

Immediate Effect of Therapeutic Patellar Taping on Pain and Disability in Patellofemoral Osteoarthritis

Garg Chaya*, Arora Nupur**

Abstract

Background and purpose: Patellar taping is an inexpensive intervention with minimal side-effects for Patellofemoral Osteoarthritis with evidence both in favor and against it. Therefore the purpose of our study is to find out immediate effect of patellar taping on pain and disability in individuals with patellofemoral osteoarthritis.

Material and Methods: Male and female subjects with age > 50 yrs, referred to physical therapy centers for treatment of Patellofemoral Osteoarthritis (n=30) were included. All subjects underwent the Step test and Timed up and go test twice first without tape and then with the therapeutic tape. During each of the test pain was evaluated using VAS.

Results: Using a paired sample T-test the results demonstrated a significant improvement in the step test and timed up and go test along with significant reduction in pain.

Conclusion: The finding of this study supports the experimental hypothesis that therapeutic taping reduces pain and observed disability in patients with patellofemoral osteoarthritis.

Keywords: Patellar taping, patellofemoral osteoarthritis

Introduction

Osteoarthritis also known as Osteoarthrosis/Degenerative joint disease is a chronic joint disorder in which there is progressive softening and disintegration of articular cartilage accompanied by new growth of cartilage and bone at the joint margins (osteophytes) and capsular fibrosis⁽¹⁾. Osteoarthritis comprises 20% of a Rheumatologist's workload with the knee the most common joint affected⁽²⁾. It is most common degenerative disease affecting

thousands of Indian citizens⁽³⁾ and is the major cause of pain and disability in older people⁽⁴⁾.

Osteoarthritis of the knee is characterised by structural joint changes including joint space narrowing and osteophyte formation⁽⁵⁾. There is great number of personal and social consequences of osteoarthritis. In osteoarthritis, the knee is the joint most commonly associated with clinical symptoms and disability⁽⁶⁾. Pain and disability are apparent in almost half of the patients with radiographic disease^(6,7). Thirty-three percent of persons 63 to 94 years of age are affected by knee osteoarthritis, which often limits the ability to rise from a chair, stand comfortably, walk, and use stair⁽⁶⁾. Much of the disability associated with knee osteoarthritis is attributed to quadriceps weakness and pain rather than radiographic changes^(7, 8, 9).

The knee is a complex tricompartmental joint⁽¹⁰⁾ - lateral tibiofemoral compartment, the medial tibiofemoral compartment and the

Author Affiliation: *Lecturer, Banarsidas Chandiwala Institute of Physiotherapy, Maa Anandmai Marg, Kalkaji, New Delhi -110019, **Physiotherapist, National Heart Institute, New Delhi.

Reprint's request: Garg Chaya, Lecturer, Banarsidas Chandiwala Institute of Physiotherapy, Maa Anandmai Marg, Kalkaji, New Delhi-110019.

E-mail : chayagarg79@gmail.com

(Received on 11.07.2011, accepted on 04.04.2012)

patellofemoral compartment. Although isolated patellofemoral osteoarthritis is relatively rare⁽¹¹⁾, patellofemoral joint (PFJ) is one of the most commonly affected compartments⁽¹²⁾. Disease of this compartment of knee joint can cause severe pain when the patient is using stairs, squatting or kneeling⁽³⁾. Malalignment of the patella, with consequential abnormal force distribution on the lateral facet, is thought to be the cause of these symptoms⁽³⁾. Patellofemoral joint lesions have been found to be lateral in 89% of all of patellofemoral osteoarthritis⁽¹⁰⁾.

There is no permanent cure for OA, thus conservative treatment aims to reduce pain and limit functional impairment. Inexpensive interventions with minimal side-effects are desirable⁽¹³⁾. Jenny Mc Connell in 1986 developed an easy, painless safe and inexpensive alternative. The treatment involved a unique method of taping the painful knee to realign the patella within the femoral trochlea, as well as stretching of lateral soft tissues, VMO strengthening and close kinematic chain training⁽¹⁴⁾.

Extensive research has been done to evaluate the effects of patellar taping. Several studies suggested that pain associated with Patellofemoral Joint is significantly reduced with patellar taping with evidence to suggest that patellar tape improves patella alignment measured radiographically and improves quadriceps function (torque production and extensor moments)⁽¹⁴⁾. Cushnaghan et al (1994)⁽⁴⁾ in 14 patients with patellofemoral joint (PFJ) OA, found medial patellar taping significantly reduced pain compared with neutral and lateral taping. Rana S Hinman et al in 2003⁽¹⁵⁾ concluded that therapeutic taping was found as an efficacious treatment for the management of pain and disability in patients with knee osteoarthritis. Kay M. Crossley⁽¹⁶⁾ study on 28 individuals, 14 with patellofemoral joint OA and 14 asymptomatic concluded that patellar tape may reduce malalignment and pain associated with patellofemoral joint OA.

