



IMMEDIATE EFFECTS OF McCONNELL TAPING ON PAIN AND DISABILITY IN PATIENTS WITH UNILATERAL PATELLOFEMORAL PAIN SYNDROME

Physiotherapy

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ABSTRACT

Objective: Various Physiotherapy procedures are used in the management of Patellofemoral pain syndrome and taping is one adjunct therapy commonly used. However, the efficacy of taping in patients with patellofemoral pain syndrome is not clearly established. This study aims to determine the effect of McConnell taping on pain and functionality in patients with patellofemoral pain syndrome. **Methods:** This placebo-controlled randomized study included 30 (13 males and 17 females) patients with patellofemoral pain syndrome. Patients were assigned randomly into one of the three groups using quasi randomization procedure: Group 1 (McConnell taping with corrections), Group 2 (sham taping without any correction to the patella) and Group 3 (No taping). Pre taping outcome measurements for pain during functional activities (NRS at rest, NRS at step test, NRS at timed up and go test) and number of steps climbed per 15 seconds and time taken for timed up and go test were measured. Multivariate Analysis of Variance (MANOVA) was used for comparing mean of differences between the three groups with post hoc analysis with Bonferroni correction if MANOVA showed significance. **Results:** Significant differences were observed in all outcome measures between the groups ($p < 0.05$) and post hoc analysis showed McConnell taping showing better improvements in pain and functionality as compared to the other two groups ($p < 0.05$). No significant differences were observed between the sham taping and No taping groups in the outcome measures ($p > 0.05$) except pain during stair climbing ($p = 0.004$) and number of steps taken ($p = 0.013$). **Conclusion:** McConnell taping can be used as an effective method to reduce pain and improve function of patients with Patellofemoral pain syndrome. However, as per the objectives of this study, the effects were immediate to application of taping.

KEYWORDS

Patellofemoral pain syndrome, McConnell taping, Pain, Numerical Rating Scale, Timed Up and Go Test

INTRODUCTION

Self-reported knee pain has prevalence between 7% and 19% in an adult general population of 15-75 years. Eleven percent of young children report incidents of everyday knee pain. Patellofemoral pain syndrome (PFPS), one of the most common musculoskeletal disorders, is reported to affect 15%-33% of an active adult population and 21%-45% of adolescents. It is a condition presenting with anterior knee pain or pain behind the patella (retro patellar pain). It is commonly experienced during running, squatting, stair climbing, prolonged sitting, and kneeling. Malalignment of the patella, or altered patellar tracking, may be a predisposing factor for patellofemoral pain, chondromalacia, and articular cartilage degeneration. Several authors have espoused the theory that abnormal patellar alignment is often the root cause of pain.

Correct alignment of the patella may depend in part on the balance between the vastus medialis obliquus (VMO) and vastus lateralis (VL) muscles, so an imbalance in the activity of the VMO relative to the VL is one proposed mechanism for abnormal patellar tracking. Generalized quadriceps muscle weakness may result in malposition of the patella.

Physiotherapy plays an important role in the conservative management of PFPS, with treatment frequently advocated for pain control and muscle strengthening. One specific treatment regime, the McConnell approach, has been reported to have long term success in alleviating the symptoms associated with PFPS. The McConnell approach involves taping the patellofemoral joint with the aim of correcting abnormal patella alignment (tilt, glide, or rotation), and performing exercises that are purported to favor activation and strengthening of the VMO. The McConnell patellar-taping program is intended to correct patellar tracking by medializing the patella, allowing patients to engage in pain-free Physiotherapy exercises.

McConnell suggested 3 components of patellar orientation that need to be assessed before patellar tape is applied :

1. Glide component: The amount of gliding is characterized by the distance between the midpoint of the patella and the medial and lateral femoral epicondyles.
2. Tilt component: Patellar tilt is characterized by the difference in the

heights of the medial and lateral borders of the patella, which indicates the tightness of the lateral structures.

3. Rotation component: Internal and external rotation of the patella is represented by the alteration in alignment between the longitudinal axis of the patella (from the superior to the inferior poles) and the longitudinal axis of the femur.

Researchers found out from clinical exposure that vast variations exist in the management of patients with Patellofemoral pain syndrome. Conventional therapies target strengthening, stretching and alleviating pain. Biomechanical corrections are required in these patients, without which strength achievement in the long run is questionable. Availability of literature directly addressing this issue is very less, so this study was conducted in order to find out possible biomechanical corrections and its associations with pain and disability. The results of the study will be of great significance to clinical therapist regarding to whether taping can be used as an adjunct therapy to facilitate rehabilitation or not.

