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Effect of joint mobilization and kinesiotaping on knee osteoarthritic patients

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ABSTRACT

Background: Osteoarthritis (OA) is the most common form of degenerative joint disease affecting millions of people worldwide. The knee joint is the most frequently affected by OA. Pain is the most frequent reason for patients with OA knee to seek medical attention and rehabilitation, if left untreated, pain and stiffness will result in a loss of physical function and self-independence. **Purpose**: This study was conducted to determine the combined effect of knee mobilization and kineso taping (KT) on range of motion (ROM), proprioception accuracy and functional level in patients with mild to moderate knee OA. **Methods**: Sixty patients from both sexes, aged from 40 to 60 years, diagnosed as grade II knee OA participated in this study. The patients were randomly assigned into 4 equal groups; 15 patients in each group. All patients received conventional program of IR and exercise 2 times per week for 4 weeks. In addition, group A received joint mobilization, group B received KT, group C received joint mobilization and KT and group D was control group. Knee extension ROM was measured by electro goniometer, Knee Proprioception accuracy was measured by Isokinetic Biodex 3 and functional level was assessed by the WOMAC Index. **Results:** There was a statistical significant difference between pre and post treatment mean values of Knee extension ROM, proprioception accuracy and Knee functional level for all groups. There was no statistical significant difference among the four groups in the mean value of the Knee extension ROM, proprioception accuracy and Knee functional level. **Conclusion:** Both passive joint mobilization and KT were effective and showed marked improvement of knee extension ROM, proprioception accuracy and functional level in knee OA. Combination between joint mobilization and KT with exercise program has the same effect.

Key word:Joint mobilization, kinesiotaping, Knee osteoarthritis

INTRODUCTION:

Osteoarthritis (OA) is the most common form of degenerative joint disease affecting 15 to 40% of people aged 40 and above [**1**].One hundred fifty one million people worldwide experienced OA in 2004, whichwas ranked sixth as a leading cause of moderate and severe disability [2].

The knee is the joint most frequently affected by OA [3], and is a significant contributor of pain and functional impairment in community- dwelling adults [1].

Management of pain in OA knee is a multidisciplinary approach. Physiotherapy, as a mainstay of conservative treatment for OA knee involves the use of various modalities such as manual therapy, exercises, patellar taping, thermal modalities and electrical stimulations as a direct or an indirect pain reduction method. Manual therapy includes soft tissue manipulation, massage, manual traction, joint manipulation and joint mobilization[4].

Joint mobilization which involves low-velocity passive movements within or at the limit of joint range of motion reduces pain by modulating the nervous tissues and increases joint motion[4, 5].Moss et al. (2007) has provided new experimental evidence that accessory mobilization of a human osteoarthritic knee joint has both an immediate local and a more widespread hypoalgesic effect. Clinically therefore, joint mobilization may be an effective means of reducing osteoarthritic pain and may potentially improve motor function[6].

It is well recognized that joint movements activate receptors in the joint, skin and muscle. In turn, any of these receptors may play a role in the perception and control of limb movement and joint angle. Position sense has been associated with a distinct class of sensory receptors; particularly those found in the muscles and related deep tissues[7].

Kinesio Taping was a technique developed by Dr. KenzoKase in the 70s. The adhesive pliable material, directly applied to the skin, differs from classical tape in its physical characteristics. This technique claims four effects: to normalize muscular function, to increase lymphatic and vascular flow, to diminish pain and aid in the correction of possible articular misalignments[9].

There are many proposed benefits of KT including proprioceptive facilitation [9, 11], reduced muscle fatigue, reduced delayed-onset muscle soreness, pain inhibition [12, 13], and enhanced healing such as reducing oedema, improvement of lymphatic drainage and blood flow[14].

So this study was conducted to investigate the combined effect of joint mobilization and KT in knee OA patients with the attempt of providing an addition to the rehabilitation program of knee osteoarthritic patients.

MATERIALS AND METHODS

This study was conductedat outpatient of the Faculty of Physical Therapy and the isokinetic laboratory from November 2013 to June 2014.The study was approved by the Institutional review board.

Subjects

Sixty patients from both sexes, with age ranged from 40 to 60 years old suffering from mild to moderate OA were included after obtaining informed consent to participate in the study. The patients were randomly assigned into 4 equal groups; each group was consisted of 15 patients.

