



## Kinesio Taping versus sensorymotor training for patients with knee osteoarthritis

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### ABSTRACT

**Background:** Osteoarthritis is a chronic disabling disease that generates many impairments of functional health status. The purpose of this study was to compare between Kinesiotaping and sensorymotor training for treating patients with knee osteoarthritis.

**Methods:** Sixty patients with knee osteoarthritis aged from 30-50 years were assigned into three equal groups. Group (I) received traditional exercise program, group (II) received the same program in addition to kinesio taping for knee joint, group (III) received the same program plus sensorymotor training for eight weeks. blind assessment was conducted at the beginning of the study and after 8 weeks of the treatment to measure pain intensity, proprioceptive acuity and functional disability.

**Results:** The results revealed that there was a significant improvement in proprioception acuity and functional activities in sensorymotor training group while pain level is significantly better improved in kinesio taping group ( $p < 0.05$ ). **Conclusion:** sensorymotor training is most efficient modality producing more positive effects on proprioception and functional activity level than kinesio taping for treating patients with knee osteoarthritis.

### INTRODUCTION

Osteoarthritis (OA) is a degenerative joint disease affecting mainly weight bearing joints of the lower limbs. The pathological changes associated with OA have a uniform and focal manner, affect not only articular cartilage, but also all joint structures [1]. These changes lead to reducing joint proprioception, and quadriceps muscle weakness [2]. Patients clinically complain of pain, decreased range of motion, and joint instability, all of which may lead to impairments of the joint function [3].

Increasing the incidence of knee OA claimed to create a variety of protocols aiming to improve both patient complaints and overall functional activities. These protocols include traditional exercises programs with a variety of strength training, flexibility exercises, acupuncture, ultrasound and range of motion exercises [4]. Nevertheless the ultimate treatment goals to decrease patient complaints and improve function activities levels cannot be fully restored [5].

Recently, attention has been given to other approaches that focus on improving sensorimotor function by emphasizing sensory inputs, such as proprioception training and neuromuscular exercises [6,7]. These training may allow patients to develop adequate motor skills for dealing with potentially destabilizing forces on the knee that may be encountered during activities of daily living, thus would be of value in improving the functional activities of knee OA patients [8]. Sensorimotor training is a form of exercise that was designed for management of patients with chronic musculoskeletal pain syndromes. It emphasizes progressive challenges to sensory motor system aiming to restore normal motor program, increase dynamic joint stability and decrease joint loading forces. [9,10].

Kinesio tape, invented by Kenzo Kase in 1996, is a new application of adhesive taping. It is a thin and elastic tape which can be stretched up to 120–140% of its original length, making it quite elastic and resulting in less mechanism constraints, compared with conventional tape. Kinesio taping, an organized wrapping technique using special type of tape proposed by Kase, is claimed to be able to reduce pain, swelling and muscle spasms [11]. Different studies revealed the effects of knee taping on minimizing pain intensity, increasing muscle strength, improving gait pattern and enhancing functional outcome of patients with sports injury, OA and patellofemoral joint function. [12-14].

Also, it is hypothesized that the tactile sensation added to the skin by the tape affects the excitatory attributes of the central nervous system interacting with motor control, and serves to sufficiently change muscular power [15]. Among literature, there is lack of experimental clinical trials which explore the therapeutic effects of kinesio taping and /or sensorimotor training in patients with knee osteoarthritis. Hence, the aim of the current study was to compare between Kinesio taping and sensorimotor training on pain intensity, proprioception acuity and functional disabilities in patients with knee osteoarthritis.

## Materials and methods

This study was approved by the ethical committee of the Faculty of Physical Therapy, Cairo University. Participation was voluntary and participants provided written consent to be involved in the study

### Subjects

This is a randomized single blind study in which sixty patients of both gender (18 male, 42 female) with unilateral chronic knee OA were recruited from the outpatient clinic of the Faculty of Physical Therapy, Cairo University. Their mean age was  $38.8 \pm 7.2$  years, height  $170.7 \pm 8.7$  cm, and weight  $88.3 \pm 13.8$  kg. Patients were diagnosed by an orthopedist as having grade II knee OA with the presence of knee pain, osteophytes and definite joint space narrowing based on the American College of Rheumatology criteria [16]. The exclusion criteria were rheumatoid arthritis, intra-articular steroid injection, knee

surgery, any neurological condition affecting lower limbs, or use of assistive devices for walking. All patients were refrained from seeking other forms of treatment during the study.