METHODS

This quasi-randomized controlled study was conducted in out-patient Physiotherapy departments in Surat. It included 30 patients fulfilling the inclusion criteria, both male and females in the age group 20 to 60 years, who were clinically diagnosed with unilateral PFPS. The diagnostic criterion for PFPS were presence of retro patellar pain elicited by one of the following symptom provocation tests: Resisted terminal knee extension, Stair descent, or unilateral partial squat, knee pain ≥ 3 cm as assessed using Pain-Numerical Rating Scale (NRS) and pain duration for 2 months and more.

Patients with past history of knee surgery (previous 6 months), History of joint replacement—Hip or knee, Intra-articular steroid injections at knee joint (previous 6 months), Systemic arthritic condition, known allergy to tape and any skin infection at the site of taping were excluded.

30 patients were assigned randomly to three groups: McConnell Taping (MT) group, Sham taping (ST) group and no taping (NT) group. Assignment of patients to group was quasi randomized in terms of their visit to the clinic. First patient with PFPS was assigned to Group 1, second visiting patient to Group 2 and third visiting patient to

Group 3 and the same procedure was followed for consecutive patients. MT and ST were applied by a Physiotherapist trained in taping techniques. Patients were blinded to whether they underwent McConnell or sham taping.

Written Informed consent was obtained from the participants prior to the commencement of the study after explaining the details of the study in accordance with the Institutional Ethical standards of the ethics committee on human experimentation and the Helsinki declaration of 1975.

Patients in the MT group were given McConnell taping with corrections in sequence as explained by McConnell. Knee was maintained in slight flexion throughout the taping procedure and patients were instructed to report any symptoms of skin irritation whilst wearing the tape.

In ST group, tape was applied at the same location of the knee as with McConnell taping techniques but with no biomechanical corrections done to the patella. In control group (NT), participant's baseline measurements were taken at the time of visit followed by 5 minutes rest period.

OUTCOME MEASURES:

NRS : It was measured at rest and after the patients performed step test and timed up and go test. Unit of measurement was in Centimeters.

Step Test : Patients were asked to stand barefoot in front of 20 cm step weight bearing on the affected limb, whilst stepping the unaffected foot on and off the step as many times as possible in 15seconds. Number of steps climbed in given duration was calculated (Steps/15seconds). Unit of measurement was number of steps.

Timed up and Go Test (TUG Test) : The Timed Up and Go Test is a modified version of a previously established tool, the Get Up and Go Test. The Timed Up and Go Test is a test of basic mobility function that is appealing in its simplicity and objective nature. Patients were instructed to rise from a standard arm chair, walk around a cone on the floor 3 meters away, return to the chair and sit down again, whilst being timed by a stop-watch. This test was performed barefooted. Duration taken to cover this distance was calculated (seconds).

Outcome measurements were taken before and after the application of tape, by same investigator who was trained in the procedures.

Statistical analysis of the study was performed using SPSS version 20. Descriptive statistics of mean, standard deviation for continuous variables and frequency, percentage for categorical variables were used to describe the demographic and clinical characteristics of participants. Multivariate Analysis of Variance (MANOVA) was used for comparing mean of differences between the three groups. Post hoc analysis with Bonferroni correction was used if statistical significance was observed in MANOVA. Results were considered to be significant at $p < 0.05$ and confidence interval of 95%.

RESULTS

Table 1. Demographic and Baseline Clinical characteristics of participants in all three groups

Variable	MT Group (n=10)	ST Group (n=10)	NT Group (n=10)	F	p value*
Mean (SD)					
Age (in years)	35.7 (15.59)	43 (14.62)	35.9 (15.7)	0.737	0.488
Height (in cms)	165.2 (8.61)	161.66 (9.15)	166.12 (6.24)	0.844	0.441
Weight (in kgs)	65.7 (14.19)	68.15 (12.11)	63 (11.03)	0.423	0.659
BMI (kg/m ²)	24 (4.6)	26.12 (4.64)	22.67 (2.74)	1.806	0.184
n (%)					
Gender				χ^2	p
Male	5 (50)	4 (40)	4 (40)	0.271	0.873
Female	5 (50)	6 (60)	6 (60)		
Affected Knee					
Right	7 (70)	6 (60)	6 (60)	0.287	0.866

Left	3 (30)	4 (40)	4 (40)		
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*Significant at $p < 0.05$

MT: McConnell Taping Group; ST: Sham Taping Group; NT: No Taping Group; SD: Standard Deviation, BMI: Body Mass index

Table 1 shows homogeneity in demographic characteristics of participants distributed to the groups in all the continuous variables: age ($F(2, 29) = 0.737$; $p = 0.488$), height ($F(2, 29) = 0.844$; $p = 0.441$), weight ($F(2, 29) = 0.423$; $p = 0.659$) and BMI ($F(2, 29) = 1.806$; $p = 0.184$).

