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EFFICACY OF KINESIO-TAPING VERSUS PHONOPHORESIS ON KNEE OSTEOARTHRITIS: AN EXPERIMENTAL STUDY

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ABSTRACT

Background: Osteoarthritis (OA) is the most common type of joint disease. Pain is the most common symptom of knee osteoarthritis. Also it characterized by sign, symptoms of inflammation, pain, stiffness and loss of mobility. This study was conducted to explore the efficacy of kinesio taping (KT) versus Aescin, Diethylamine Salicylate gel phonophoresis (PH) on pain level, range of motion (ROM), and proprioceptive accuracy on mild to moderate knee OA patients.

Methods: Forty females with knee OA from Outpatient Clinic of Physical Therapy Faculty participated in the study with mean age (49±5.82) years. They were randomly assigned into 2 equal groups. Group I: received Aescin, Diethylamine Salicylate gel PH with pulsed ultrasound therapy and group II received KT. All patients received hot packs and selected exercise program for four weeks; three sessions per week. Visual analogue scale was used in assessment of pain level. Electronic digital goniometer was used in assessment of knee flexion ROM. Iso-kinetic daynamometer was used in assessment of knee proprioceptive accuracy.

Results: There was a significant relieving of pain perception, increasing of knee flexion ROM and improving proprioceptive accuracy in knee joint post-study in both groups. But application of Aescin, Diethylamine Salicylate gel PH had significant relieve of knee pain than KT.

Conclusion: Using of Aescin, Diethylamine Salicylate gel PH is more effective than KT application in reliving knee pain in knee osteoarthritic patients.

Keywords: Osteoarthritis- Knee - Kinesio taping- phonophoreses- pain

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INTRODUCTION

Osteoarthritis is the most common type of joint disease. It is degenerative disorder arising from the biochemical breakdown of articular (hyaline) cartilage in the synovial joints osteoarthritis involves not only the articular cartilage but the entire joint organ, including the subchondral bone and synovium[1].

One of the most affected sites of OA is knees. The symptoms of knee OA are inflammation, pain, stiffness, loss of mobility and often associated with significant functional impairment[2]. Women had higher incidence of knee OA than men especially after age fifty[3]. Men have 45% lower risk of incidence knee OA than women [4].

One of the recommended management of knee OA patients is physiotherapy. Physical modalities are using to produce beneficial therapeutic effects; like heat, cold and electricity have been used to accelerate healing and decrease pain. Heat therapies are aiming to produce analgesia, relieve muscle spasm, increase collagen extensibility and accelerate metabolic processes [5].

Phonophoresis (PH) is a method of physical therapy, involves the use of ultrasound (US) combined with a medication gel. Phonophoresis means introducing of drugs into body through the skin by the mean of US waves which help passage of medication into injured body part [6].

Phonophoresis was improved drug delivery by increasing cell permeability, enhancing drug diffusion through increase particle oscillations within the tissue, and inducing drug molecule motion through radiation pressure forces. These lead to intercellular diffusion of drug molecules along with vibration of the cell membrane and its component from high-speed vibration[7].

Anti-inflammatory and local anesthetic agents are applied in the form of phonophoresis aiming to management of pain and inflammation in musculoskeletal conditions such as epicondylitis, tendinitis, tenosynovitis, bursitis and OA. This is non-invasive technique, with minimal risk of hepatic and renal injury, and easy tolerated[7].

Aescin acts on vessel walls, in particular the capillary membrane, and has the effect of reinstating normal permeability conditions. Its effect is largely independent of the nature of the causative factor (trauma, inflammation, etc.). Besides regulating capillary permeability, Aescin also enhances capillary resistance. It inhibits inflammatory phenomena and improves microcirculatory conditions[8].

Diethyl-amine salicylate (DEAS) has the advantage of penetrating freely through the skin and hence exerts its analgesic action in the depths of the affected area. It rapidly produces a subjective feeling of improvement, which is of value in encouraging the patient to persist with treatment. The anti- inflammatory effect also possessed by DEAS potentiates the anti-inflammatory powers, and besides relieving purely subjective symptoms. It attacks the etiological factors responsible for the disease process[9].

Kinesio-taping technique was developed by Dr. Kenzo Kase in the 70s, in which adhesive pliable material, directly applied to the skin. KT differs from classical tape in its physical characteristics. Its effects on the body are including; normalization of muscular function, increasing lymphatic and vascular flow, decreasing pain and correction of possible articular mal-alignments[10].