### Instrumentations

1- Visual analogue scale (VAS): The level of knee pain was assessed using VAS before taping application and after compliance of all treatment sessions. Its validity and reliability have been tested [17].

2- Isokinetic dynamometer: Biodex 3 Pro Multijoint system (Biodex Medical Inc., Shirley, NY) was used to detect joint position sense through active repositioning accuracy test. This test can measure the patient's ability to repositioning a target angle. The difference between the target angle and the reposition angle is known as the reposition error. The absolute value of this error was used in analysis [18]

### procedures

Patients were randomized into three equal groups, crossover between groups was not allowed to avoid the order and carry over effects between treatments; Group (I) received traditional exercise program, group (II) received the same program in addition to kinesio taping for knee joint, group (III) received the same program plus sensorimotor training. All measures were conducted at baseline and after 8 weeks by an assessor who was blinded to the group allocation. Assessment included measurement of pain intensity, proprioceptive acuity and functional disability

### pain intensity:

Pain intensity was measured by Visual numerical scale (VNS), the subject was asked to choose a number between 0 and 10 on a 1 cm chart with 0 indicating no pain and 10 indicating unbearable pain. The subject marked the number corresponding to the average pain level experienced [17].

### proprioception acuity:

Proprioception acuity was determined using the passive-active joint position reproduction method, which has been reported to be a valid method in the evaluation of proprioception [18]. Biodex 3 Pro multijoint Isokinetic dynamometer (Biodex Medical Inc., Shirley, NY, United States) was used to test the ability of the patient to actively repeat the passively positioned knee angle. The target angle was 45 and the test was repeated three times and the difference between the target angle position and the patient perceived end range position was calculated and averaged.

### Measurement of Functional disability level:

The functional disabilities related to knee OA were measured by the arthritis impact functional assessment scale. This scale has been shown to be reliable [19]. It assess the level of disability on five subscales including pain, walking distance, walking aids, standing, and climbing stairs. Patients were asked to rate their pain and ability to perform various ADL, scoring between 0 and 24 points. Lower scores indicate better subjective functional abilities.

### Exercise program

Patients in all groups receive the same traditional exercise program included Range of motion ,isometric and isotonic exercises for three sessions /week on alternate days for 8 weeks in succession. The exercise program was carried out according to the following protocol:

In the first to third weeks of the treatment, exercises include Range of motion for the knee joint, quadriceps / hamstring isometric strengthening exercise and stretching exercises for hamstring and calf muscle in the fourth to sixth weeks (in addition) exercises included short-arc terminal extension exercise for the knee joint, Straight leg raising exercises and isometric exercises for the abductor and adductor muscles of the hip joint. In the seventh and 8th weeks (in addition to previous) , patients performed a Short-arc terminal extension exercise with resistance for the knee joint and isotonic strengthening exercise with resistance for the hamstring muscles [6].

#### **Sensory motor training**

Patients were exercised through three stages: static, dynamic, and functional. Within each stage patients' progress through exercises in different postures, bases of support, and challenges to their center of gravity. Sensory motor training was performed 3 times per week for 8 weeks. It applied gradually from easy to difficult and the patient was not progressed to a more difficult stage until performing the easier one according to the following protocol [20- 22]:

1st and 2nd weeks: Static phase:

1. standing upright position (30 sec) begin with a firm surface, then on a soft surface
2. Single leg stance with open eyes then closed eyes (first the affected limb, then the non-affected limb) for 10 sec on a firm surface, then on a soft surface.
3. Half-step position for 10 sec with repetition of 3-5 times during session.
4. One-leg balance for 10 sec (weight bearing on affected knee).

3rd and 5th weeks: Dynamic stage, in addition:

1. Forward stepping lunge exercise.
2. T-band kicks exercise (weight bearing affected knee).

6th and 8th weeks: Functional phase, in addition:

1. Walking exercise on a firm surface, then progress to on a foam surface:

(a) Toe skipping with toes straight ahead for 20 min, toes pointing outward for 20 min and toes pointing inward for 20 min.

(b) Heel skipping with toes straight ahead for 20 min, toes pointing outward for 20 min and toes pointing inward for 20 min.

2. Squatting exercise: against a wall and away from the wall, begin with One leg squats on the affected and non-affected limb.

3. Balance exercise on wobble board:

(a) Multidirectional rolling movement from sitting position.

(b) Multidirectional rolling movement from standing position on both legs between parallel bars with eyes open, then eyes closed.

(c) Multidirectional rolling movement from standing position on one leg between parallel bars with eyes open, then eyes closed.