However, some other studies have failed to find a difference. It appears unlikely that mechanical changes produced by application of tape can specifically produce the clinical effects seen, as a number of studies have failed to find significant changes in patella position with taping⁽¹⁷⁾. Gigante et al. (2001)⁽¹⁸⁾ used a CT scan to assess patellofemoral mechanics and showed that patellar taping didn't affect the patella orientation and concluded that this approach doesn't improve patellofemoral incongruence by changing patella position. Further research by R. S. Hinman, K. M. Crossley (2004)⁽¹⁹⁾ showed that application of therapeutic tape worsened joint position sense at a knee angle of 40 and concluded that neither immediate application nor continuous use of tape (for 3 weeks) appears to influence sensorimotor function in people with symptomatic knee OA.

Due to this mixed evidence of patellar taping our aim of study is to find out immediate effect of patellar taping on pain and disability in individuals with patellofemoral osteoarthritis.

Methodology

Both males and females subjects with age > 50 yrs, referred to physical therapy centers for treatment of Patellofemoral Osteoarthritis (n=30) were included in the study if they had pain on climbing stairs⁽¹³⁾ and had a Minimum 4 out of 7 following clinical features⁽²⁰⁾.

- (a) Pain on griding of patella
- (b) Crepitation on griding of patella
- (c) Crepitation on knee motion
- (d) Peripatellar tenderness
- (e) Pain on compression of patella
- (f) Limitation of patellar mobility
- (g) Clarke's test-positive

Those with Bilateral Knee involvement- more painful knee was considered⁽¹³⁾. Subjects were excluded from the study if they had undergone Physiotherapy treatment for knee injury or pathology in previous 12 months, had any history of Lower limb joint

replacement, Knee Intra articular steroid injection during previous 6 months, allergic tape reaction, underlying Systemic arthritic condition, severe medical condition precluding safe testing, fragile skin around the knee⁽¹³⁾, cognitive, mental, neurological, cardiac, vascular or sensory problems⁽²¹⁾.

Potential subjects were apprised of the procedure and its potential risks and benefits and the evaluation was done. Subjects who fulfilled the inclusion and exclusion criteria and gave their informed consent were included in the study. All the subjects were familiarized with the testing procedures during the trial session.

All subjects underwent the Step test and Timed up and go test. During each of the test pain was evaluated using a 10-cm horizontal VAS. A rest of 5 minutes was given between the test conditions. After the testing was over therapeutic tape was applied. The subjects were again tested with the therapeutic tape for the dependant variables. Participants rested for 5 minutes between test conditions.

Pain Measurement

Pain experienced during each of the 2 disability tasks was evaluated using a 10-cm horizontal Visual Analogue Scale (VAS). Results were scored from 0-10 cm in increments of 1 cm⁽²²⁾ with 0 representing no pain and 10 worst pain.

Step Test

The step test is a functional, dynamic test of standing balance with known reliability and validity⁽²³⁾. In this subjects were asked to stand on the most painful knee i.e Osteoarthritic limb. While other knee was kept over the stool of height 15cm. Subject stood barefooted on the osteoarthritic limb, whilst stepping the opposite foot on and off the step as many times as possible over 15sec. The number of times the participant could place the foot on to the step and return it to the floor was recorded, with higher scores indicating better balance⁽¹³⁾.

Timed Up and Go Test

The timed up and go test measures the time it takes a subject to stand up from an arm chair, walk a distance of 3 meters, turn, walk back to the chair and sit down. A chair of 46 cm of height was used for the study. A 3 meter distance was marked on the floor in front of the chair. The test began with each subject sitting, back against chair, arms resting on the lap and feet supported on the ground. The subject was instructed that on the word "GO"; he should stand up, walk comfortably and safely to the mark on the floor, turn around, come back and sit on the chair. The subject was informed that the trial would be timed. Timing began at the word "GO" and ended when the subject's back rested against the chair upon returning⁽²⁴⁾.