There are many proposed benefits of KT, this technique facilitate proprioception awareness[11], delay muscle soreness onset, and inhibit pain[12].

METHODS

Forty female patients from Outpatient Clinic of Faculty of Physical Therapy, Cairo University suffering from knee OA participated in the study. Their age were ranged from 40 to 60 years, BMI ranged from 25-35 kg/m^2 and grade 2, 3 OA according to Kellgren and Lawrence radiological classification of OA. Subjects were excluded who had previous knee operation, recent knee joint injury, vascular disease as atherosclerosis, and history of intra-articular steroid or hyaluronic acid injections in the last 6 months. They were randomly assigned into 2 equal groups.

Group I: Twenty knee OA patients received Aescin, Diethyl-amine Salicylate gel PH with pulsed ultrasound therapy (50% duty cycle),1 MHZ, 1.5 W/cm^2, 5 min [13].

Group II: Twenty knee OA patients received KT.

In addition to a selected physical therapy program which included hot packs application, stretching exercises of the hamstrings and calf muscles, straight leg raising (SLR) exercise, and quadriceps isometric strengthening exercise. The treatment extended for four weeks; three sessions per week.

Evaluation procedures:

Assessment of each patient in the two groups was performed as follows:

I- Pain assessment by VAS: VAS used to measure pain level. Each patient asked to determine the pain intensity by marking a 10-mm line with 2 extremes: no pain and worst imaginable pain [14].

II - Knee range of motion assessment:

The first step was to identify the bony land marks (the greater trochanter, the lateral femoral condyle, head of fibula and the lateral malleolus) on the subject. Sticky markers were put over these bony land marks for more standardization.

The patient instructed to lay in prone lying position with both feet out of plinth and. Tested lower limb was at the edge of plinth. Each patient was asked to maintain his trunk completely supported on the bed, the contra lateral limb as well as the pelvis were well supported on the bed to avoid any substitutions of movements. The starting position for knee flexion measurement was full extended knee.

The goniometer stationary arm was stabilized parallel to the long axis of the femur along the line extending from the greater trochanter to the lateral femoral condyle of the femur by adhesive strap. The movable arm was stabilized to the long axis of the fibula in line with the head of fibula

and lateral malleolus by another adhesive strap.Patient was asked to flex his knee till the end position then data was recorded [15].

III- Proprioception accuracy test procedures:

3 multi-joint testing and rehabilitation system (Biodex medical system, Shirley, NY, USA); one of the modern isokinetic systems that was used to measure proprioceptive accuracy in knee joint. It is provided with computer system with a menu of programs and a testing chair for the subject to be tested. The test aim was explained for the patient. The patient was familiarized with isokinetic dynamometer through giving full instructions about the procedures to be done. Subjects were wear loose fitting, comfortable clothes.

1- Biodex system pro Isokinetic dynamometer equipped with a special forward reclined back attachment was used to measure the reposition accuracy of the knee joint .Each subject was asked to sit on the chair of the Biodex system with the knee of the tested leg aligned with the axis of the dynamometer and positioned in 90° flexion (starting position), the subject was stabilized in the test position by straps around the trunk, pelvis and thigh and was blind folded to eliminate visual input during testing, the tibial pad was secured to the shank 3 cm superior to the lateral malleolus[16].

2- Type of test was chosen (active repositioning test with speed 30°/s) with three repetitions for each test. Prior to testing each subject performed 2 tests to be familiarized with the procedures.

3- Initially the anatomical reference angle was set at 45° then the subject leg was returned to the starting position [16].

4- For standardization, the tested limb was allowed to move to target angle (45°) actively then was held for 10 seconds as a teaching process for the subject so the subject could memorize the position, and then the limb was allowed to return to the starting position by the apparatus[17].

5- After a 5-second rest, the subject was asked to move his limb to the target angle (45°) actively, when the subject felt that she reached the target angle actively she would stop the apparatus using the Hold/Release button. Subjects were not permitted to correct the angle [16].

6- Three trials were done with rest period of 30 seconds between each trial [18].

The mean angular differences of the 3 trials, between the target angle position and the subject perceived end range position (absolute error) was recorded in degrees as the deficit in repositioning accuracy and was used in the statistical analysis[19].

Treatment procedures:

Before starting the treatment, complete explanation was given to each patient about what was going to be done for each group.

I- Hot packs was applied before each treatment session for 15-20 minutes[20].

II- Selected physical therapy exercise program in the form of:

1- Self Stretching of the hamstring muscles from long setting position for 3 successive times, 30 seconds each with rest for 1 minute in between stretches.