(d) Balance with two legs, multidirectional, eyes open then eyes closed.

(e) Balance with one leg, multidirectional, eyes open then eyes closed

#### **Kinesio taping application**

Kinesio tape was pre-cut and then individually tailored to each subject just before application .The Superior 'Y' technique was used.The tape measure from the mid-thigh to just below the knee cap .The K-tape was applied from origin to insertion for the facilitation of quadriceps muscle. The split Y application was applied at superior pole of the patella. Patient was instructed to assume a sitting position with affected leg out of the bed and hip joint maintained in flexed position. The application of tape began with the Kinesio "Y" strip approximately mid-thigh over the vastus medialis muscle with (25% of available) or paper off tension until "Y" in Kinesio strip reaches the superior pole of the patella. Glue activation was initiated prior to any further patient movement. Then patient will flex the knee to maximum flexion. The tails of the kinesio strip was then applied around the medial and lateral border of the patella with light (25% of available) or paper off tension. The tip of the tail should end with no tension on the tibial tuberosity. Again initiation of glue activation will be done prior to any further patient movement [23].

Second tape was applied for mechanical correction. It consists of application of mechanical correction with tension on the tail of "I" strips. With this technique the tension was placed on the tape to use "the recoil effect" of the elastic quality of the kinesio tape to create proprioceptive tension. The base of the "I" strip was applied on the medial joint line while knee in relaxed position. With one hand the base was held to ensure no tension be added during application. Then tail of "I" strip was applied with moderate (50% of available) and inward pressure along the inferior pole of the patella. The last approximately one inch of the tail was applied with no tension on lateral joint line. All patients was instructed to wear tape for two days and return for review after 24 hours removing tape. Subjects were also be instructed to remove tape if they fill itching, heat redness or discomfort [24].

#### **Data Analysis**

The data was analyzed using SPSS for Windows software, version 18.0 (SPSS, Inc., Chicago, IL). Statistical significance was set at  $P = 0.05$ . Paired  $t$ -tests were performed to detect any differences between baseline and post-treatment values within groups including: VAS pain score, proprioception accuracy, and functional disability score. Analyses of variance

test was used to determine differences between groups for all measured parameters

## RESULTS

60 patients with knee osteoarthritis, aged from (30 to 50) years who fulfilled the inclusion criteria agreed to participate in the study and were randomly allocated to either the exercise (group I) , taping (group II) or sensorymotor (groupIII) treatment groups. Demographic characteristics and baseline measurement of the three groups before the treatment are shown in (Table 1). There was no significant difference between the three groups regarding age, weight,height and symptoms duration at the baseline measurements ( $P>0.05$ ).

**Table 1. Demographic data and baseline assessment of 60 Patients**

Variables	Group A	Group B	Group C	F ratio	P value	Sig.
	Mean ± SD	Mean ± SD	Mean ± SD			
Age (year)	38.7±7.7	38.6±7.5	37.6±5.6	0.094	0.911	NS
Height(cm)	170.9±7.9	171.8±9.6	169.4±8.9	0.4	0.67	NS
Body weight (Kg)	85±1.96	85.3±8.99	85.47±7.66	1.02	0.36	NS
Symptom duration (month)	13.8±3.4	15.2±2.7	14.2±3.2	1.87	0.163	NS

### Pain intensity

Fig.1 represents comparison between the mean differences of VAS score between groups before and after treatment. The results revealed that, Kinesio taping group (group II) showed a highly significant reduction in the pain intensity compared with the exercise and sensory motor training groups.

**Fig.1. Comparison between pain intensity pre and post treatment between groups**

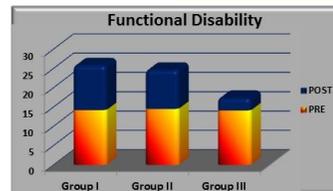


**Fig.1. Comparison between pain intensity pre and post treatment between groups**

### Proprioception acuity

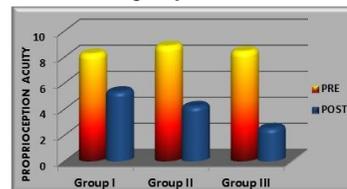
Regarding proprioception acuity, no statistically significant difference ( $p > 0.05$ ) was found between the groups at pretreatment measurement. post-treatment measurement comparison between groups showed a highly significant improvement in proprioception accuracy ( $p = 0.001$ ) in favour of the sensory motor group (group III), Fig. 2.

