Kinesio taping or sham taping in knee osteoarthritis? A randomized, double-blind, sham-controlled trial

Figen Kocyigit, Mehmet Besir Turkmen, Merve Acar, Nezahat Guldane, Tugce Kose, Ersin Kuyucu, Mehmet Erdil

PII: S1744-3881(15)30009-8
DOI: 10.1016/j.ctcp.2015.10.001
Reference: CTCP 607

To appear in: Complementary Therapies in Clinical Practice

Received Date: 3 August 2015
Revised Date: 11 September 2015
Accepted Date: 4 October 2015


This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.
Kinesio taping or just taping in knee osteoarthritis? A randomized, double-blind, sham-controlled trial

Correspondence: Figen Kocyigit *1, MD, Assistant Professor

*1: Denizli State Hospital, Department of Physical Medicine and Rehabilitation, Denizli, Turkey

1: Permanent address: Pamukkale University, School of Physical Therapy and Rehabilitation, Denizli, Turkey

Mailing Address: Pamukkale Universitesi, School of Physical Medicine and Rehabilitation, Denizli/TURKEY

e-mail : figen7876@yahoo.com
Tel : +902584444295
Fax :+902582964494

Mehmet Besir Turkmen*2, MD

*2: Denizli State Hospital, Department of Physical Medicine and Rehabilitation, Denizli, Turkey

Mailing Address: Denizli State Hospital, Murat Dede Mah. Sehit Albay Karaoglanoglu Cad. No:1 Denizli/TURKEY

2: Permanent address: Norobilim Medical Center, Department of Physical Medicine and Rehabilitation

e-mail:drbesir@hotmail.com

Merve Acar*3, MD

*3: Denizli State Hospital, Department of Physical Medicine and Rehabilitation, Denizli, Turkey

Mailing Address: Denizli State Hospital, Murat Dede Mah. Sehit Albay Karaoglanoglu Cad. No:1 Denizli/TURKEY

3: Permanent address: Kecioren Training and Research Hospital, Department of Physical Medicine and Rehabilitation, Ankara, Turkey

Nezahat Guldane*, Physiotherapist

*: Denizli State Hospital, Department of Physical Medicine and Rehabilitation, Denizli, Turkey

Mailing Address: Denizli State Hospital, Murat Dede Mah. Sehit Albay Karaoglanoglu Cad. No:1 Denizli/TURKEY
Tugce Kose\textsuperscript{a}, Physiotherapist

\textsuperscript{a}: Denizli State Hospital, Department of Physical Medicine and Rehabilitation, Denizli, Turkey

**Mailing Address:** Denizli State Hospital,, Murat Dede Mah. Sehit Albay Karaoglanoglu Cad. No:1 Denizli/TURKEY

e-mail: nezle_43@hotmail.com

Ersin Kuyucu \textsuperscript{b}, MD

\textsuperscript{b}Medipol University, Faculty of Medicine, Department of Orthopedics and Traumatology

**Mailing Address:** Medipol University, Faculty of Medicine, Department of Orthopedics and Traumatology, Göztepe Mahallesi, Metin Sokak No:4, 34214 Bağcılar/Istanbul

e-mail: ersinkuyucu@yahoo.com.tr

Mehmet Erdil \textsuperscript{b}, Associate Professor, MD

\textsuperscript{b}Medipol University, Faculty of Medicine, Department of Orthopedics and Traumatology

**Mailing Address:** Medipol University, Faculty of Medicine, Department of Orthopedics and Traumatology, Göztepe Mahallesi, Metin Sokak No:4, 34214 Bağcılar/Istanbul

e-mail: mehmet.erdil@medipol.com.tr
**Purpose:** to compare effects of kinesiotaping with sham taping at the end of 3 consecutive taping periods in knee osteoarthritis.