Table 2. Mean comparison of baseline values of outcome measures used in the study

Variable	MT Group (n=10)	ST Group (n=10)	NT Group (n=10)	F	p value*
Mean (SD)					
Pre NRS-Rest	4.2 (0.91)	4.9 (1.3)	4.5 (0.85)	1.074	0.356
Pre NRS-Step	6.2 (1.87)	7.3 (1.88)	5.9 (1.37)	1.820	0.181
Pre NRS-TUG	5.1 (1.37)	5.9 (1.44)	5 (0.94)	1.500	0.241
Pre Steps	6.3 (1.16)	6.2 (0.91)	6.2 (1.03)	0.031	0.970
Pre TUG	13.3 (2.29)	12.52 (1.63)	13.9 (1.86)	1.258	0.300

*Significant at $p < 0.05$

MT: McConnell Taping Group; ST: Sham Taping Group; NT: No Taping Group; SD: Standard Deviation, NRS: Numerical Rating Scale; TUG: Timed Up and Go Test

When compared between groups, all outcome variables were statistically non-significant on baseline with $F(2, 29) = 1.074, 1.820, 1.5, 0.031, 1.258$; $p > 0.05$ for NRS at rest, NRS at step test, NRS at TUG, number of steps taken and TUG test respectively.

Table 3. Comparison of mean differences of outcome measures

Variable	MT Group (n=10)	ST Group (n=10)	NT Group (n=10)	F	p value	Partial Eta Squared
NRS-Rest	-2 (1.05)	-0.3 (1.49) ⁺	0.6 (0.84) ⁺	12.896	0.000	0.489
NRS-Step	-2.8 (1.13)	-1.5 (1.17) ⁺	0 (0) [^]	21.996	0.000	0.620
NRS-TUG	-1.9 (1.19)	-1.1 (0.56)	-0.3 (0.94) ⁺	7.230	0.003	0.349
Steps	1.8 (0.421)	1.2 (0.78)	0.3 (0.674) [^]	13.619	0.000	0.502
TUG	-2.31 (2.05)	-0.79 (0.55)	-0.22 (0.38) ⁺	7.479	0.003	0.357

Significant at $p < 0.05$

Pairwise comparisons of post-hoc analysis - #NT Vs MT; ^NT Vs ST; +ST Vs MT

MT: McConnell Taping Group; ST: Sham Taping Group; NT: No Taping Group; SD: Standard Deviation, NRS: Numerical Rating Scale; TUG: Timed Up and Go Test

Mean difference was computed by subtracting the mean of pre-test values from the mean of post-test values. MANOVA was used to compare the mean of mean differences between groups.

From table 3 it was observed that NRS at rest was found to be statistically significant between the groups ($F(2, 27) = 12.896$; $p = 0.000$; Partial $\eta^2 = 0.489$) and showed better improvements in MT group as compared to ST and NT groups ($p < 0.05$). NRS at step test was also statistically significant between the groups ($F(2, 27) = 21.996$; $p = 0.000$; Partial $\eta^2 = 0.620$) and the pain scores improved in MT group as compared to ST and NT groups ($p < 0.05$). Significant improvements were also observed in ST group as compared to NT group ($p < 0.05$). NRS at TUG test was also statistically significant between the groups ($F(2, 27) = 7.230$; $p = 0.003$; Partial $\eta^2 = 0.349$) and the pain scores improved in MT group as compared to ST and NT groups ($p < 0.05$).

Number of steps taken in step test was also statistically significant between the groups ($F(2, 27) = 13.619$; $p = 0.000$; Partial $\eta^2 = 0.502$) and the number of steps improved in MT group as compared to ST and

NT groups ($p < 0.05$). Significant improvements were also observed in ST group as compared to NT group ($p < 0.05$). TUG test also showed statistically significant difference between the groups ($F(2, 27) = 7.479$; $p = 0.003$; Partial $\eta^2 = 0.357$) and participants in MT group showed improvements in the time taken to complete the test as compared to ST and NT groups ($p < 0.05$).

DISCUSSION

The purpose of this study was to explore the immediate effects of McConnell taping on pain and disability in patients with unilateral patellofemoral pain syndrome. Outcome measures assessed were NRS at rest, NRS at step test, NRS at TUG test, number of steps climbed while weight bearing on the affected leg and time taken to complete TUG.

