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Original Research Article

Efficacy of Kinesio Taping In the Management of Knee Osteoarthritis

Ajeet Kumar Tiwari[1], Bibhuti Sarkar[2], Ananya Satapathy[3]

[1]Professional Trainee (PT), [2]Demonstrator, (PT), [3]Senior Professional Trainee, (PT);
Department of Physiotherapy, National Institute for Locomotor Disabilities (Divyangjan) (NILD), B.T. ROAD, Bonhoogly, Kolkata-700090, West Bengal, India.

Corresponding Author: Ajeet Kumar Tiwari

ABSTRACT

Background: The purpose of this study was to find out the efficacy of kinesio taping in the management of knee osteoarthritis in aspect of relieving pain, improving knee joint range of motion, muscle strength and reducing functional disability.
Methods: 30 subjects with unilateral or / bilateral knee osteoarthritis were included and randomly assigned into two groups. Group - A (n= 15) received kinesio taping once a week for 3 weeks along with supervised exercise program, Group- B(n=15) received supervised exercise program only, thrice weekly for 3 weeks. The outcome parameters measured were pain intensity by Numerical pain rating scale (NPRS), Range of Motion (ROM), Muscle strength (MS) and WOMAC score were measured pre- intervention, post –intervention and at three weeks follow up.
Results: Statistically significant improvement was found in both groups for all outcome parameters ($p<0.05$). In between group analysis of post intervention data, Group-A has shown significant improvement in NPRS, ROM, muscle strength (MS), and WOMAC score in comparison to Group-B. Follow up data at three weeks has also shown significant changes in NPRS, ROM, MS and WOMAC Score as compared to Group-B.
Conclusion: The study demonstrated that kinesio taping along with supervised exercise program is more effective than supervised exercise program alone in relieving pain, increasing range of motion, strength and improving functional capacity in subjects with knee osteoarthritis.

Key Words: Osteoarthritis, Numerical pain rating scale (NPRS), Range of Motion (ROM), Muscle strength (MS), WOMAC & Kinesio taping.

INTRODUCTION

Osteoarthritis (OA) is a common chronic degenerative synovial joint disease of multi factorial etiology usually targets specific joints, pathologically characterized by focal loss of articular hyaline cartilage with proliferation of new bone at the margins, sub-chondral sclerosis and remodeling of joint contour. [1,2]

Osteoarthritis is classified as primary and secondary osteoarthritis. Osteoarthritis having no known cause and are mostly related to aging are known as primary osteoarthritis. Osteoarthritis caused by another disease or condition which may be hereditary, developmental, metabolic and mechanical deficits are known as secondary osteoarthritis. [2] Considering the tri-compartmental nature of the knee joint and the unique functions of each, knee osteoarthritis is classified as patellofemoral osteoarthritis, medial tibiofemoral osteoarthritis and lateral tibiofemoral osteoarthritis. Patellofemoral joint is one of the most commonly affected compartments by osteoarthritis. [3]

Symptoms of knee osteoarthritis may include joint pain, tenderness, stiffness, locking and sometimes an effusion, deformity, coarse crepitus, instability and restricted ability. [2]

Conservative treatment for knee osteoarthritis consists of exercises (strengthening and stretching exercises), electrotherapy (Ultrasound, TENS, Neuromuscular electrical stimulation, Contrast bath, Whirlpool bath), NSAIDs (non-steroidal anti-inflammatory drugs), corticosteroid therapy, Kinesio taping, acupuncture, weight management and the use of orthosis. [4]

Kinesio taping (KT) is thin, cotton, porous fabric with acrylic adhesive that is non medicated, latex-free and heat activated. The cotton fibres allows evaporation and quicker drying leading to longer wear time, up to 4-5 days. Knee taping is believed to relieve pain by improving alignment of the patellofemoral joint and/or unloading inflamed soft tissues. Knee taping often allows pain free exercise by decompressing and derotating the patella. [5,6,13]

There are a limited number of studies highlighting the effects of kinesio taping in knee osteoarthritis. Several studies have found out that kinesio taping is effective in number of musculoskeletal injury like tennis elbow, ligament injury, whiplash injury etc. [6] So in order to overcome the limitation of previous studies and to achieve greater effectiveness for longer duration in case of knee osteoarthritis, Kinesio taping can be combined with supervised exercise program during treatment.