**Methods:** 41 patients diagnosed with knee osteoarthritis according to American College of Rheumatology were randomized to receive either KT or sham taping. Baseline evaluations included a visual analog scale (VAS) for activity and nocturnal pain, Lequesne index for functional assessment and Nottingham Health Profile (NHP) for the quality of life. Taping was applied every four days, three times, and all of the assessments were repeated at the end of the treatment period.

**Results:** In both groups VAS for activity pain, VAS for nocturnal pain, Lequesne index score, NHP score decreased significantly. NHP energy scores were different significantly between the groups in favor of sham taping at the end of the 12-day period.

**Conclusion:** Our findings indicate inconclusive evidence of a beneficial effect of kinesiotaping over sham taping in knee osteoarthritis.
Kinesio taping or sham taping in knee osteoarthritis? A randomized, double-blind, sham-controlled trial

1.1 Introduction

Osteoarthritis (OA) is the most frequent form of arthritis. The knee is one of the most commonly involved joints because of weight bearing and repeated movements. Knee osteoarthritis is one of the leading causes of knee pain and functional limitation [1, 2]. The different types of pain (activity, at rest, nocturnal) and functional limitation may affect the quality of life in the elderly population [3].

Management of knee OA represents a challenge for the scientific community [1]. Non-operative measures, such as modification of daily living activities, weight loss, physical therapies including exercise, electrotherapy and taping, nonsteroidal anti-inflammatory drugs, and injection therapies alleviate symptoms in most of the patients with mild-moderate knee OA.

Kinesio taping (KT) has emerged as an interesting method that can be applied virtually in any musculoskeletal injury. Kenzo Kane, a chiropractor, introduced this technique in 1979 in Japan. Kinesio tape is an elastic adhesive material that has a high stretching capacity to ensure the free mobility of the applied area [4].

Immediate effects of KT in knee OA was investigated in a recent study. Pain decreased significantly immediately after taping in KT group compared to sham taping [5]. Another study investigated effects of KT on isokinetic quadriceps torque in knee osteoarthritis and concluded that therapeutic KT was effective in improving isokinetic quadriceps torque and reducing pain [6]. Likewise, this study also investigated the immediate effects of KT and sham taping was applied with KT. None of the mentioned studies investigated effects of KT on functional parameters and quality of life.

Namely there is not much mention of KT for knee OA management in the literature. Moreover, sham taping design of previous studies is somewhat inadequate. Taping in the same way as therapeutic banding but with a non-therapeutic material would fit better with the definition of ideal sham taping. The results would be more attributable to the therapeutic material instead of taping method.
The aim of this study is to compare effects of KT with sham taping in patients with knee OA. Also we investigated the effects of KT on functional status, quality of life as well as pain during activity and nocturnal pain at the end of 3 consecutive taping periods.
1.2 Materials and Methods

This is a randomized, double-blinded, placebo-controlled study that aims to investigate the efficacy of KT in patients with knee OA when compared to the sham taping.

We performed power analysis for the sample size estimation. Type I error ($\alpha$) was set at 0.05 and power of the test was selected 0.80 and calculated sample size appropriate to test the hypothesis and have confidence was 41. The number of patients to ensure that the final sample size is achieved was calculated to be 46 when the proportion of attrition is accepted 10% [7]. We allocated 43 patients for the study and stopped recruitment when the estimated study size was achieved. All procedures performed in our study were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. All volunteers were informed about the study procedure, and they gave oral and written informed consent.

1.2.1 Study Population

50 patients who were presented to the institutional outpatient clinic with a primary complaint of knee pain were scrutinized for enrollment in the study to reach the estimated allocation number. One patient had documented anterior cruciate ligament rupture and knee joint instability. One patient was diagnosed as ankylosing spondylitis. Two patients had electrotherapy for knee, and one patient had intra-articular knee injection in last six months. We excluded five patients because they did not match inclusion criteria. Two patients declined to participate. Finally, 43 patients were allocated. One patient from KT group was unwilling to continue taping because of difficulty in transportation. We excluded one patient during the follow-up because of mild pruritic rash in the control group. Finally, data from 41 patients were analyzed (Figure 1). Table 1 shows the inclusion and exclusion criteria for the study.
Table 1. Inclusion and exclusion criteria for the study