Significant differences were observed between the groups when compared for the outcome measures ($p < 0.05$). MT group showed better improvements in pain score at rest (2 cm) as compared to ST group (0.3 cm). Pain increase by 0.6 cm in NT group. Similarly pain during step test improved by 2.8 cm in the MT group as compared to ST group (1.1 cm). There was no change in the pain scores in the NT group. Pain during TUG test also improved in MT group (1.9 cm) as compared to ST (1.1 cm) and NT (0.3 cm) groups. Participants in the MT group had improved step counts in the stipulated time (1.8) as compared to ST (1.2) and NT (0.3) groups. Participants in the MT group completed the TUG test with a difference from pre taping values of 2.31 seconds whereas ST group showed a difference of 0.79 seconds and NT group 0.22 seconds.

Study done by Hinman et. al evaluated the effects of knee tape in population with knee osteoarthritis and the result showed that therapeutic tape reduced pain by up to 50% compared with the untaped condition. In a study done by Janet Cusnaghan et al, a cohort of 14 patients with Patellofemoral Joint disease, the effect of tape was evaluated over 4 days. Results showed that medial patellar taping reduced overall daily pain by 25% compared with neutral and lateral taping. They demonstrated an immediate pain reduction of 35–55% in cohort. Martin Whittingham et.al also concluded similar findings from the results of their study. Results of the present study showed better percentage improvements of pain in taped group as compared to the results of the above studies.

Several mechanisms may be responsible for the pain-reducing effect of taping technique. Considering that PFPS has a strong correlation with patellar malalignment, which is associated with increased peak patellofemoral contact pressures and loading on the lateral facet, taping may be useful to ease pain by improving patellar alignment.

An immediate reduction in pain level with the application of patellar taping is consistent with previous findings. It has been suggested that reducing pain via the application of patellar tape helps improve performance in symptomatic individuals and also has been argued that patellar tape may elicit neural inhibition by facilitating large afferent fiber input.

S M Cowan et. al observed that when patients with PFPS completed the stair stepping task, therapeutic taping of the patellofemoral joint resulted in changes in the mean pain reported by the patients as they completed the stair stepping task. Pain was significantly less in the therapeutic taped condition than in both the placebo and no tape condition. There was no difference between the no tape and placebo taped condition. Taping was also shown to have immediate effects that were greater than placebo. The pain experienced on performing a step test decreased by an average of 47% with the application of active patella taping in the study, compared to only 10% with placebo tape.

A study done by Chhaya Verma & Vijaya Krishnan showed highly significant pain relief in stair ascent and descent. Pain and function in the study were measured on Jette Functional Status Index. In a study conducted by Marc Campolo et. al, pain level was measured using the 0-10 Numeric Pain Intensity Scale (NPIS), before the activity and during the activity. There was a statistically significant difference in median pain scores between the three conditions, i.e. Kinesio Taping (KT), Mc Connell Taping (MT) and no tape, during the stair activity. Both KT and the MT were effective in reducing pain during stair climbing when compared to the no tape condition.

A Review article by K. Crossley et. al says that few studies have

controlled for a potential placebo effect of taping, where subjects report a pain reduction due to the belief that taping may be beneficial. One study investigated the placebo effect of taping on knee pain in patients with patellofemoral joint osteoarthritis. The authors found that medial patellar tape induced a significantly greater pain reduction than the placebo tape. In a study by Gretchen B. Salsich, subjects walked with a faster cadence during the taped trials compared to the untaped trials (stair ascent: 85.4 steps/min taped, 73.6 steps/min untaped).

In contrast to the above mentioned results, Janet H.L. Keet et.al – found that the patellofemoral pain group experienced significantly more pain during all the tests. However, no significant differences were found in the pain scores of the patellofemoral pain group between the no-tape, placebo and tape conditions during all of the tests. Medial patellar tape did not result in a significant reduction in pain during the step testing (step-up) in the group with patellofemoral pain.

Observation made on the basis of results from the present study supports the observations of studies discussed above, concluding Mc Connell taping effectively improves pain at rest, pain during ascending stairs, pain during TUG, number of steps taken in 15 seconds and time taken to complete the TUG test. The potential placebo effect of taping is also addressed in this study by adding a sham taping group and a control group and results show placebo taping does not reduce pain and improve functionality as Mc Connell taping and in most of the outcome measures had similar effects as the no taping group.

Limitations

Major limitation of this study was the small sample size and the period of intervention. This study focused only on the immediate effects of McConnell taping. Hence, studies involving a large sample size and an objective to determine the short and long term effects of taping can be taken for future considerations.

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