On the basis of the above stated studies, it can be concluded that limited literature and combined effects of different modes of treatment for knee Osteoarthritis are the two major shortcomings a researcher faces. Thus, a need arises which addresses these perspective for new management strategies. The present study is designed to meet the above-mentioned purpose. The current study thus proposes to evaluate the efficacy of Kinesio taping in the management of knee osteoarthritis.

MATERIALS AND METHODS

Subjects: This Pre-test - post-test group study evaluated the efficacy of kinesio taping in the management of OA knee patients came to the NILD, (Divyangjan), Kolkata, India between April, 2016 to February, 2017. Scientific and Ethical approval was taken from Institute Ethical Committee (IEC) on 13th April, 2016. Inclusion criteria were 1) Subjects who have met the American college of Rheumatology clinical and radiological classification criteria for knee Osteoarthritis; 2) Age: 40-65 years; 3) Both genders (males & females); 4) Subjects with involvement of tibiofemoral and patellofemoral compartments i.e. tri-compartmental Knee Osteoarthritic patient; 5) Body Mass Index = 18-30 kg/m 6) Grade = 2nd [Kellen and Lawrence (1957) classification]; 7) Unilateral / Bilateral cases (more painful knee indicated by the subject will be considered for data collection); 8) Pain intensity level between 3-8 point of NPRS; 9) Lateral tracking of patella.

The subjects were excluded if they had 1) Allergy to tape; 2) Infective condition of the skin of the knee and fragile skin around the knee; 3) Surgery of the knee complex or history of joint replacement and steroid injection in knee (within last 6 months); 4) Physiotherapy for the knee (within last 3 months); 5) Soft tissue injury around Knee; 6) Unstable medical condition like hypertension, diabetes; 7) Increased Q-Angle range >20 degree; 8) Uncooperative subjects.

Total 30 subjects were included in the study

Procedure: Aim and procedure of the study were explained to all subjects in their preferred language before data collection. Informed consent form (which also includes permission to use their data and photograph. for presentation and publication purpose) written in their preferred language (English/ Hindi/ Bengali) was taken from all the subjects who agreed to participate. Subjects

were allocated to two different treatment groups, Group-A (Kinesio taping along with supervised exercise program) and Group-B (Supervised exercise program only) by simple random sampling (chit picking method), consisting of 15 subjects each. For each subject, demographic data was collected. The baseline data for pain intensity during activity of knees, range of motion of knees, knee extensor muscle strength & functional disability was taken before starting the intervention and at the end of 3 weeks of intervention and after 3 weeks at follow up. Total 9 treatment sessions were given to each subject with the frequency of 3 sessions per week for 3 consecutive weeks. Each subject of Group-A was given kinesio taping once per week for 3 consecutive weeks. Kinesio tape once applied was left in place for 5 days. After Kinesis tape application, all the OA knee subjects, underwent supervised exercise program. Post treatment, after application of kinesis tape, Q-angle was measured and X-ray of knee joint was taken to observe the correction of lateral tracking of patella.

Supervised exercise program was continued as home exercise program, after completion of 3 weeks of intervention, for 3 weeks.

Medications (NSAID) duly prescribed by the physician was continued along with the physiotherapeutic approach in both groups in the study.

The following precautions were explained to the subjects of both groups as an ergonomical advice: Avoid extreme knee bent positions, avoid squatting, crossed-leg sitting, frequent stair climbing or lifting heavy objects, avoid fatiguing postures except for infrequent short durations tasks, change posture frequently and use support where possible and avoid giving excess strain to the knees. [7]

The measurement of pain intensity (during activity) was done using a Numerical Pain Rating Scale (NPRS). Each subject was asked to indicate, the level of their perceived pain intensity at knee joint on the scale. The readings was taken pre-intervention marked as NPRS0, at the end of 3 weeks of treatment marked as NPRS1 and at the end of 3weeks of follow up marked as NPRS2.