<table>
<thead>
<tr>
<th>Inclusion Criteria</th>
<th>Exclusion Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knee pain diagnosed as knee osteoarthritis according to clinical diagnostic criteria proposed by ACR.</td>
<td>History of previous knee fracture/surgery in last six months</td>
</tr>
<tr>
<td>Mild –moderate knee pain (VAS between 20-70 mm)</td>
<td>Previous or concurrent diagnosis of cruciate and collateral ligament tear</td>
</tr>
<tr>
<td>Age between 30-70 year</td>
<td>Presence of acute inflammation findings in the involved knee (swelling, erythema, redness)</td>
</tr>
<tr>
<td>No previous application of Kinesio taping.</td>
<td>Inflammatory joint disease</td>
</tr>
<tr>
<td>Approval of inclusion in the study</td>
<td>History of electrotherapy or injection for the knee in the last three months</td>
</tr>
</tbody>
</table>

The admission complaint of the patients was knee pain and/or stiffness. We diagnosed the patients as knee osteoarthritis according to clinical criteria for the classification of idiopathic OA of the knee that were developed by American College of Rheumatology (ACR) [8]. Comprehensive physical and neurological evaluations were performed to rule out other clinical conditions (paresis, cruciate ligament tears, inflammatory arthritis) causing knee pain. We questioned and recorded co-morbidities.
All patients were advised to modify daily living activities (avoid kneeling, restriction of walking distance to the painless range) to obtain relative rest and prevent further loading of the affected knees. Use of nonsteroidal anti-inflammatory drugs was restricted during the study period. Patients were informed to contact the doctor if they experience pain that does not respond to rest.

Figure 1. Flow diagram showing the progress of subjects at each stage of the clinical trial
1.2.2 Group Assignment and Taping Technique

We used the numbered envelopes method for randomization of patients into two groups. Group 1 (n=22) was the KT group, and group 2 (n=21) was the sham taping group.

‘Y-strip’ is the most widely used of all strips in KT. It consists of a length of tape with a single longitudinal section continuing from one end for a specified distance along the center of the tape. The other end of the tape is left intact, resembling the letter “Y”. I-strip has no cut down the middle of the tape. When a little bit of the paper is torn off, and the tape is applied directly to the skin as it comes off the paper backing, a “paper-off” tension is used. The first strip was a Y-strip representative of the quadriceps. It was applied when the patient was lying in the supine position, knee in maximal flexion. Tails of the quadriceps strip were applied to the patella, wrapping patella medially and laterally with 25% tension. The base of the strip was applied with paper-off tension towards the anterior superior iliac spine. The second strip, a Y-strip was applied between tibial tuberosity and inferior pole of the patella when the knee is flexed 90 degrees. The tails of the second strip are again applied wrapping patella medially and laterally. The tails are directed towards vastus medialis and vastus lateralis. The third strip was an I-strip applied when the knee was flexed 30 degrees. The strip was applied to patella mediolaterally with 75% tension in the middle and paper-off tension at the ends. (Figure 2).

Figure 2. Kinesio taping application
The control group received sham taping with 5 centimeters Beta fix Surgical Hypoallergenic Flexible Tape. Identical strips were used for sham taping that did not attempt to correct misalignment by reducing muscle spasm and enhance local circulation as expected for KT. We did not apply tension to the tape during application; as the structure of the tape was not suitable for tension. The tape was overlaid on the skin (Figure 3). Taping was applied immediately following initial measurements by the same physiotherapist in each patient. Taping was repeated every four days, three times.

Figure 3. Sham taping application

The taping applications looked similar except for the color of the tape. Therefore, we do believe that blinding of the subjects was appropriate. All of the patients stated that they were unaware of their group assignment at the end of the study.