Taping

Therapeutic tape was applied in a standardized manner by the same investigator, regardless of clinical presentation. Skin was shaved prior to tape application⁽¹³⁾. Subjects were made to lie down on a plinth and the knee was exposed. Two pieces of rigid tape were applied to provide the medial patellar glide and correct the lateral and AP tilt according to Mc Connell taping technique⁽²⁵⁾ and two further pieces of tape applied distal to the patella to unload the infrapatellar fat pad. Participants were asked to report any adverse symptoms whilst wearing tape.

Results

The study was done on 30 subjects out of which 30% were males and 70% were females. The basic characteristics of the group are summarized in Table 1. The test results are summarized in Table 2.

Step test

- *Number of steps in 15 sec*

There was a test condition*test score interaction with $t=-11.486$, $p<0.001$ indicating a statistically significant increase in the number of steps taken with the therapeutic tape. (Fig 1)

➤ VAS

Table 1: Basic characteristics of subjects (N=30)

CHARACTERISTIC	MEAN	S.D
AGE	60.03	9.33
HEIGHT	157.56	6.77
WEIGHT	68.65	10.55

S.D=Standard Deviation

Table 2: Comparisons of test scores

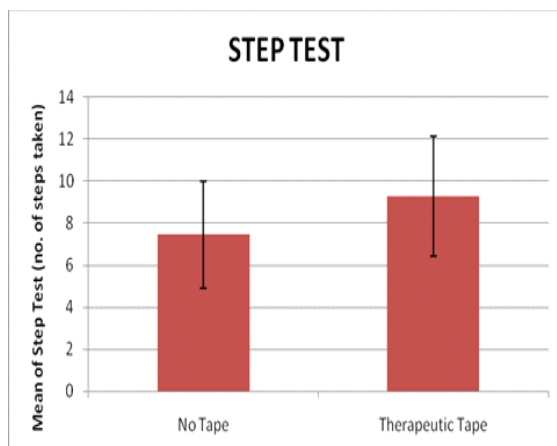
VARIABLE	NO TAPE MEAN (S.D)	THERAPEUTIC TAPE MEAN(S.D)	% DIFFERENCE
Step test (no of steps in 15 sec)	7.47 (2.54)	9.30 (2.85)	24.5%
VAS (during Step test)	5.8 (1.58)	3.9 (1.99)	32%
TUG (time taken in sec)	16.55 (8.08)	14.19 (7.4)	14%
VAS (during TUG test)	4.9 (1.63)	3.17 (1.51)	35%

VAS-Visual Analogue Scale

TUG test-Timed up and go test

S.D=Standard Deviation

Fig 1: Number of steps taken during Step Test



There was a test condition*test score interaction with $t=12.960$, $p<0.001$ indicating a statistically significant decrease in the VAS score with the therapeutic tape. (Fig 2)

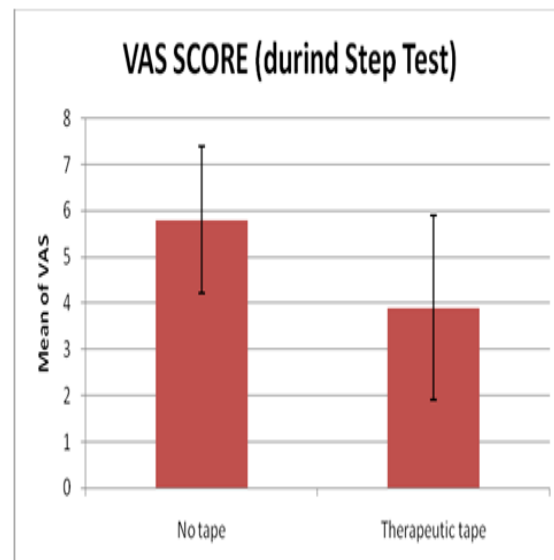
Timed up and go test

➤ Time taken

There was a test condition*test score interaction with $t=8.706$, $p<0.001$ indicating a statistically significant decrease in the time taken with the therapeutic tape. (Fig 3)

➤ VAS

Fig 2: VAS Scores during Step Test



There was a test condition*test score interaction with $t=12.835$, $p<0.001$ indicating a statistically significant decrease in the VAS score with the therapeutic tape. (Fig 4)