The outcome measures of ROM of knee joint passive flexion was obtained using universal goniometer. Passive ROM for knee flexion was measured in prone, with both feet off the end of the examining table. The subject was asked to extend the knees and position the hips in 0 degrees of flexion, extension, abduction, adduction, and rotation. Hip was stabilized to maintain neutral position. Hip was not allowed to flex. Fulcrum of the goniometer was Centered over the lateral condyle of the femur. Stationary arm was aligned with the lateral midline of the femur, using the greater trochanter as a reference. Movable arm was aligned with the lateral midline of the fibula, using the lateral malleolus and the fibular head as reference. Therapist passively flex the knee by lifting the lower leg off the table. At the end of knee flexion ROM, the examiner uses one hand to maintain knee flexion and also to keep the distal arm of the goniometer aligned with the lateral midline of the leg. [8] Average of three measurements was recorded. The readings were taken at baseline marked as ROM0, at the end of 3 weeks of treatment marked as ROM1 and at 3-week follow- up marked as ROM2.

Maximal isometric force generated by Knee extensor muscle group was measured using a Handheld dynamometer (HHD). The subjects were in high- sitting position with the test limb in zero degree hip rotation and 60 degree knee flexion (Figure-3.4). The device was placed anteriorly 2.5cm proximal to the ankle and therapist was in front of the subject and asked to perform a maximum voluntary contraction (MVC) against the dynamometer, which was used to measure the applied force. At the initial testing session, and this testing sequence was maintained in the same order at the re-test session. Subjects were instructed about the procedure, they were asked to perform submaximal contraction

against the therapist hand as a trial to check if they were performing the contraction correctly. Then an additional practice trial, in the form of an MVC against the HHD was applied. The individual test was administered 3 times to reduce a possible learning effect & the mean of the three values was recorded in kg (kilogram), because these procedures are commonly applied in MVC testing. There was a 30 second rest period between each trial. [9] The readings were taken at baseline marked as MS0, at the end of 3 weeks of treatment marked as MS1 and at 3-week follow- up marked as MS2.

Figure- 3.4: Measurement of knee exrensor strngth

Pain, stiffness and disability was assessed using the WOMAC index, which is a questionnaire that evaluates the condition of patients with OA knee using twenty four (24) parameters which is divided into three (3) subscales. The WOMAC measures five items for pain, two for stiffness and seventeen (17) for functional limitation. The patient's response to each question produces a score. Where for possible knee pain score ranging from 0-20, for stiffness 0-8, and for physical function 0-68. Physical functioning questions cover everyday activities such as stair use, standing up from a sitting or lying position, standing, bending, walking, getting in and out of a car, shopping, putting on or taking off socks, lying in bed, getting in or out of a bath, sitting, and heavy and light household duties. The subject were asked to rate the activities in each category according to the following scale of difficulty 0 = none, 1 = slight, 2 = moderate, 3 = very, 4 = extremely. These markings were added to get the full score of WOMAC at baseline, post-intervention and follow-up. So, WOMAC scores indicate more disability. [10] The readings were taken at baseline marked as WOM0, at the end of 3 weeks of treatment marked as WOM1 and at 3 weeks follow- up marked as WOM2.

For measuring the Quadriceps angle; Subject´s position was in supine lying. Three landmarks were identified on the involved limb namely; anterior superior iliac spine (ASIS), centre of the patella and tibial tuberosity. For marking center of patella, borders of patella were palpated and outline of patella was drawn using a body marker and making sure that the skin is not stretched while doing it. Intersecting point of maximum vertical and transverse diameters of patella has to be taken as centre of patella. The point of maximum prominence at anterior upper end of tibia was marked as the tibial tuberosity. Then the squaring of pelvis was done. Subjects were instructed to relax the quadriceps muscle with lower limbs in neutral rotation and the foot pointing upwards as well as perpendicular to the resting surface. The axis of goniometer was placed on centre of the patella, fixed arm aligned with the ASIS and the movable arm with the tibial tuberosity. The first line was drawn from the ASIS to the center of the patella using the straight edge of measuring tape. The second line was drawn from the tibial tuberosity to the centre of patella & then extending the second line upwards, the angle formed between these two upper lines was Quadriceps angle. [11]