2- Self Stretching of the calf muscles from standing position for 3 successive times, 30 seconds each with rest for 1 minute in between stretches.

3-Straight leg raising exercise; in which the patients was positioned in the crook lying position with the unexercised limb is the flexed one then the patients was asked to contract the quadriceps muscle and elevate the limb to 45º and hold for 6 seconds, slowly lower the limb and then relax for 6 seconds, three sets of 10 repetitions were be done [21].

4- Quadriceps muscle isometric strengthening exercise in the form of 3 sub maximal isometric contractions of increasing intensity, then 6 maximal isometric contractions for 5 seconds. These procedures were repeated at multiple knee angles (30º–60º–90º) degrees respectively, each contraction was followed by 30 seconds rest period and each set of contractions at each knee angle was followed by 1 minute rest [22].

III- Aescin, Diethylamine Salicylate Phonophoresis application:

Ultrasound device; It is a Phyaction (SONICATOR, 730), 50-60Hz made in the California. The US therapy session was used ultrasound waves for 5 minutes and intensities 1 MHz and 1.5 W/cm² pulsed waves (50% duty cycle), was used in the therapy sessions on affected knee with Aescin, Diethyl-amine Salicylate gel put on ultrasound head [13].

IV- Application of Kinesio Tape

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

The length of tape is measured from a hand breadth above the patella to the tibial tuberosity. The tape is cut in such a way that the base is a hand breadth long. The backing paper is pulled back at the end of the base up to the Y-tape tail. A narrow strip of the base, approximately a fingerbreadth, is affixed over the upper margin of the patella, then is the remainder of the base affixed. Using both hands, the two tail tapes are affixed around the patella up to its apex, while the patient pulls up his/her knee to its maximum bending capacity. The tape ends lay one over the other on the tibial tuberosity. Both tape ends are affixed without tension [23].

RESULTS

I- Demographic data of the subjects: In this study, 40 females with knee OA were assigned into 2 equal groups. There was no significant difference between the 2 groups in their ages, weights and heights where their P-values were 0.767, 0.707, and 0.506 respectively. As shown in table 1.

II- Pre study means values within both groups:

There was no significant difference between two groups pre-study in pain level, proprioception accuracy and knee

flexion ROM as P value was 0.111, 0.734 and 0.089 respectively as shown in Table 2

III- Post study means values within both groups:

There was significant difference between two groups post-study in pain level as P value was 0.000 in favor to group I, while was no significant difference between two groups in proprioceptio accuracy and knee flexion ROM as P value was 0.710 and 0.175 respectively as shown in Table 3

IV- Comparison of pre and post study for two groups:

There was significant difference between pre-study and post-study for both groups in pain level, proprioception accuracy and knee flexion ROM as P value was 0.000 as shown in Table 4

DISCUSSION

This study was applied to investigate the efficacy of Aescin, Diethylamine Salicylate PH against KT application on pain level, ROM, and proprioceptive accuracy in patients with knee OA.

Therapeutic US has many benefits. It speeds up of the healing process as a result of increasing blood flow in the treated area. It decreases pain as a result of reduction of swelling and edema. It produces gentle muscles, tendons and ligaments massage in the treated area which softens scar tissue. These benefits of US are achieved by two effects; thermal and non thermal effects[24].

Combination of US with specific medication is used to enhance penetration of the drug molecules, which is known as PH. Subcutaneous circulation absorbs Significant amounts of drug and dissipate them to depths of several centimeters. High frequency US waves encourage the penetration of topically applied drugs. Thermal effect of US increases the drug molecules kinetic energy, dilates the entry points of the cell membrane and improves the circulation to the treated area. These physiological changes deliver the drug molecules to the stratum corneum and finally into the dermis through blood circulation. Also non thermal effects of US increase cell permeability. US waves have mechanical characteristics that increase drug diffusion by cells oscillation at high speed, altering the cell membrane resting potential [25].

Pain improvement in group I may be attributed to the effects of Aescin, Diethylamine Salicylate which is a basic gradient of the gel used for the treatment that evoked a number of pharmacological effects deep within the knee soft tissues, including analgesia, reducing inflammation[26]. Also improvement may be the result of the use of US as ultrasound is used for pain relief, decrease muscle spasm and increase tissue extensibility. The PH helps more and efficient absorption of the gel which infiltrates the tissue to a higher depth than topical application [24].