Fig 3: Time Taken during TUG Test

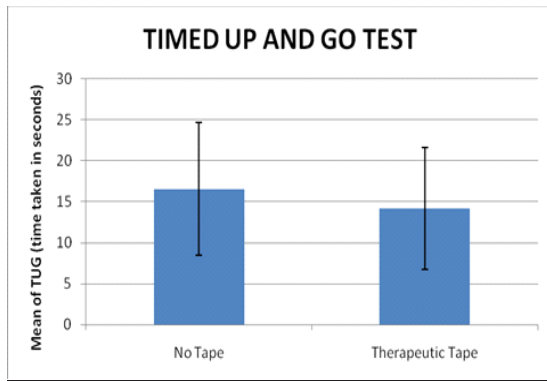
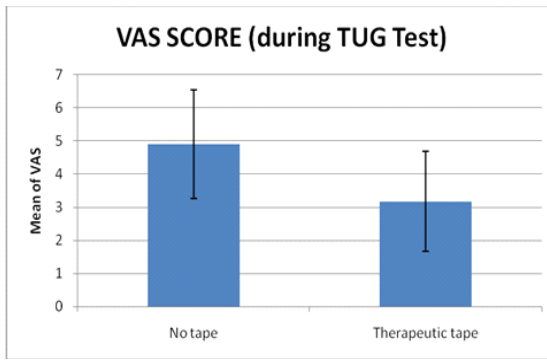


Fig 4: VAS Scores during TUG Test



Discussion

This study provides an evidence to support the use of Mc Connell taping in managing painful Patellofemoral osteoarthritis. Our results suggest that patellar taping reduced pain and observed disability in patients with Patellofemoral Osteoarthritis.

Pain level

An immediate reduction in pain level, as quantified by the Visual Analogue Scale(VAS), with the application of patellar taping was seen. Several mechanisms may explain the pain-relieving effect of therapeutic tape. Many studies suggest that tape can improve patellar alignment in healthy controls and those with

PFPS⁽²⁶⁻²⁸⁾. It has been seen that Patellofemoral joint degeneration is present in most people with knee OA^(2,29), predominantly affecting the lateral compartment^(30,31). Radiographic PFJ OA has been correlated with patellar malalignment⁽³²⁾, and this in turn is associated with increased peak patellofemoral contact pressures and loading of the lateral facet⁽³³⁾. Therapeutic tape may thus ease pain by improving patellar alignment by the repositioning of the patella within the trochlear groove (McConnell 1996) thereby relieving pressure on the damaged lateral facet of the patellofemoral joint and improving tracking of the patella and function of the quadriceps mechanism^(34,35). Radiological studies of Larsen et al.(1995)⁽³⁶⁾ and Roberts (1989) and the MRI study of Davies (1998), which have all shown taping to have a positive effect on patella alignment^(37,38). However a number of studies have failed to find significant changes in patella position with taping. For instance, in a radiographic study by Bockrath et al., although patella taping was found to contribute to a dramatic reduction in pain, it was not associated with change in patella position. Some et al found that taping reduced pain by 45% and improved medial tilt of the patella, but had no effect on patella glide. Thus the pain relief from taping may be due to mechanisms other than mechanical or positional changes⁽¹⁷⁾. It is seen that infrapatellar fat pad is a pain-sensitive soft tissue, often inflamed secondarily to other knee joint pathology and is proposed as a source of pain in knee OA⁽¹³⁾. Pain relief is also probably achieved by unloading painful, inflamed infrapatellar fat pad⁽¹⁹⁾. It is proposed in some studies that therapeutic tape, by shortening the soft tissue of the fat pad, may relieve pain based on the principle that inflamed soft tissue does not respond well to stretching⁽³⁹⁾.

Alternatively some studies suggested pain relief may be due to cutaneous effect of patellar tape by eliciting neural inhibition by facilitating large afferent fiber input. Changes in neural input through afferent receptors, such as cutaneous mechanoreceptors and Messner corpuscles, from the patellar tape application may have been enough to block

nocioceptive input and cause neural inhibition via the large afferent fibers, thus causing pain relief⁽⁴⁰⁾.

Observed disability

The step test is a functional, dynamic test of standing balance⁽²³⁾ and showed significant improvement in our study. A study reported that dynamic standing balance (step test) improved with therapeutic tape, but was not attributable to concurrent pain reduction. As participants reported a sense of 'support' when wearing therapeutic tape, improved confidence in the knee may have resulted in more steps with the contralateral limb whilst standing on the symptomatic limb⁽¹³⁾.

