Connell Taping group and Sham Taping group with negative percentage of change showing that there is decrease in the post means and with clinical significance effect with large effect size.

Comparison of pre taping means of VAS score (table-3) between three group shown that there is no statistically significant difference in stair Climbing VAS score between the three groups. When the means of VAS during stair descent and Squat lift were compared there is a statistically significant difference between the three groups.

Comparison of post taping means of VAS score (table-4) shows that between Kinesiotaping and Mc Connell groups there is no statistically significant difference in means of stair climbing, but there is a significant difference in stair descent and Squat lift between these two groups. When the means of VAS during stair Climbing, stair descent and Squat lift compared with sham there is a statistically significant difference between the three groups.

Table 1: Basic Characteristics of the subjects studied

Basic Characteristics of the subjects studied		Kinesiotaping	Mc Connell Taping	Sham Taping	Between the groups Significance ^a
Number of subjects studied (n)		15	15	15	--
Age in years (Mean ± SD)		37.07 ± 3.01 (32-40)	35.27 ± 2.78 (32-40)	36.33 ± 36.33 (34-38)	p= -0.155 (NS)
Gender	Males	9	8	8	-
	Females	6	7	7	
	Within Group Significance ^b	P=0.000**	P=0.000**	P=0.000**	
Side	Right	8	8	9	-
	Left	7	7	6	
	Within Group Significance ^b	P=0.000**	P=0.000**	P=0.000**	
BMI		25.33 ± 0.81 (24-27)	26.33 ± 1.19 (24-28)	25.70 ± 0.56 (24.50-26.50)	p=0.013**

a. Pearson Chi-Square b. Fisher's Exact Test

Table 2: Analysis of VAS within the Kinesio taping, Mc Connell Taping, Sham Taping Groups

VAS in mm during	Pre Taping (Mean ± SD) min-max	Post Taping (Mean ± SD) min-max	Percentage of change	Z value ^a (Non parametric significance)	t value ^b with Parametric Significance P value	95%Confidence interval of the difference		Effect Size (r)
						Lower	Upper	
Kinesiotaping Group								
Stair climbing	64.47 ± 5.47 (48- 71)	48.73 ± 6.20 (41- 62)	-24.41%	-3.413 p = 0.001**	13.460 p < 0.000**	13.22	18.24	+ 0.80 (Large)
Stair descent	33.60 ± 2.19 (31- 40)	28.93 ± 2.91 (24-34)	-13.89%	-3.329 p = 0.001**	9.091 p < 0.000**	3.56	42.48	+ 0.67 (Large)
Squat lift	52.27 ± 4.16 (46- 58)	40.27 ± 3.41 (35-46)	-22.95%	-3.423 p = 0.001**	28.210 p < 0.000**	11.08	12.91	+ 0.84 (Large)
Mc Connell Taping Group								
Stair climbing	64.20 ± 2.54 (61- 68)	50.60 ± 2.69 (45- 54)	-21.18%	-3.432 p = 0.001**	44.516 P < 0.000**	12.94	14.25	+ 0.93 (Large)
Stair descent	49.00 ± 3.31 (44- 53)	39.60 ± 3.92 (32-46)	-19.18%	-3.426 p = 0.001**	20.172 P < 0.000**	8.40	10.39	+ 0.79 (Large)
Squat lift	66.13 ± 1.64 (63- 68)	53.13 ± 1.06 (51-55)	-19.65%	-3.423 p = 0.001**	23.925 P < 0.000**	11.83	14.16	+ 0.97 (Large)
Sham Taping Group								
Stair climbing	65.80 ± 2.17 (62- 69)	56.27 ± 3.80 (52- 65)	-14.48%	-3.419 p = 0.001**	13.697 P < 0.000**	8.04	11.02	+ 0.83 (Large)
Stair descent	54.33 ± 2.28 (51- 59)	48.60 ± 1.63 (47-52)	-10.54%	-3.425 p = 0.001**	14.478 P < 0.000**	4.88	6.58	+ 0.82 (Large)
Squat lift	63.53 ± 2.20 (60- 67)	56.53 ± 3.90 (50-63)	-11.01%	-3.422 p = 0.001**	13.096 P < 0.000**	5.85	8.14	+ 0.74 (Large)

** Statistically Significant difference p < 0.05; NS- Not significant; a. Wilcoxon Signed Ranks Test; b. Pared t test.

Table 3: Comparison of VAS score between the three groups- (PRE TAPING COMPARATIVE ANALYSIS)

