KINESIO TAPING AND PATELLOFEMORAL PAIN SYNDROME: A SYSTEMATIC REVIEW

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Abstract. Patellofemoral pain syndrome occurs when there is a degeneration of the patellar cartilage between both bone surfaces of the femur and the patella. Its characteristic symptom is anterior knee pain that worsens when this joint is moved. The aim of the study was to determine the effectiveness of kinesio taping on patellofemoral pain syndrome through the analysis of published scientific studies up until June 2014. A literature search was carried out in the following electronic databases: Scopus, Sport Discus, PEDro, Cochrane Library Plus, Embase, Web of Science and Science Direct to locate studies that were relevant to this review. Out of 159 articles examined, after eliminating duplicates and upon completion of reading them, the review was finally reduced to 12 articles. After reviewing the literature regarding the effectiveness of kinesio taping on the improvement of knee pain, we concluded there is insufficient scientific evidence to support this theory. It is an inexpensive technique that can be combined with other therapies and has no side effects, but there is controversy in the analyzed studies on its possible benefits on the patellofemoral pain syndrome. For this reason, it is essential to carry out further methodologically sound research regarding the usefulness of kinesio taping in the treatment of this syndrome.

Key words: kinesio tape, elastic tape, chondromalacia patella, knee pain

Introduction

Patellofemoral pain syndrome (PFPS) or chondromalacia patella is a degeneration of the patellar cartilage existing between both bone surfaces of the femur and the patella. Its most important clinical symptom is characterized by anterior knee pain that is magnified when movements from flexion to extension are performed by the knee while the patella does not move smoothly within the trochlear groove (Dutton et al. 2014). There are several reasons that can cause this syndrome: a disalignment femoro-tibial, muscle weakness, patellar prior traumatic injury (fracture, dislocation), overuse of the joint, arthritis, etc. (Dutton et al. 2014; Freedman et al. 2014; Kase et al. 2003). The main objectives to rehabilitate this pathology will be to reduce the pain and improve the neuropropioceptive information (Mendez et al. 2014).

Different rehabilitation strategies like electrotherapy, exercise, cryotherapy, etc. can be used to achieve both objectives. However the present review will focus on the effectiveness of a specific treatment: the use of kinesio taping (KT). KT is a cotton tape with a layer of hypoallergenic adhesive which can elongate up to 140% of its original length. Its characteristics are similar to human skin and have several mechanisms of action such as: biomechanics, exteroceptive, circulatory, analgesic... (Brateanu 2009). KT lifts the skin forming convolutions, increases the blood and lymphatic circulation of the subdermal area where it is applied (Kase et al. 2003; Celiker et al. 2011; Bassett et al. 2010). This methodology of elastic tape is being increasingly used by trainers, osteopaths and physiotherapists around the world (Bandyopadhyay and Mahapatra 2012; Calero and Cañón 2012). However, there is still controversy about the effects of KT in the treatment of PFPS. Some studies which have been performed on PFPS found improvements in parameters such as muscle activity, functionality and especially on pain intensity (Campolo et al. 2013; Osorio et al. 2013; Montalvo et al. 2013; Chen et al. 2008; Chang et al. 2012; Yang et al. 2014). However, others do not achieve results that support such effectiveness (Aytar et al. 2011; Akbas et al. 2011; Mendez et al. 2014; Bayracki et al. 2008). Therefore, this systematic review was conducted to shed light on the effectiveness of KT. Consequently, the objectives of this review will be: To update data on the effectiveness of KT in the treatment of PFPS, provide possible guidelines for the application of KT on PFPS and promote future research on this issue.

Methods

Search strategy

The following seven electronic databases were searched from their inception through June 2014: Scopus, Cochrane Library Plus, Physiotherapy Evidence Database (PEDro), Sport Discus, Embase, Web of Science (all databases) and Science Direct. The search terms used were based on two concepts. Concept one included terms for the Kinesio Tape (Kinesio* tap*, elastic tap*, neuro tap*, vendaje neuromuscular) and concept two included terms for patellofemoral syndrome (PFS) (Knee, chondromalacia, patell*, femoro-tibial). The terms of the same concept were combined together with the Boolean operator “OR” and then the two concepts were combined using the Boolean operator “AND” (Benito et al. 2007). The keywords that consisted of more than one word were enclosed in quotes. In addition, the reference lists of all included papers were manually searched.