For Kinesio tape application, the subjects were asked to lie down supine on a couch with their knee slightly flexed with the help of wedge to allow quadriceps relaxation (Figure-3.5a and 3.5b). Patient was asked to shave the treatment area usually 12 hours before Kinesio tape application. The area of treatment was

cleaned and dried. Kinesio tap was applied medially to the patella to provide medial glide, medial tilt and antero-posterior tilt to the patella and reduce strain on the infrapatellar pad or pes anserine. One end of theY-shaped Kinesiotape was secured to the lateral patellar border and the patella was glided and tilted medially by the use of the thumb while maintaining 50–75% tension of the tape. It was applied up to medial border of medial hamstring tendon. Similarly, another I-shaped kinesio tape was applied slightly inferior to the first one as reinforcer and to reduce strain on infrapatellar pad or pes anserinus. [5,6,12,13]

According to Kase Wallis principles of KT, a gap of at least 30 min was given after the tape application to achieve a complete activation of the glue, which is believed to improve the performance of the kinesiotape in patellar alignment correction. The tape was applied once a week for 3 weeks and was kept in place for 5 days after each application. [5,6,12,13]

Both the experimental and control group received supervised exercise program. All subjects continued current treatments but was instructed to refrain from starting new ones. The total treatment period was of 3weeks. [5]

Figure 3.5a- Patellar taping

Figure 3.5b- Patellar taping

Supervised exercise program includes stretching and strengthening exercises along with warm up and cool down exercises. Warm up and cool down exercises was given before starting and after the completion of supervised exercise program in both groups.

Warm up Exercise are as follows; 1) Active knee Range of motion exercises (within limit of pain) was performed by the subjects in supine & sitting position. 20 repetitions × 1 set. 2) Free active movements of hip (abduction-adduction, flexion-extension) in all planes & ankle (dorsiflexion – plantarflexion) × 20 repetitions each × 1 set. Rest interval of 1-2 minutes was given. Cool down period was given following the exercise period. Exercises are similar to those of the warm-up period. Both warm up and cool down period lasted for 5 to 10 minutes. [14,15]

Flexibility exercise includes 1) Capsular stretching; Subject was in sitting position on treatment table (Figure-3.6). One lower limb flexed to 90^0 at hip, knee extended and ankle planter flexed and other limb was on the side of treatment table. Both hand was placed on above the knee joint, one over the another to apply pressure to stretch the posterior knee joint capsule. Wedge was placed at the lower end of tibia to keep the knee slightly elevated from treatment table. The knee progressively extended until a gentle stretch is perceived in the posterior capsule. This position was held for 30 seconds and repeated 3 times. Between each repetition there was a rest periods of 5 seconds. [16,17]