	Percentage of difference	Effect Size r	Between two Groups Significance a p value	95%Confidence interval of the difference		Between three Groups ^b
				Lower	Upper	
STAIR CLIMBING						
Kinesiotaping and Mc Connell	0.41%	0.03 Small	P = 0.979 (NS)	-17.75	-13.05	0.803 p = 0.455(NS)
Mc Connell and Sham	2.46%	0.32 Small	P = 0.470(NS)	-7.68	-2.98	
Kinesiotaping and Sham	2.04%	0.15 Small	P = 0.590 (NS)	-23.08	-18.38	
STAIR DESCENT						
Kinesiotaping and Mc Connell	37.28%	0.94 Large	p = 0.000**	-17.75	-13.05	247.598 p = 0.000**
Mc Connell and Sham	10.31%	+0.68 Large	p = 0.000**	-7.68	-2.98	
Kinesiotaping and Sham	47.15%	+0.97 Large	p = 0.000**	-23.08	-18.38	
SQUAT LIFT						
Kinesiotaping and Mc Connell	23.41%	0.91 Large	p = 0.000**	-16.42	-11.31	98.244 p = 0.000**
Mc Connell and Sham	-4.01%	+0.94 (Large)	P = 0.045**	0.04	5.16	
Kinesiotaping and Sham	19.44%	+0.29 (Medium)	p = 0.000**	-13.82	-8.71	

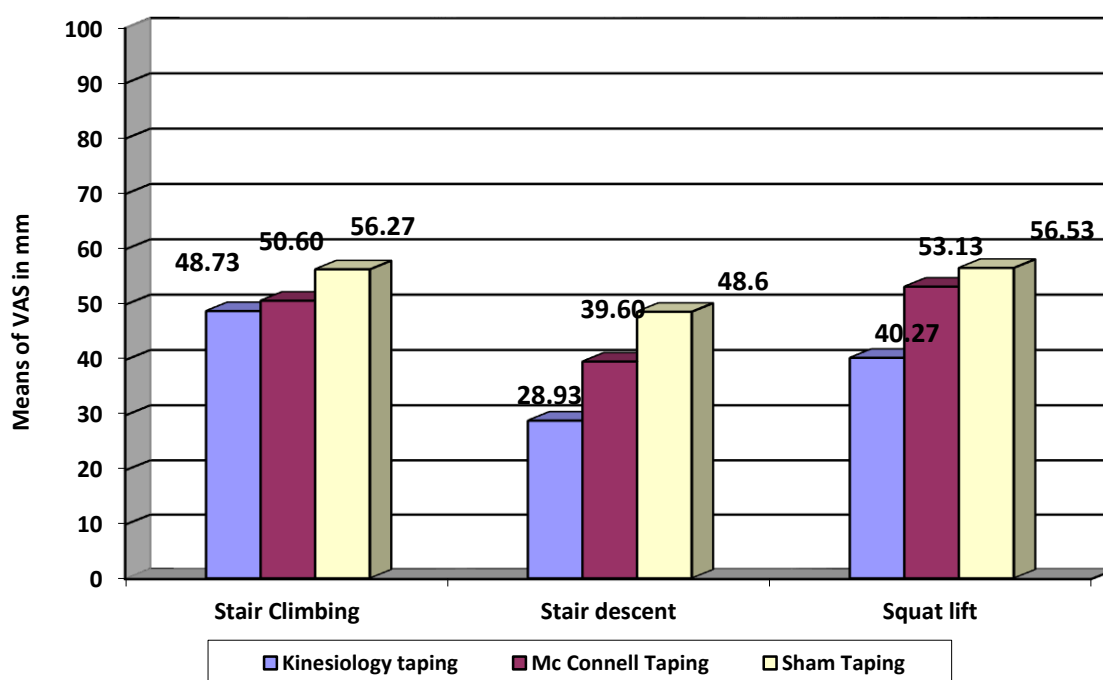
** Statistically Significant difference p < 0.05; NS- Not significant. a. Post Hoc Tests -Tukey HSD b. Kruskal-Wallis Test

Table 4: Comparison of VAS score between the three groups - (POST TAPING COMPARATIVE ANALYSIS)

	Percentage of difference	Effect size r	Between two Groups Significance a p value	95%Confidence interval of the difference		Between three Groups ^b
				Lower	Upper	
STAIR CLIMBING						
Kinesiotaping and Mc Connell	3.76%	0.19 Small	P = 0.495(NS)	-5.84	2.11	11.496 p = 0.000**
Mc Connell and Sham	10.61%	0.65 Medium	p = 0.003**	-9.64	-1.69	
Kinesiotaping and Sham	14.32%	+0.59 Medium	p = 0.000**	-11.51	-3.56	
STAIR DESCENT						
Kinesiotaping and Mc Connell	31.13%	+0.84 Large	p = 0.000**	-13.31	-8.03	164.090 p = 0.000**
Mc Connell and Sham	20.40%	+0.83 Large	p = 0.000**	-22.31	-17.03	
Kinesiotaping and Sham	50.74%	+0.97 Large	p = 0.000**	-11.64	-6.36	
SQUAT LIFT						
Kinesiotaping and Mc Connell	27.53%	+0.93 (Large)	p = 0.000**	-15.58	-10.16	118.196 p = 0.000**
Mc Connell and Sham	6.20%	+0.51 (Large)	p = 0.011**	-6.11	-0.69	
Kinesiotaping and Sham	33.59%	+0.91 (Large)	p = 0.000**	-18.98	-13.56	