All groups received conventional program of IR and exercise, in addition to; Group A receivedjoint mobilization, group B received KT, group C received joint mobilization and KT and group D was control group for 2 times / week for 4 weeks[15].

Chronic mild or moderate knee OA patients with pain in one knee, able to walk short distances with or without an aid[6].The diagnosis of OA was made clinically and radio graphically by orthopedic specialist as grade II OA, with Body mass index were less than 30 kg/m^2[16].

Excluding from the study; subjects who had recently undergone lower limb surgery, had co-existing inflammatory or neurological conditions, experienced altered sensation around their knee, or exhibited cognitive difficulties[6]. Also subjects who had allergy to tape or history of joint replacement, symptoms or signs suggestive of another cause of knee pain, rheumatoid arthritis, steroid injection (previous six months)[17].

Procedures

Assessment was done for each subject one day before starting the treatment program and after four weeks of treatment. Assessment was included ROM of knee extension, Knee proprioception accuracy at 60° and knee functional level.

ROM Measurements

Electro goniometerwas used to assess the ROM in degrees. The fulcrum of the device was adjusted with the lateral epicondyle of the femur, the stationary arm of the goniometer was placed parallel to the long axis of the femur along the line extending from the greater trochanter to the lateral femoral condyle and the movable arm was placed to the long axis of the fibula in line with the head of fibula and lateral malleolus. Two adhesive straps were used to stabilize each arm of electro goniometer one of them was at most distal part of the stationary arm and the other was on the movable arm[18]. Reliability of measuring knee joint ROM using an electro goniometer was 0.85-0.88[19].

Joint Proprioception Accuracy Level Measurement

A Biodex 3 Isokinetic Dynamometer was used to assess knee proprioception error. This System has acceptable mechanical reliability and validity [20].Each subject was sitting in the positioning seat with hip and knee flexed at 90 degrees. The subject was attached in position after adjustment of depth of the seat, the height of the dynamometer and length of the support lever that allowing the axis of rotation of the dynamometer to be aligned to the most inferior aspect of the lateral femoral epicondyle. The lower leg was attached to the dynamometer lever arm above the medial malleolous by 2 inches [21].

The subject was secured on the seat by one 10 cm. wide strap which placed diagonally on the subject chest, and thigh strap attach to the seat was used to stabilize the thigh.The subject data were entered to the computer program database, test protocol was set from the software program; unilateral protocol proprioception testing with extension of the knee ROM was set from 90° to 60°. Knee joint was placed in starting angle 90°. To memorize target angle, subject was passively moved leg to the target angle 60°, hold knee at target angle for 5 sec., and returned to starting position 90°. Then, ask subject to actively moved toward target angle. The patient was instructed to press the stop button when the memorized angle was recreated while eyes closed, and the Biodex assess the angle at which the subject stop and measure the difference between this angle and the target angle. The test was performed three times, a quiet place selected for this test [21].

Functional Assessment of Knee joint

Western Ontario and McMaster Universities index of OA (WOMAC) was used to assess patient functional disability. It is a disease-specific, self-administered, health status measure. It consists of three subdivisions of pain, stiffness and physical function. The index consists of 24 questions (5 pains, 2 stiffness and 17 physical functions) and can be completed in less than 5 minutes[22].

Individual question responses are assigned a score between 0 (none) and 4 (extreme). Individual question scores are then summed to form a raw score ranging from 0(best) to 96(worst). The WOMAC is a valid and reliable instrument[23].

Conventional Treatment

Physiotherapy is the best conservative treatment for OA knee involves various modalities such as manual therapy, exercises, patellar taping, and thermal modalities [4].

Infra-Red

Patients in each group received IR as a warming up before the session. The patient was in long sitting position with 50 cm distance from the lamp and instructed not to touch and not to look to the lamp. The lamp was switched on and the patient asked to tell the therapist when he feels heat till mild comfortable warmth, after 15 minutes the lamp was switched off [24].

Hamstring muscle Stretch

From supine lying position, therapist moved the patient hip into flexion up to pain limit with knee full extended, maintained for 30 sec. and repeated 3 times, with 30 sec rest between each one [15].