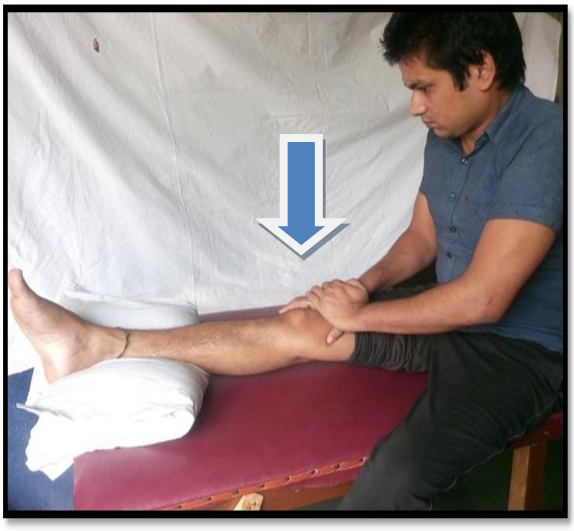

Figure-3.6-Capsule stretch

2) **Quadriceps Stretch:** Subjects was in prone position on treatment table (Figure-3.7). Both hips and knees extended. A band of cloth was placed around the ipsilateral ankle and brought posteriorly and superiorly over the ipsilateral shoulder. The subject grasped the band of cloth in the ipsilateral hand and bent the knee by straightening his/her elbow and pulling on the band of cloth. The knee was progressively flexed until a gentle stretch was felt in the anterior thigh. This position was held for 30 seconds and repeated 3 times. Between each repetition there was a rest periods of 5 seconds. [16,17]

Figure 3.7: Quadriceps stretching exercise

3) **Hamstring Stretch:** Subject was in supine position with the contralateral lower extremity maintained as straight as possible. The ipsilateral hip was flexed to 90°. The knee was straightened and the proximal lower leg supported with the hands until a moderate pull was perceived in the posterior thigh and calf. The ipsilateral ankle was dorsiflexed. This was held for 30 seconds and repeated 3 times. Between each repetition there was a rest period of 5 seconds. [16,17]

4) **Range of motion exercises;** a) Knee in mid-flexion to full-extension: Subject was in supine position. Knee was brought to 45° of flexion with the ipsilateral foot sliding on the surface that the subject was lying on. The knee was then fully extended with a strong quadriceps femoris muscle contraction against any limitation to full knee extension. Two 30 seconds bout with 3 seconds hold at the end range was performed. b) Knee in mid-flexion to full-flexion: Subject was in supine position. Knee was brought to full flexion with assistance of the upper extremities or a band of cloth. A gentle challenge to end-range flexion was sustained. Two 30 secs bouts with 3 secs hold at the end range was performed by the subjects. [17]

Strengthening exercise includes 1) Isometric Quadriceps Exercise: Subject was in supine position with the knee in full extension with a pillow or a towel roll under the knee. Subjects were asked to contract the quadriceps femoris muscle causing the patella to glide proximally and pushes the knee down while maintaining the foot in full dorsiflexion. Hold each contraction for 5 seconds. 3sets of 10 repetitions was performed. [15,16,18] 2) Hamstring setting exercise; Subject was in supine or long sitting position with the knee in extension or slight flexion with a towel roll under the knee. Subjects were asked to contract the knee flexors isometrically just enough to feel the tension developing in the muscle group by gently pressing the heel into the treatment table and holding the contraction for 5 seconds. 3 sets of 10 repetitions was performed. [15,16,18] 3) Vastus Medialis Obliqus strengthening: Subject was in supine position with roll under thigh and

knee in 50 degrees flexion and leg externally rotated. Subjects were asked to extend the knees to 20 degrees. This was held for 5 seconds. 3 sets of 10 repetitions was performed. [15,16,18] 4) Straight leg raises exercises: Patient was in supine position with the knee extended. Patients were asked to set the quadriceps, and then lift the leg to 45 degrees of hip flexion while keeping the knee extended; hold for 5 seconds & then was lowered. 3 sets of 10 repetitions was performed. [15,16,18]