** Statistically Significant difference p < 0.05; NS- Not significant a. Post Hoc Tests -Tukey HSD b. Kruskal-Wallis Test

Graph 1: Comparison of VAS score between three groups (Post taping Comparison)



The above Graph-1 shows that that between Kinesiotaping and Mc Connell groups there is no statistically significant difference in means of stair climbing, but there is a significant difference in stair descent and Squat lift between these two groups. When the means of VAS during stair Climbing, stair descent and Squat lift compared with sham there is a statistically significant difference between the three groups.

DISCUSSION

It is found from the analysis that Kinesio taping, McConnell taping and sham taping shown immediate effect on reducing pain during functional activities such as stair climbing, stair descent and squat lift with greater percentage of pain reduction was found following Kinesiotaping and McConnell taping. When the effect of Kinesiotaping, and McConnell taping were compared with sham taping there was a significant difference in immediate pain reduction, when the improvement in pain levels were compared between Kinesiotaping and Mc Connell taping there is no statistically significant difference in means of stair climbing, but there is a significant difference in stair descent and Squat lift between these two groups.

In McConnell group, 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.⁸⁻¹⁴ Therefore, similar improvements from McConnell taping that obtained in the present study, also relates to finding of previous studies.

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 helps to improve the timing of force distribution and decrease the pressure placed on a particular portion of the articular cartilage.^{7, 8-14}

In kinesiotaping group, the immediate effects of KT tape can be 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. KT also reduces pain through neurological suppression. Pain modulation via the gate control is one of the proposed theories as the tape stimulates neuromuscular pathways via increased afferent feedback.^{4,15-24} Taping provides immediate sensorimotor feedback, and patients often report symptom relief, improved comfort level, or stability of the involved joint. Thus, KT has been

theorized to be an effective treatment to restore muscle function and decrease pain in PFPS subjects.

Marc Campolo et al compared the effects of KT and McConnell taping to no tape on pain during squatting and stair ascent and descent and found that both KT and MT may be effective in reducing pain during stair climbing activities.⁴ 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.^{9,15} 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.¹⁴

In Sham group, there is significant difference in all three functional activities- stair climbing, stair descent and squat lift. These results demonstrate the potential elicitation of a placebo effect, which has been found to be reducing knee pain in PFPS patients.

In this study, VAS scale, a subjective measure was used as an outcome measure. Standardization of even a simple outcome measure can affect the outcome of the study and so objective measure could have strengthened the study more. Most of the subjects in the study had never experienced KT or MT; therefore a placebo effect must be considered as a possible mechanism by which pain was diminished.

The results revealed a significant improvement on immediate pain within the groups but not between the groups during functional activities in PFPS subjects. Therefore the present study accepts the null hypothesis.

Limitations of the study:

Only Immediate effects was studied. Long term effect were not known. A single application of the patellar tape during a short time period may not have been enough to elicit neuromuscular adaptations and kinematic alteration, although it may have brought changes in cutaneous sensations. The findings were based only on subjective measure VAS score was used as an outcome measures, objective outcome measures were not measured.

Recommendations for Future Research:

Further study is recommended to find long term effects of Kinesio taping and McConnell taping on PFPS during stair climbing, stair descent and squat lift. Further research is needed to see the effectiveness of different techniques of Kinesio

taping and McConnell taping on various functional activities. 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.

CONCLUSION

The study concluded that Kinesio taping, McConnell taping and sham taping shown immediate effect on reducing pain during functional activities such as stair climbing, stair descent and squat lift with greater percentage of pain reduction was found following Kinesiotaping and McConnell taping. When the effect of Kinesiotaping, and McConnell taping were compared with sham taping there was a significant difference in immediate pain reduction, when the improvement in pain levels were compared between Kinesiotaping and Mc Connell taping there is no statistically significant difference in pain levels during stair climbing, but there is a significant difference in stair descent and Squat lift between these two groups. Further long term studies using a larger sample size, different technique of Kinesio taping and McConnell taping should be performed in order to support the current findings.

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Conflicts of interest: None

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