Straight Leg Raises

In which the patient position was crock lying with un exercised limb was the flexed one then the patient asked to contract the quadriceps muscle and elevate the limb to 45° and hold for 6 sec. , slowly lower the limb and then relax for 6 sec. three sets of 10 repetitions were done [25].

Quad Sets

Static (Isometric) quad sets exercise from long sitting with knee extended and put pillow under knee joint. the patient asked to contract the quadriceps isometrically and dorsiflex the ankle, causing The patella glide proximally , then hold for 10 sec. The patient performed exercise 3 sets; every set had 10 repetitions with holding for 10 sec. with 10 sec. of rest in between [26].

Hip Abduction

The patient was in side lying position with the trained knee up and knee down was flexed to 90° and hip is flexed at 45°. The body weight shifted forward and the trained leg is straight, the patient left it up and held for 10 sec, gently lower it down to starting position then rest for 10 sec [26].

Isometric strengthening of quadriceps muscle

In the form of 3 sub maximal isometric contractions of increasing intensity followed by 6 maximal 5 sec isometric contraction was repeated at multiple knee angles (30-60-90) degrees respectively , each contraction was followed by 30 sec rest period and each set of contractions at each knee angles was followed by 1 minute rest [27].

Application of KT

After completion of the session KT was applied and the patient asked not to remove until the next session as it was removed by the physiotherapist and reapply at the end of session.

The tape length for the functional correction using a fascia application was measured from a hand breadth above the patella to the tibial tuberosity figure (1). The tape was cut in such a way that the base is a hand breadth long. The backing paper was pulled back at the end of the base up to the Y-tape tail. At first, only a narrow strip of the base, approximately a fingerbreadth, was affixed over the upper margin of the patella then was the remainder of the base affixed. Using both hands, the two tail tapes were affixed around the patella up to its apex, while the patient pull up his/her knee to its maximum bending capacity. The tape ends was lied one over the other on the tibial tuberosity. Both tape ends were affixed without tension, where percentage of stretching 40-50% in the middle of tape, with no stretch at the ends of the tape[28].

Fig. 1 KT Y-application for knee OA.

Joint mobilization

Joint mobilization was including antero-posterior (AP) glide of tibia on femur, and patella glides in all directions. Techniques of application were based on guidelines developed by Mitland et al (2005);mobilization of grade II and III was applied [5].

Antero-posterior glide of the tibia on the femur**,** the patient was positioned comfortably in supine, knees in slight flexion to about 70º with foot resting on plinth. Therapist was sitting on plinth with patient's foot was under the thigh for stabilization. Thenar eminence of both hands over tibial condyles, while fingers wrap posteriorly into the popliteal fossa. Graded anteroposterior mobilizations produced by pushing on the proximal tibia [5].

Three sets of 3 min, alternating with 30 sec rests were done, so total of 10 minutes. Patients were attended at the same time of day on two occasions, each separated by at least 72 h in order to control for carry-over effects[29].

Statistical analysis

The analysis of these data included descriptive analysis of means and standard deviation of pre and post treatment values of the four groups. All data analysis was performed using SPSS (version 16).

Paired t-test was calculated on the pretreatment to post test change for each group for ROM and proprioception. Wilcoxon Signed Ranks test for functional assessment by WOMAC. Comparison among groups pre and post-treatment was done by using ANOVA test for ROM and proprioception and Chi-

Square value of Kruskal Wallis test for functional assessment by WOMAC. Level of significant was $p < 0.05$.

RESULTS

There was no statistical significant difference among four groups in their ages as shown in table (1).

Table (1): Subjects age in the four groups.

	Age (years) Mean±SD
Group A	51.06 ± 4.33
Group B	49.40 ± 6.60
Group C	49.06 ± 6.22
Group D	49.73 ± 5.49
F-value	0.35
p-value	0.78*

P: probability *Non significant as P > 0.05.

Knee Extension ROM

T-test revealed that there was a statistical significant difference between pre and post treatment Knee extension ROM mean values for all groups. ANOVA test revealed that there were no statistical significant differences among the four groups for the pretreatment and the post treatment values as shown in table (2).