**Fig.2. Comparison of proprioception accuracy between groups pre and post treatment**



**Fig.3 Mean and SD of functional disability score between groups before and after treatment**

**Fig.3 Mean and SD of functional disability score between groups before and after treatment**



**Fig.2. Comparison of proprioception accuracy between groups pre and post treatment**

### Functional disability

Analysis of the functional disability results revealed that subjects in sensory motor training group (group III) experienced significant reduction in the functional disability of the knee joint, compared with patient in the kinesiotaping and exercise groups fig.3.

## DISCUSSION

This study was designed to compare between the effect of kinesio taping and sensory-motor training on pain intensity, proprioceptive acuity and functional disability in patients with knee OA. The results of the current study demonstrated that subjects in sensory motor group (group III) experienced significant reduction in knee joint dysfunction, and improvement in proprioception accuracy than those in the kinseo tape group (group II). However, Pain was significantly

reduced in kinsio tape group compared with the sensory motor group.

Pain modulation via the gate control theory is one plausible explanation for such a change determined in the kinesiotape group, because it has been proposed that tape stimulates neuromuscular pathways via increased afferent feedback. Under the gate control theory an increase in afferent stimulus to large-diameter nerve fibers can serve to mitigate the input received from the small-diameter nerve fibers conducting nociception[25].

One potential mechanism that might account for the observed pain relief is fit with the accepted theory of patellar malalignment in both anterior knee pain and knee OA, where there is lateral displacement of the patella relative to the femoral trochlear groove resulting in increased the peak patellofemoral pressure forces and loading of the lateral facet. Taping is thought improve patellar alignment by correct tracking of the patella, so change the patellofemoral joint contact area, which relieving pressure on the damaged lateral facet of the patellofemoral and reduce joint stress [26].

Additionally, it is possible that alternative mechanisms may explain the pain relieving effects of patellar tape. Importantly, the infrapatellar fat pad is one of the most pains-sensitive structures in the knee joint which inflamed secondarily to knee joint pathology and is often described as a potential source of pain in knee OA, it is possible that the patellar tape may shortening the soft tissue of the fat bad, that reliving pain based on the principle that inflamed soft tissue doesn't respond well to stretching [27].The findings of the present study lend support to the work of Hinman et al., who concluded that therapeutic taping has a significant immediate impact on pain when compared with neutral and untapped condition in patients with knee arthritis[ 28]

In the present study the addition of sensory motor training to the traditional exercise produced better improvement of proprioception accuracy.Maintaining functional joint stability through complementary relationships between static and dynamic restraints is the role of the sensory motor training. The sensory motor training encompasses all of the sensory, motor, and central integration and processing components involved in maintaining functional joint stability.Theoretically, it could be predicted that sensorimotor training affects proprioception more than classic traditional exercise program as sensorimotor training improves sensory input to the central nervous system thus improving sensorimotor function of the knee joint. Kinesthaesia and balance training were reported to improve proprioception and functional performance of knee OA patients [19]

The complex interactions and relationships among the individual components of the sensory motor system make measuring and analyzing specific characteristics and functions extremely difficult. Adding further complexity are the numerous compensatory mechanisms interspersed throughout the

system. For example, the normal ability to close one's eyes during stance without loss of postural equilibrium resides with the ability of the somatosensory and vestibular senses to provide sufficient afferent information despite the absence of visual input. Similarly, vestibular sense deficient persons are able to maintain equilibrium as long as visual or somatosensory (or both) inputs are available[30].

The results of sensory motor training group in line with the findings of recent research work done by **Demirhan et al., 2005** who investigated the effects of a short term program of balance and kinaesthesia exercise on knee osteoarthritis. The results showed statistically significant positive changes in the kinaesthesia group compared with the strengthening group in functional performance and pain, and this matched with the result of sensory motor training group[32].

Also, the findings of the current study are in agreement with those of **Jau-YihTsaou et al. 2008** who conducted a studyon osteoarthritic patients to investigate the effect of sensory motor training on knee proprioception and function using active joint repositioning, functional testing, and self-report function with the western Ontario and McMaster universities arthritis index before and after the eight-week intervention. It was concluded that there was a significant improvement in proprioception and functional activity after training for eight weeks [33].

The findings of sensory motor training group was in accord with the work of Kelley et al.who investigate the effect of agility and perturbation training in a thirty women with a diagnosis of bilateral knee OA.It was reported that there is an improvement in pain, and reduction of instability level [32].

## Conclusion

The result of this study provide evidence that sensorymotor training is most efficient modality producing more positive effects on proprioception and functional activity level than kinesio taping for treating patients with knee osteoarthritis.

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