It was found that the weakness of the quadriceps is most commonly associated with knee osteoarthritis⁽⁴¹⁾. Several studies provide evidence to suggest that while VMO and VL onset occurs simultaneously in asymptomatic subjects, there is a delay in VMO onset relative to VL in subjects with PFP during the performance of functional tasks. A number of studies have investigated the effect of taping on temporal and spatial characteristics of vasti muscle activity. For example, Cowan et al reported a change in timing of vasti muscle activity during a stair stepping task following the application of tape. Gilleard et al (1998) found that during the step up task the onset of the VMO activity occurred earlier with the taping but there is no change in VL activity and because of the early activation of the VMO as compared with VL activity allows more optimal positioning of the patella into the trochlea. Also this early activation of VMO as compared with VL activity during step down task helps to improve the timing of force distribution and decrease the pressure placed on a particular portion of articular cartilage. The change in onset of muscle activity may change the relative excitation of the VMO and VL⁽⁴²⁾.

The percentage improvement of 14% was apparent in Timed up and go test. This could be attributed to concurrent pain relief, improved patellar tracking, increased

quadriceps peak torque and improved proprioception.

Some studies have reported an increase in overall quadriceps peak torque or force generating ability and improved functional performance^{37, 38, 44}. There are two main explanations for this: The most commonly reported one is due to reduction in arthrogenic inhibition of the quadriceps (Herrington, 2004)³⁷. Plausible hypothesis being that taping reduces the inhibition of the quadriceps causing increase in quadriceps peak torque. Reflex inhibition of the quadriceps and its contribution to weakness following trauma have long been established (Stokes & Young 1948). The reduction in muscle activation being due to abnormal afferent input (sensory information), decreasing alpha motor neuron excitability, via a reflex loop at the dorsal horn of the spinal cord (Hurley 1997)⁴⁴. This in turn decreases the activation of the muscle. Taping possibly brings about a change in afferent input into the dorsal horn decreasing the inhibition placed upon alpha motor neuron excitability. Alternatively, the taping unloads the mechanically irritated and swollen periarticular soft tissues, such as the synovium, instantaneously relieving pain (Dye et al. 1999)⁴⁵. An alternative explanation suggest that the repositioning of the patella by patellar taping brings about a change in the leverage offered to the quadriceps by the patella, maximizing the mechanical advantage of the quadriceps. The larger the mechanical advantage, the less the quadriceps force (and therefore less patellofemoral joint compression) required to produce the same torque (Norkin & Levangie 1992)⁴⁶. Conway et al. (1992) proposed that the distal displacement of the patella during knee flexion is limited by anchoring the patellar tape to the medial aspect of the femur. This would maintain the knee extensor moment arm in a more advantageous position, thus accounting for the increase in quadriceps function⁽⁴⁷⁾.

Proprioceptive deficits have been found in osteoarthritic knees⁴⁸. Callaghan suggested that patellar taping improve proprioception and the sense of mechanical stability of the

patella to promote normal knee function⁴⁸. Under the influence of patellar taping, altered afferent input from the muscular, ligamentous and cutaneous structure in and around the patellofemoral joint may improve proprioceptive function in patients with PFPS^{43,49}. One study evaluated tape's effects on knee proprioception in 52 healthy volunteers using a taping procedure similar to our technique and found that no change in JPS was demonstrated. However, when participants with good and poor proprioception were compared, taping improved poor proprioceptive acuity, suggesting that tape only benefits individuals with poor acuity at the outset⁽⁴⁹⁾. On the contrary a study on immediate and short-term effect of continuous (3 weeks) application of knee tape on quadriceps sensorimotor function in individuals with symptomatic knee osteoarthritis (OA) did not observe beneficial effects of tape on proprioception. Plausible reason cited being (a) immediate, increased input from cutaneous afferents, triggered by contact and movement of rigid tape on the skin, may 'confuse' the nervous system, rather than enhance, and may explain the greater inconsistency in JPS, (b) given that muscle receptors play a primary role in mediating proprioceptive information and the relatively small area of skin covered by tape, it is probable that enhanced cutaneous sensation with tape is insufficient to result in positive changes in JPS¹⁹. Conflicting findings are reported about external knee supports and proprioception in OA.

Many studies have also suggested an increase in knee loading response with patellar taping permitting increased shock absorption and quadriceps activity. Crossley et al (2002) found that patellar taping cause a small but a significant increase in loading response in knee flexion during the taped condition while walking at two speeds, up and down ramps and up and down stairs. The magnitude of this change was very small (average) about $\frac{3}{4}$ degrees. It indicates an ability to load the knee joint with confidence during all gait conditions also stride length is improved following the taping during the ascending ramp condition³⁴.

Conclusion

The finding of this study supports the experimental hypothesis that therapeutic taping reduces pain and observed disability in patients with patellofemoral osteoarthritis.

Therefore it is suggested that therapeutic taping is of clinical value in knee osteoarthritis.

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