Knee Proprioception accuracy at 60°

T-test revealed that there was a statistical significant difference between pre and post treatment mean values of Knee proprioception accuracy at 60° for all groups. ANOVA test revealed that there were no statistical significant differences among the four groups for the pretreatment and the post treatment values as shown in table (3).

WOMAC Index

Wilcoxon Signed Ranks test revealed that there was a significant difference between pre and post treatment mean values of Knee functional test for all groups. Chi-Square value of Kruskal Wallis test revealed that there were no significant differences among the four groups for the pre treatment and the post treatment values as shown in table (4).

Table (2): Inter and intra group comparison among mean values of knee extension ROM (degrees) in the four groups measured pre- and post-treatment:

	Group A	Group B	Group C	Group D	F-value	P-value
Pre-treatment	103.18 ±6.87	102.82 ±5.90	105.07± 5.92	103.50 ±6.00	0.38	0.76*
Post-treatment	113.63 ±6.14	113.79 ±5.10	114.90± 4.65	111.8± 6.29	0.74	0.53*
Difference	10.45	10.97	9.83	8.3		
% of improvement	10.12%	10.66%	9.34%	8.09%		
t-value	15.94	12.58	14.75	13.07		
P-value	0.0001 **	0.0001 **	0.0001* *	0.0001 **		

P: probability *Non-significant as P > 0.05. ** Highly significant as p < 0.05

Table (3): Inter and intra group comparison among mean values of knee Proprioception accuracy at 60° (degrees) in the four groups measured pre- and post-treatment:

	Group A	Group B	Group C	Group D	F-value	P-value
Pre-treatment	5.82±1.7	5.96±2.7	6.45±3.5	5.74±15	0.23	0.86*
Post-treatment	3.99±1.2	3.88±1.6	3.46±1.4	4.30±15	0.83	0.48*
Difference	1.93	1.08	2.99	1.44		
%of improvement	31.44%	34.89%	46.20%	25.08%		
t-value	5.31	5.56	3.24	5.92		
P-value	0.0001**	0.0001**	0.0001**	0.0001**		

P: probability *Non-significant as P > 0.05. ** Highly significant as p < 0.05

Table (4): Inter- and intra-group comparison among mean values of WOMAC scale in the four groups measured pre- and post-treatment.

	Group A	Group B	Group C	Group D	χ^2 value	P-value
Pre-treatment	68.03± 16.20	66.57±13.76	66.33±12.37	67.15± 11.2	0.440	0.932*
Post-treatment	52.83± 13.35	53.54±12.80	54.57±10.80	57.09± 8.36	1.138	0.768*
Difference	15.2	13.03	11.76	10.06		
% of improvement	22.34%	19.57%	17.73%	14.98%		
Z-value	-3.408	-3.408	-3.408	-3.408		
P-value	0.001**	0.001**	0.001**	0.001**		

χ^2 value= Chi-Square value of Kruskal Wallis test (non parametric statistics).
Z value= Wilcoxon Signed Ranks test (non parametric statistics).
* Non significant as P > 0.05. ** Highly significant as p < 0.05.

DISCUSSION

The objective of this study was to study the combined effect of passive joint mobilization and KT in treatment of knee OA.

In this study, all treatment groups showed successful outcomes, as Knee extension shows increase in ROM where pre and post treatment percentage of improvement in group A 10.12%, group B 10.66%, group C 9.34 % and group D 8.09%. Knee propriception accuracy shows improvement at angle 60° where pre and post treatment percentage of improvement in group A 31.44%, group B 34.89%, group C 46.20% and group D 25.08 %. Functional activities shows reduction in scores pre and post treatment where percentage of improvement in group A 22.34 %, group B 19.57%, group C 17.73 % and group D 14.98 %.

According to Maitland et al. (2005) there are five classification grades for the different ways of applying mobilizations and their physiological effects: grade I is characterized by micro-movements at the beginning of the arc of movement, with the physiological effect of inputting neurological information through mechanoreceptors, by activating the spinal gating; grade II show large movements in the middle of the arc that, besides activating spinal gating, stimulate venous and lymphatic return, thereby causing joint clearance; grade III show movements over the whole arc, causing the same effects as in grade II, plus stress in the shortened tissue due to adherences; grade IV demonstrate micro-movements at the end of the arc that promote tissue stress capable of moving fibrotic tissue slightly. These four grades are classified as joint mobilizations; grade V relates to joint manipulation, demonstrates minuscule high-speed movement at the end of the arc that promotes the breakage of adherences, activate Golgi tendon organs and may drastically alter the condition of the tissues surrounding the joint[5].