1.2.3 Outcome Measures

We assessed all patients at baseline, at the end of taping period (12th day). Assessments were performed by the same physiatrist (FK, MBT or MA) for each patient. Taping was applied by the same physiotherapist in each patient (NG or TK). Physiatrists evaluated the patients after the tapes were removed and, therefore, were blinded to the type of taping. The primary outcome
measures were pain intensity with activity and at night. We measured pain intensity during activity and at night on a 100-millimeter visual analog scale (VAS).

We applied Lequesne index for functional assessment and Nottingham Health Profile (NHP) for the quality of life evaluation.

Lequesne index was developed in 1987 to evaluate the severity for osteoarthritis of the hip and knee. The Index has three sections to evaluate pain or discomfort, maximum distance walked and activities of daily living. The total score ranges between 0-24, and high scores demonstrate more severe involvement [9].

NHP is a self-administered questionnaire that is used to determine and quantify perceived health problems. It is divided into six subscales (sleep, mobility, energy, pain, emotional reactions, social isolation) and consists of 38 items [10]. Validity and reliability of the Turkish version of NHP were documented in 2000 [11].

1.2.4 Statistical Analysis

We performed statistical analysis with SPSS software, release 21.0 (SPSS Inc., an IBM Company, and Chicago, IL, USA). We used standard descriptive statistics to summarize characteristics of the participants including means and standard deviations (SD) of all continuous variables and counts and percentages for the categorical variables. An independent samples T-test or Mann-Whitney U test was used to compare group parameters before the taping. The paired sample t-test and Wilcoxon Signed-Rank test were used to compare outcomes before and after treatment. The Mann-Whitney U-test was used to compare improvements and differences between groups. Two-sided Statistical significance was defined as p<0.05.
1.3 Results

The study included 13 males (32%) and 28 females (68%). The mean age was 45 ± 15 years (range 20-65 years).

The mean age of the KT group was 52 ± 7.5 (range 40-70 years). The mean age of the control group was 52 ± 10 (range 32-70 years). Mean symptom duration was 90 ± 94 weeks (range 4-260 weeks) in the KT group and 58±55 weeks (range 4-208 weeks) in the control group. VAS for activity pain was 50±19 mm (range 20-100 mm) in the KT group and 54±21 mm (range 20-100 mm) in the control group. VAS for nocturnal pain was 40±27 mm (range 5-95 mm) in the KT group and 41±27 mm (range 0-100 mm) in the control group. There were no significant differences between the groups regarding symptom duration, VAS for activity pain, VAS for nocturnal pain at the baseline (p values were 0.123, 0.564, 0.839 respectively). Table 2 shows other demographic parameters.
Table 2. Demographical parameters of the study patients according to groups

<table>
<thead>
<tr>
<th>Demographical Parameter</th>
<th>Kinesio taping group</th>
<th>Control group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Number</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>17</td>
<td>0.597</td>
</tr>
<tr>
<td>Male</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Employment Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present employee</td>
<td>3</td>
<td>5</td>
<td>0.232</td>
</tr>
<tr>
<td>Unemployed</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Retired</td>
<td>6</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Presence of comorbidities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>9</td>
<td>8</td>
<td>0.866</td>
</tr>
<tr>
<td>Only one comorbidity</td>
<td>8</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>&gt;1 comorbidities</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Involvement</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right</td>
<td>7</td>
<td>5</td>
<td>0.886</td>
</tr>
<tr>
<td>Left</td>
<td>3</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Bilateral</td>
<td>11</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

The mean Lequesne index score was 10.2 ± 3.4 points (range 4-19.5). The mean NHP pain subdivision score was 56.54 ± 28.7 points (range 5.83-100), and the mean NHP physical activity
subdivision score was 32.8 ± 21.91 points (range 10.79-89.43). Table 3 shows baseline values of the evaluated parameters for each group.