Selection criteria

The selection criteria to identify studies that examined the effect of KT on the patellofemoral syndrome were: Clinical trials whose main objective was to evaluate the effect of KT treatment on anterior knee pain. In addition to papers, master/doctoral dissertations and conference proceedings were also accepted. No language or publication date restrictions were imposed.

The initial screening of papers was conducted from the title and summary of them. Finally with the selected studies, we proceeded to read the full texts. Names of the authors, years of publication, sample sizes, study variables, KT techniques applied and results of each study were extracted for this review.

Results

After the literature review, 12 relevant studies about the effectiveness of KT on PFPS were selected. The results that describe each study (Table 1) and most studied parameters are detailed below:

Table 1. Summary of selected studies

Author, year	Sample size	Outcomes	KT technique	Results
1	2	3	4	5
Akbas et al. 2011	N = 31 F Age = 45 GC = 16 GE = 15	Pain intensity, Functionality, Flexibility Patellar alignment	Common E for both Gs. GE: I-shaped KT over TFL from origin to insertion, Y-shaped KT over internal vastus, hamstrings and femoris rectus. The strip over femoris rectus surrounds patella with 50–75% tension.	To add KT to conventional treatment does not improve pain, but seems to improve hamstring flexibility.
Aytar et al. 2011	N = 20 M Age = 24 GE = 12 GP = 10	Muscle strength, joint range, static and dynamic balance, pain	GE: I-shaped KT over medialis and lateralis vastus from origin to insertion. A I-shaped strip over femoris rectus ending Y-shaped form to both sides of patella (hight tension). KT was applied without tension in the sham G.	KT did not work on the reduction of pain or on the propioceptive sensation, but improved strength and balance.
Campolo et al. 2013	N = 20 Age = 24 – 3 15 F y 5 M	Knee pain climbing stairs Sore Knees doing squats with weight	One of Gs, a I-shaped KT strip was applied over femoris rectus (10% tension) ending Y-shaped form to both sides of patella (50–75% tension). Another G had the McConnell technique applied: rectangular tape over knee.	Both methods (KT y McConnell taping) reduce pain during functional activities (climbing stairs, for example) vs control.
Jancaitis et al. 2007	N = 14 Age = 25 ±8 8 F y 6 M GE GP	Pain during activities or at rest	No provided information.	KT did not improve pain and functionality in the KT G vs. Sham KT although there was improvement on pain when walking downstairs. The results were not significant.
Kuru et al. 2012	N = 30 26 F y 4 M Age = 32 ±12 1 = KT + E 2 = E" + E	Pain, joint and muscle range, functionality, life quality	I-shaped KT was applied over rectus femoris from origin to insertion ending Y-shaped over both sides of patella. The same application was carried out over the internal vastus.	KT and electrostimulation improve pain intensity, functionality, strength and quality of life. No differences between both Gs.
Osorio et al. 2012.	N = 20 Age = 21 ±9 13 F 7 M	Strength Pain Isokinetic resistance	Taping McConnell: A KT strip over knee and a leukotape strip over internal side of patella. Taping Spider: A previously cut strip on inferior pole of patella and two Y-shaped strips surrounding patella with tension.	KT improves PFPS but no differences were found between the KT techniques applied.
Chen et al. 2008.	GE = 15 F Diagnosed with PFPS GC = 10 healthy F	Reaction force, EMG activity of medialis and lateralis vastus	KT over medialis and lateralis vastus according to Kase manual. Evaluation of different Gs to walk up and down stairs: KT G, CG, sham G.	KT can reduce pain and improve activity of certain muscles that stabilize the patella
Bayrakci et al. 2008.	15 F diagnosed with PFPS 15 healthy F Age = 44	Go and up test, 10 m walking test, down and up stair test	Both Gs had the McConnel taping technique applied and patellar KT	There was positive effect of KT on healthy subjects but not in patients diagnosed with PFPS.
Chang et al. 2012.	N = 15 Age = 23	Pain Strength EMG activity	KT was applied over lateralis and medius vastus of quadriceps but patients were asked prior to flex their knee.	Pain was reduced significantly and increased maximal isometric contraction. KT applied around the knee improves functionality.