Range of motion improvement in group I might be due to the effects of the introduced materials that inhibit pain, this allowed easier application of stretching and strengthening exercises. The increased ROM enables the patients to maintain more active knees and reduce its immobilization. The accumulated effect of stretching exercises through 12 sessions that tend to increase knee capsule extensibility and increase joint ROM in addition to its sedative effect [21].

Improvement in the proprioception in group I may be attributed to the role of US to decrease pain, inflammation and improve functional activity and to the role of Aescin diethylamine salicalate induced by PH which proved to have analgesic and anti-inflammatory effect which improving the proprioceptive accuracy.

Kinesio Taping

According to Kenzo Kase, the creator of Kinesio TM tape, the aims of KT application are strengthening weakened muscles, increasing of blood and lymph circulation through preventing subcutaneous bleeding, neurological suppression which relieves pain, and restoring fascia and muscle function[10]. **Murray and Husk, 2001**, which describes Kinesio TM tape, suggested that it improves proprioception awareness via stimulation of cutaneous mechanoreceptors[27].

The primary function of KT application is pulling the skin up, so increasing the interstitial space between the skins and underlying connective tissues. This leads to increasing blood and lymph fluids in treated area[28.29]. The secondary function is stimulation of the neurological system which decreasing pain perception. The neurological system Stimulation leads to sending the efferent signal from the brain that closing the way of afferent pain signal to the brain [28, 29]. Also, KT corrects the joint mal-alignment and supports weakened muscles surrounding the joint so, decreasing muscle spasm and joint [12,30].

Stretching of the skin under tape stimulates cutaneous mechanoreceptors and displaying information of joint position and motion [31]. Furthermore, the cutaneous mechanoreceptors have assessing role to joint mechanoreceptors in detecting joint position and movement [11] . KT could improve proprioceptive function[27].

Exercise

Bennell, 2005 concluded that aerobic exercise is more effective for functional outcomes for osteoarthitic patients in the long-term, while the strengthening exercise is more effective for specific impairment-related outcomes in the short term[32].

Brosseau, 2003 showed that aerobic exercise is superior or equivalent to strengthening exercise [33]. However, Roddy, 2005 reported that both aerobic walking and home-based muscle strengthening exercises decrease pain and disability in cases of knee OA[34].

Hurley, 2009 concluded that integrated rehabilitation program is the best way of treating the huge number of people suffering chronic knee pain[35]. Moderate exercise program, including isotonic and isometric muscle strengthening exercises, was more beneficial for improving the knee extensor and flexor muscles strength[36].

CONCLUSION

From this study, it was concluded that Aescin, Diethylamine Salicylate gel PH with the selected exercise program is more effective than KT application in reliving knee pain in knee osteoarthritic patients.

Tables

Table 1: General subject characteristics:

Item	Group I			Group II			t-value	P-value
	Mean ±SD	Range		Mean ±SD	Range			
		Min	Max		Min	Max		
Age (years)	49.25 ±5.82	40	60	48.7 ±5.82	40	57	0.30	0.767
Height (cm)	165.1 ±2.49	163	170	165.45 ±3.3	160	170	-0.38	0.707
Weight (Kg)	72.85 ±4.02	68	80	71.95 ±4.44	67	80	0.67	0.506

Table 2: Pre study means values within both groups:

Items	Pain	Proprioception (degrees)	Knee flexion ROM (degrees)
Group I	7.1±0.788	3.57±1.62	96.8±7
Group II	7.5±0.761	3.73±1.32	100±4.14
t-value	-1.63	-0.34	-1.76
P-value	0.111	0.734	0.089

Table 3: Post study means values within both groups

Items	Pain	Proprioception (degrees)	Knee flexion ROM (degrees)
Group I	4.12±0.705	2.43±0.894	107.5±6.82
Group II	5.85±0.745	2.56±1.2	110±4.32
t-value	-7.52	-0.37	-1.39
P-value	0.000	0.710	0.175

Table 4: Comparison of pre and post study for both groups

Items	pain		Proprioception (degrees)		Knee flexion ROM (degrees)	
	Group I	Group II	Group I	Group II	Group I	Group II
Pre-study	7.1± 0.788	7.5 ±0.761	3.57 ±1.61	3.73 ±1.31	96.8 ±7	100±4.14
Post-study	4.12 ±0.705	5.85 ±0.745	2.43 ±0.894	2.55 ±1.19	107.5 ±6.82	110±4.31
% of improvement	41.9 %	22 %	31.9 %	31.6%	11 %	10 %
t-value	44	11	4.86	7.45	-22.73	-13.26
P-value	0.000	0.000	0.000	0.000	0.000	0.000

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