In the KT group VAS for activity pain (p=0.01), VAS for nocturnal pain (p=0.009), Lequesne index score (p=0.001), NHP pain (p=0.01), and physical activity (p=0.035), scores decreased significantly after the treatment period. However control group also demonstrated significant changes concerning VAS for activity pain (p=0.011), VAS for nocturnal pain (p=0.001), Lequesne index score (p=0.001), NHP pain (p=0.03) after the treatment period (Table 3).

NHP energy scores (p= 0.016) were different significantly between the groups in favor of sham taping at the end of the 12-day period (Table 3).
Table 3. The baseline and post-taping scores for tested variables in the KT and sham taping group

<table>
<thead>
<tr>
<th>Variable</th>
<th>Kinesio taping group</th>
<th>Sham taping Group</th>
<th>Intergroup p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Day 12</td>
<td>p-value</td>
</tr>
<tr>
<td>---------------------------------</td>
<td>----------</td>
<td>--------</td>
<td>---------</td>
</tr>
<tr>
<td>VAS* activity</td>
<td>54±21</td>
<td>45±21</td>
<td>0.015</td>
</tr>
<tr>
<td>VAS nocturnal pain</td>
<td>40±27</td>
<td>26±22</td>
<td>0.009</td>
</tr>
<tr>
<td>Lequesne Index Score</td>
<td>9.9±2.6</td>
<td>7.7±3.1</td>
<td>0.001</td>
</tr>
<tr>
<td>NHP** pain score</td>
<td>57.65±31.53</td>
<td>43.45±32.84</td>
<td>0.010</td>
</tr>
<tr>
<td>NHP physical activity score</td>
<td>33.57±24.24</td>
<td>26.50±22.11</td>
<td>0.035</td>
</tr>
<tr>
<td>NHP energy score</td>
<td>46.35±28.71</td>
<td>53.02±32.54</td>
<td>0.354</td>
</tr>
<tr>
<td>NHP sleep score</td>
<td>32.19±35.52</td>
<td>24.67±35.13</td>
<td>0.215</td>
</tr>
<tr>
<td>NHP social isolation score</td>
<td>13.08±23.44</td>
<td>10.47±19.8</td>
<td>0.554</td>
</tr>
<tr>
<td>NHP emotional reactions score</td>
<td>16.25±25.88</td>
<td>15.40±26.01</td>
<td>0.851</td>
</tr>
<tr>
<td>NHP Total Score</td>
<td>199.81±124.51</td>
<td>173.62±138.03</td>
<td>0.183</td>
</tr>
</tbody>
</table>

*: Visual analog scale  **: Nottingham Health Profile
1.4 Discussion

We investigated the effects KT application on pain, functional performance and quality of life in patients with knee osteoarthritis. The results indicated that KT or sham taping both decreased the activity pain and nocturnal pain at the end of the treatment period. The study also revealed a similar significant increase in functional performance after taping in both groups. However, NHP energy and NHP total scores were significantly higher in sham taping group at the end of taping period.

Taping is an alternative method to reduce pain in knee osteoarthritis. There are different methods of taping. There are competing theories as to the mechanism through which the taping technique may be alleviating knee pain. One possible mechanism is at the proprioceptive level, with the tape providing knee position awareness. However, the typically expected effect is to increase the patellofemoral contact area, thereby decreasing joint stress and reducing pain [12].

On the other hand, KT is unique when compared to other types of tapes. KT is approximately the same weight and the thickness of skin and its elasticity allows for elongation to 30%-40% of its resting state. Reduction of pain through stimulation of sensory afferents, correction of misalignment by reducing muscle spasm, restoration of correct muscle function by supporting weakened muscles, enhancement of local circulation are the proposed mechanism of action suggested by the manufacturer [13]. Among these proposed mechanisms of action, restoration of correct muscle function and enhancement of local circulation are unique for KT.

Cho et al. investigated pain, active range of motion and proprioception in patients with knee OA. Pain decreased significantly immediately after taping in KT group compared to the sham taping. However Cho et al. performed a single KT application in this study; thus, the long-term effects of KT application are unclear [5].