1	2	3	4	5
Yang et al. 2014.		Pain, EMG activity over vastus medialis and lateral	GE = 5 days applying KT and stretching exercises GC = sham KT without stretching exercises Both Gs had ultrasound treatment	KT decreases pain intensity and increases muscle activity in the GE vs. GC.
Miller et al. 2013	N = 18 Age = 19,5 ±1.15	Functionality of lower extremity, joint range, balance	3 Gs: KT G (two upright crossed strips on femur and ending on iliac crest), manipulation G (thrust technique over lower back) and sham KT G (a I-shaped horizontal KT strip from posterior iliac crest to anterior iliac crest).	KT encourages muscle activity of medius gluteus and improves postural stability of lower extremities
Freedman et al.	N = 49 Age = 12 – 25	Functionality Jump test Pain	GE: An I-shaped KT strip was applied over 2/3 femur, then surrounding patella and ending tibial tuberosity. The ends of bandage were applied without tension. GC: Two horizontal strips, one of them above the superior patella pole and the other below the inferior pole of the patella.	KT improve pain in comparison with sham treatment

Notes: N – size sample; GE – experimental group; GC – control group; M – males; F – females; GP – placebo group; TFL – Tensor fascia lata; 1 – first group; 2 – second group; E" – electrotherapy; E – exercises; EMG – electromyography, Groups: Gs.

Effect of KT on Pain

Some studies found reduced pain in the experimental group (EG) after applying KT compared with the control group (CG) (Chen et al. 2008). Others found no difference between the KT and other types of taping (Campolo et al. 2013; Kuru et al. 2012; Osorio et al. 2013). Finally, there were studies in which the KT had no effect on pain (Akbas et al. 2011; Aytar et al. 2011).

Effect of KT on muscle activity

On the other hand, some studies found an increase in muscle activity of the lower limb (mainly quadriceps) in the EG after applying KT compared to CG (Aytar et al. 2011; Yang et al. 2014; Chen et al. 2008). Others, however, found no difference between the KT and other therapies for muscle stimulation (Kuru et al. 2012) or between other types of taping (Osorio et al. 2013).

Additionally, other parameters were also studied: Akbas et al. (2011) observed an improvement in the flexibility of certain muscle groups (hamstrings and tensor fascia lata) at 6 weeks after applying KT compared with the control group; another studied parameter was the patellar alignment in which Akbas et al. (2011) found no differences between the control and KT group, conversely Chen reported that KT encouraged a previous activation of quadricep muscles and a patellar alignment in the trochlear groove. Another studied parameter was balance; in this case the author Aytar et al. (2011) found an improvement in static balance after applying KT.

Discussion

Aytar et al. (2011) carried out a study on 20 patients diagnosed with PFPS in order to analyse the short-term effects of KT on pain. The application of KT did not decrease pain intensity nor did it influence the propioceptive sense of the patients. However, there was a reported increase in quadricep strength 45 minutes after KT application. Along the same lines, Akbas et al. (2011) compared two groups that did the same type of strenghthening and flexibility exercises for lower limbs, but differed in that one group had KT applied and the other did not. At the end of the study it was demonstrated that KT did not decrease pain nor did it improve functionality. Campolo et al. (2013)

found a beneficial effect of KT in patients diagnosed with PFPS in functional activities such as climbing stairs or standing up from a sitting position. However Jancaitis et al. (2007) observed that after applying KT on patients with PFPS, they could walk down stairs better than before; however, these results were not statistically significant, so it was concluded that KT could have had a placebo effect.

Kuru et al. (2012) conducted a comparative study to show which of the two treatments (KT or electrostimulation) reported greater improvements on PFPS. 30 patients were separated into two groups: one of the groups had KT applied and were given knee exercises and the other had electrostimulation applied and had to perform exercises. Sessions were individual and lasted for 45 to 50 minutes, 3-times a week for 6 weeks. Patients were asked to do exercises at home on non-treatment days. These were strengthening exercises (Quadriceps muscle isometric contraction) and stretching exercises of quadriceps, hamstring, gastrocnemius and iliotibial muscles. There were improvements in both groups on pain and muscle activity. In addition, Yang et al. (2014) achieved an increase in muscle activity in the rectus femoris, hamstrings and tibialis anterior after KT application.

In a study by Osorio et al. (2013) on 20 patients with active PFPS it was observed how KT improved perceived pain. Osorio noted a decrease in pain after applying both Spider and McConnel techniques versus the baseline; however there was a greater decrease in pain after applying the Spider technique. It is assumed that the reason for this difference is because the latter type of bandage (Spider) covers a larger area on the knee than the McConnel technique. Moreover, Osorio et al. (2013) noticed an increase in isokinetic quadriceps strength after applying both Spider & McConnel techniques compared to the baseline, but found no difference between the two.