Joint mobilizations of grades II and III have the aims of directing the tissue remodeling process, reducing the proliferation of fibrosis tissue and decreasing the formation of crossed collagen bridges and tendon adhesions to tissues that surround it. This also influences the fluid dynamics, which help to decrease the accumulation of inflammation by-products and thus modulate the pain processes and increasing ROM[30].

Mehdi and Bahrpeyma (2010)had studied the effect of Grade 1 Mobilization on OA Knee Pain and study showed that grade 1 mobilization can increase ROM of knee OA [16].

According to Swatiet al. (2013)supervised clinical exercise and Maitland manual therapy achieved greater improvements than home exercise in functional outcome, ROM and mini squats repetition. Patients were treated with Maitland manual therapy combined with supervised clinical exercise. The results of the study indicate that there was highly significant ($p < 0.01$) decrease in pain, stiffness and physical function [31].

Moss et al. (2007)show that manual therapy had previously been shown to induce immediate hypoalgesia in individuals with knee OA, compared with placebo and control conditions, with concurrent improvements in function. Findings suggest that manual therapy might had a beneficial short-term effect in reducing pain and improving physical function for patients with knee OA compared with no intervention, and in OA compared with exercise therapy [6].

According to Kase et al. (1996) the creator of KT, these proposed mechanisms may include:(1) correcting muscle function by strengthening weakened muscles, (2) improving circulation of blood and lymph by eliminating tissue fluid or bleeding beneath the skin by moving the muscle, (3) decreasing pain through neurological suppression, and (4) repositioning subluxed joints by relieving abnormal muscle tension, helping to return the function of fascia and muscle [8].

First, KT application causes the skin to be raised toward the outside of the body, increasing the interstitial space between the skins and underlying connective tissues such as muscles, ligaments, and tendons. This action allows blood and lymph fluids to travel smoothly through the treated area. Therefore, it can improve the venous and lymphatic circulation of the area being treated which is the primary function of kinesio taping[32].

Second, the neurological system is stimulated by the application which alters the subject's perception of pain. Stimulation of the neurological system causes the brain to send the efferent signal which does not allow the afferent signal, pain perception, to go up to the brain[33].

Third, muscle spasm is reduced by the correction of joint mal-alignments. When a joint is in an abnormal position, the muscles surrounding the joint must work to compensate. As a result, the muscles contract either stronger or weaker than normal which can cause spasm of the muscles. KT may help with muscle spasm or pain raised from a joint mal-alignment by correcting the joint mal-alignment and supporting weakened muscles[34].

Lastly, existing muscle imbalance from improper training techniques and biomechanics was improved by supporting weakened muscles or over-trained Muscles .Normal movement facilitation can be accomplished by the other functions of KT. KT application might relieve the symptoms caused from Repetitive throwing by enhancing the blood flow to the shoulder complex and supporting the fatigued muscles [33].

Aytaret al. (2011)used a randomized, double-blind study to evaluate the effects of KT compared with placebo KT on pain, strength, joint position sense, and balance in patients with patellofemoral pain syndrome. The joint position sense as measured using a dynamometer did not differ significantly between the two groups[35].

Exercise

The American College of Sports Medicine categorizes exercise into several forms, including stretching/ROM, aerobic/endurance, resistance/strength training, and balance/proprioceptive exercise, with frequent areas of overlap[36].Patients with knee OA may be hesitant to participate in these health-engender activities for fear of worsening their OA. Participation in regular physical activity had been shown to provide significant benefits in the treatment of knee OA, while failure to remain active and disuse of the affected limb may accelerate impaired joint mechanics and potentially result in articular cartilage softening and matrix dysfunction, leading to more rapid cartilage degeneration [37].

Bennell and Hinman (2005)reported that strengthening exercise appears to be superior to aerobic exercises in the

short term for specific impairment-related outcomes (e.g. pain), whereas aerobic exercise appears to be more effective for functional outcomes in the long-term in patients with OA[38].