Another study investigated effects of KT on isokinetic quadriceps torque in knee osteoarthritis. The aim was to assess results after one session of taping and sham taping was applied using KT without tension. Authors reported that the application of therapeutic KT was effective in improving isokinetic quadriceps torque, reducing pain during stair climbing in knee osteoarthritis [6]. Likewise, this study also investigated the immediate effects of KT and sham taping was applied with KT.
We documented a decrease in both activity, and nocturnal pain in this study after a 12-day interval of KT application. However, a similar significant pain reduction was also observed in sham taping group. Thelen et al. did not observe significant differences in shoulder pain reduction between KT and sham taping in patients with the shoulder subacromial impingement syndrome [14]. However, they reported improvement in pain-free shoulder ROM, which may be attributable to the effect of KT on muscle function. Similarly, Campolo conducted a study to compare the effectiveness of pain control during stair climbing by the KT versus the McConnell taping in patients with anterior knee pain. The results revealed no significant difference in pain between the groups [15]. A recent review by Parreira reported that KT was either no more effective than sham taping or its effect was too small to be considered clinically worthwhile [16]. Similar analgesic effect of KT and sham taping may be explained by the approximate thickness of the KT in relation to the epidermis of the skin. The simulation of epidermis with KT may avoid sensory stimuli [13]. To this end, it is unclear to what extent the gate control theory is involved in the efficacy of KT. It is plausible that the decongestive effect of KT may play a role in the efficacy of KT on pain reduction among musculoskeletal pain with swelling [17]. Exclusion of cases with swelling in this study may be explanatory for the similar analgesic effect of KT and sham taping.

KT improved Lequesne index scores, NHP pain, and physical activity scores significantly in this study. Sham taping also improved these scores significantly. The increment in functional Lequesne index in both groups may be explained by the mechanical support provided by both taping methods. Another possible mechanism for functional improvement may be pain alleviation via gate control theory.

Comparisons between the groups documented significantly higher NHP energy and NHP total scores in favor of sham taping group at the end of the treatment period. We cannot explain the underlying mechanisms for superiority of sham taping over KT. Similar to the results of the present study, a recent review investigating the effects of KT on disability reported that KT was not more effective than minimal or other forms of intervention in the reduction of disability related to chronic musculoskeletal pain [16].

KT is marketed in a wide range of bright colors and application methods are creative in contrast with other physical therapy modalities. KT application is a visible treatment, and its popularity is
still rising among active sports professionals since 2008 Beijing Olympics that increased familiarity of KT. [16]. KT is known as a popular method that supports rehabilitation and modifies some physiological processes. However, clinicians should carefully consider the costs and the effectiveness of this intervention when deciding whether to use this intervention.

The randomized placebo-controlled double-blind study design, sample size assessment with a power of 80%, application of a sham taping in the same manner with KT are strengths of this study.

The results of the present study need to be viewed in light of several limitations. The study was performed over a 12-day period thus excluding analysis of long-term benefits. Although the present study shows short-term relief of pain, studies utilizing a longer period are warranted to determine if there is a continued reduction in symptoms and if taping remains effective over time. Second, the Lequesne index and NHP may not have been sensitive enough to document the changes occurring over such a short period. Another limitation is the absence of a control group with no treatment. However, it would be unethical to leave patients having pain without treatment for 12 days.

Another area of potential research would be to substantiate the theoretical mechanical benefits of the technique through the use of biomechanical analysis.

1.5 Conclusions

Taping may represent an effective adjunct therapy in the management of knee osteoarthritis patients for activity and nocturnal pain control. The findings of the present study indicate inconclusive evidence of a beneficial effect of KT over sham taping in knee osteoarthritis.
References


We investigated the effects of kinesio taping in knee osteoarthritis.

We observed similar improvement in pain with kinesio taping and sham taping.

Kinesio taping is not superior to sham taping in terms of function and quality of life.