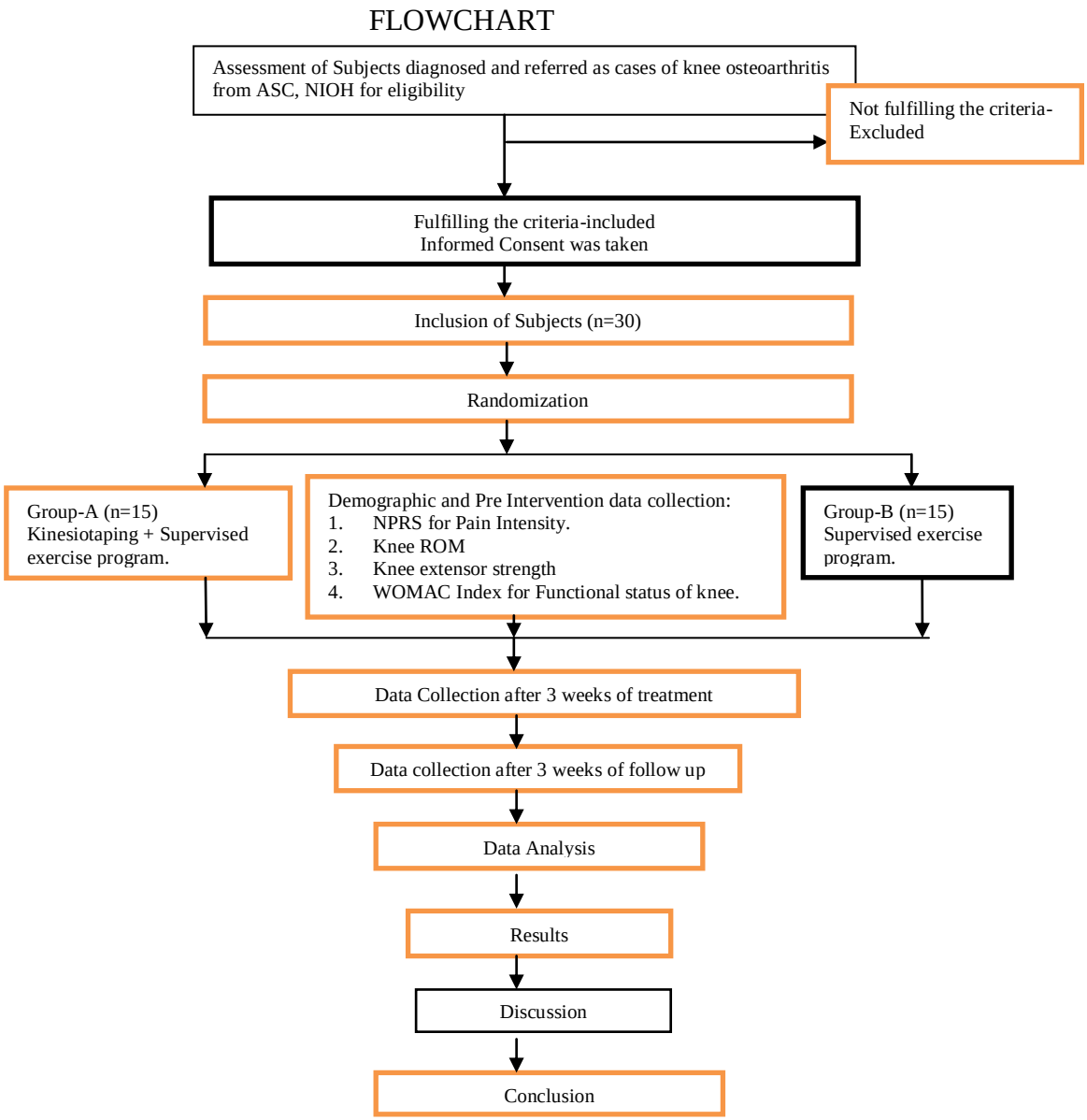

Figure - 5.3: Consort Flow Diagram

Statistical Analysis:

Statistical package for the social sciences (SPSS) version 23 software was used for analysis of the collected data. Numeric pain rating scale (NPRS), Passive Range of Motion (PROM), Knee extensor muscle strength and Western Ontario and McMaster Universities Arthritis index (WOMAC) are continuous data. To determine the normality in the distribution of data, "Shapiro- Wilk test" was used which revealed that the data was normally distributed ($p > 0.05$); thus parametric test were used for analysis of this continuous data. Demographic data (Age and BMI) and baseline characteristics of the data between

the two groups for homogeneity were measured using "One-way ANOVA". "Paired sample t-test" was done to analyze the within group difference of the outcome variables in Group A and Group B.

"One- way ANOVA" and Post Hoc – Tukey test for multiple comparisons were used to see the differences between the groups. Multiple comparisons of the mean difference i.e., difference of mean of pre-data, mean of post-data and mean of follow up data were used for comparison among the groups. The tests were applied at 95% confidence interval on p-value set at 0.05. The results were taken to be significant if $p \leq 0.05$.