In contrast**,** Brosseau et al. (2003)had reported that aerobic exercise in general is more beneficial for the OA patient than no exercise at all, and is superior or equivalent to strengthening exercise [39]. However, Roddy et al (2005)showed that both aerobic walking and home-based muscle strengthening exercises reduced pain and disability in cases of OA of the knee and that there were no significant differences in effects between the two types of exercises. Although it remains controversial, as to which type of exercise programs may be more effective for the treatment of OA of the knee, this line of evidence does indicate the short-term beneficial effects of both muscles [40].

Hurley and Walsh (2009) suggest that integrated rehabilitation programs that are acceptable, clinically effective, deliverable and affordable may be the best way of managing the large and increasing number of people suffering chronic knee pain [41].

Van Dijket al. (2006)reported that greater muscle strength, better mental health, better self-efficacy, social support and more aerobic exercise were protective factors in cases of OA of the knee in the first 3 years [42].

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الملخص العربى

تأثير المفصلو لاصقةالكينيسو على مرضى خشونة مفصلالركبةالتحريك

الخلفية:الالتهاب المفصلي العظمى هو الشكل الأكثر شيوعا من مرض المفاصل التنكسية التي تؤثر على الملايين من الناس في جميع أنحاء العالم. مفصل الركبة هو الأكثر تعرض لمرض الالتهاب المفصلي .الألم هو السبب الأكثر شيوعا لمرضى خشونة مفصل الركبة التماس العناية الطبية وإعادة التأهيل، إذا تركت دون علاج فإن الألم وتصلب المفاصل سيؤديان الى فقدان الوظيفة الجسدية والاستقلال الذاتي. **الغرض**: هذه الدراسة لتحديد التأثير المشترك للتحريك المفصليالسلبي ولاصقة الكينيسو في المرضى الذين يعانون من خشونة مفصل الركبة، لإنشاء البيانات المرجعية على مدى الحركة، استقبال الحس العميق والمستوى الوظيفيفي المرضى الذين يعانون من خشونة مفصل الركبة (خفيف الى معتدل). **الاشخاص والاساليب المستخدمة:** ستون مريض من الجنسين، أعمارهم من 40 إلى 60 سنة، يعانون من التهاب مفاصل الركبة (خفيف الى معتدل) شاركوا فىهذة الدراسة. تم تقسيم المرضى عشوائيا إلى أربع مجموعات متساوية 15 مريضا في كل مجموعة. وتلقى جميع المرضى البرنامج التقليدي من الاشعة تحت الحمراءوالتمارين الرياضية مرتان في الأسبوع، لمدة 4 أسابيع.بالإضافة إلى ذلك قد تلقت المجموعة (أ) التحريكالمفصلى، المجموعة (ب) لاصقة الكينيسو ، المجموعة (ج) ال تحريك المفصلى ولاصقة الكينيسو والمجموعة (د) كانت المجموعة الضابطة. وجرى تقييم باستخدام مقياس الزوايا الكهربي لقياس امتداد الركبة ونظام بيودكسايزوكينتك 3 لقياس الحس العميقللركبة،والنشاط الوظيفي باستخدام مقياس وماك. **النتائج**:كشفت وجود فرق احصائي كبير في القيمة المتوسطة للتمديد الركبة، لاستقبال الحس العميق الركبة ومقياس وماك ما بين قبل و بعد العلاج في المجموعات الأربعة و لكن لم يوجد هناك فرق احصائي كبير بين المجموعات الأربعة في القيمة المتوسطة للتمديد الركبة، في القيمة المتوسطة لاستقبال الحس العميق الركبة والقيمة المتوسطة مقياس وماك. **المضمون:** كلا التحريك المفصلى ولاصقة الكينيسو اظهروا تحسن ملحوظ و فعال على مدى الحركة، استقبال الحس العميق والمستوى الوظيفي فى مرضى الالتهاب المفصلى العظمى لمفصل الركبة.الجمع بين التحريك المفصلى ولاصقة الكينيسو مع التمارين الرياضية له نفس التأثير.

الكلمات الدالة:التحريك المفصلى – لاصقة الكينيسو- الالتهابالمفصلى للركبة