Chen et al. (2008) demonstrated the effectiveness of KT, which improved patellar pain and stability in 15 women diagnosed with PFPS compared with a control group of 10 healthy women; it was thought that the quadricep muscle was activated earlier in the KT group than in the no tape group, in addition there were no differences found between the placebo and the no tape group. Finally, Chen et al. (2008) also found a decrease in pain after application of KT.

On the other hand, Bayracki et al. (2008) obtained improvement on the physical condition of healthy subjects but not on patients with PFPS after using KT. Chang et al. (2012) wanted to analyse the effect of KT on muscle activity of the vastus medialis and lateral quadriceps and on pain in patients with patellar pain. The results obtained on 15 patients were positive regarding these two parameters, and therefore it was concluded that KT applied around the patella improved the functionality of the femoro-patellar joint. In the same vein, other authors agree with these results (Hassan et al. 2002; Yang et al. 2014; Chen et al. 2012).

Miller et al. (2013) applied KT on the gluteus medius; this was combined with lumbo-pelvic osteopathic manipulation on 18 patients with unilateral patellar pain, who obtained improvement over postural stability of the lower limbs.

To sum up, from the results mentioned above it can be concluded that there is a discrepancy regarding the effectiveness of KT on the treatment of anterior knee pain; some studies show statistically significant improvement in the pain variable after applying KT and others are inconclusive.

In certain studies, KT seems to influence other variables other than pain such as: muscle flexibility, muscle strength, balance, joint stability, functionality and quality of life (Akbas et al. 2011; Aytar et al. 2011; Kuru et al. 2012; Chang et al. 2012).

On the other hand, there is a more or less homogenous protocol on how to apply the KT bandage for the treatment of PFPS.

An I-strip is applied on the rectus femoris from its origin to its insertion with 10% stretch applied (muscular facilitation mode) ending in a Y-shape on either side of patella with 50–75% tension, while maintaining a slight knee flexion at 30 degrees. Finally, the ends of the bandage are applied with no tension. This technique is explained in greater detail by Campolo et al. (2013) (Figure 1) (Aytar et al. 2011; Kuru et al. 2012).

Figure 1. KT for the treatment of PFPS

This protocol of KT differs from the explained protocol by Kase et al. (2003), who reports three different options for the treatment of PFPS:

- One protocol consists in applying an I-strip over one side of the patella with 50–57% tension to make a mechanical correction.
- In the second option a Y-shaped strip is applied transversely from the internal side of the knee, passing a strip of bandage with 50% stretch applied over the upper pole of the patella and the other strip below the lower pole, without applying tension on the ends of the tape.
- Finally, the third option is similar to that described above, but is performed from the lateral side of the knee.
- These three techniques can be combined with an optional bandage that would go from origin to insertion over the vastus medialis to stimulate muscle activity, or insertion to origin to inhibit its activity (Kase et al. 2003).

KT in addition has benefits not only on the knee pain caused by PFPS. Osterhues (2004), in a study of a case of patellar dislocation, observed that using KT had improved quadricep muscle activity and joint stability during functional activities. Chang-Mo et al. (2011) in another study on 19 subjects with an average age of 65 diagnosed with degenerative osteoarthritis of the knee, obtained positive outcomes with KT on measured parameters (pain, joint range and muscle strength) in the group treated with KT. In a similar vein, other authors have also verified in their studies the beneficial effects of KT on knee osteoarthritis (Hinman et al. 2003; Hassan et al. 2002; Chen et al. 2012; Quilty et al. 2003). By contrast, there are other knee pathologies where the utility of KT is not well defined. For example, Smith et al. (2013), in a meta-analysis they designed, considered KT a nonsurgical treatment for patellar dislocations, but concluded that its clinical effectiveness was not yet clear.

Limitations of the studies: Gender, age and size of the samples, the variability in the number of sessions applied, different types of therapies that were applied with KT, different modes of application of KT for the same diagnosis... All of these factors made it difficult to determine the effect of KT.

After reviewing the literature on the effectiveness of KT on PFPS it was concluded that KT seems to improve knee pain in clinical practice, but there is insufficient scientific evidence to verify this theory. That is why we stress the importance of conducting more methodologically sound studies to clarify some questions that exist among health professionals about the scientific evidence of the effect of KT on PFPS (Mendez et al. 2014; Montalvo et al. 2013; Mostafavifar et al. 2012).

In conclusion KT is a novel therapeutic tool that can be used alone or in combination with other therapies. However, there is much controversy over its effectiveness in this clinical symptomatology. For this reason it is essential to conduct methodologically sound trials to prove the usefulness of KT in the treatment of PFPS.

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