RESULTS

DEMOGRAPHIC DATA: (TABLE –7.1). These variables had insignificant difference between the two groups ($p > 0.05$) at baseline.

TABLE –7.1: Age and B.M.I Distribution

	Group-A (n = 15)	Group- B (n = 15)	p-value
AGE	54.4 ±5.48	54.73 ±6.86	0.898
BMI	25.276±2.09	25.681±2.99	0.729

1) PAIN INTENSITY:

a) Within Group Comparison: - In both the groups i.e. Group-A &Group-B there was a statistically significant difference between $NPRS_0$-$NPRS_1$, $NPRS_1$-$NPRS_2$ and $NPRS_0$-$NPRS_2$ comparison ($p<0.05$). Both the groups had shown statistically significant improvement in pain scores post treatment and but not in follow up. The mean improvement in Group-A is ($NPRS_O$-$NPRS_1$)2.73±1.09, (NPRS1-$NPRS_2$)1.33±0.48, ($NPRS_0$-$NPRS_2$) 4.07±1.03; and in Group-B is ($NPRS_O$-$NPRS_1$) 1.26±0.45, ($NPRS_1$-$NPRS_2$) 1.0±0.65, ($NPRS_0$-$NPRS_2$) 2.27±0.59; (TABLE-7.2)

TABLE – 7.2: Within group comparison of NPRS score

	$NPRS_0$ Mean ± SD	$NPRS_1$ Mean ± SD	$NPRS_2$ Mean ± SD	$NPRS_O$-$NPRS_1$		$NPRS_1$-$NPRS_2$		$NPRS_0$-$NPRS_2$	
				t value	p value	t value	p value	t value	p value
GROUP-A (n= 15)	6.53 ±0.83	3.8 ±0.56	2.46 ±0.52	9.63	000	10.58	000	15.25	000
GROUP-B (n=15)	6.14 ±0.51	4.86 ±0.74	3.87 ±0.74	10.717	000	5.916	000	14.79	000

b) Between Group Comparison:- There was statistically significant difference between the post-treatment reading at the end of 3rd weeks ($NPRS_1$) and at the end of 6th week ($NPRS_2$). The mean difference of NPRS1 score between Group-A and B at the end of 3rd week (GrA, $NPRS_1$-GrB, $NPRS_1$) is –1.07±0.91. The mean difference of NPRS2 score between Group-A vs B at the end of 6th week is (GrA, $NPRS_2$-GrB, $NPRS_2$) is –0.06±0.88. Group-A has shown more improvement than group- B. (TABLE- 7.3).

TABLE -7.3: Between group comparison of NPRS score

	Group-A Mean± SD	Group-B Mean± SD	A vs. B p value
$NPRS_0$	6.4±0.71	6.1±0.52	0.38
$NPRS_1$	4.3±0.84	4.8 ±0.74	000
$NPRS_2$	3.1 ±1.01	3.87±0.74	000

1) RANGE OF MOTION (KNEE FLEXION):

a) Within Group Comparison:- In both groups, i.e. Group-A & Group-B there was a statistically significant difference between $PROM_0$–$PROM_1$, ROM_0–ROM_2 and ROM_1– ROM_2 comparison ($p<0.05$). The mean improvement in Group-A ($PROM_O$-$PROM_1$) is -4.267±1.83, ($PROM_1$-$PROM_2$) is -1.6±.91, ($PROM_0$-$PROM_2$) is -5.87±2.32; Group-B ($PROM_O$-$PROM_1$) is -4.87±3.56, ($PROM_1$-$PROM_2$) is -2.87±1.84, ($PROM_0$-$PROM_2$) is -7.73±3.67; (TABLE 7.4)

TABLE -7.4: Within group comparison of Range of motion

	$PROM_0$ Mean ± SD	$PROM_1$ Mean ± SD	$PROM_2$ Mean ± SD	$PROM_O$-$PROM_1$		$PROM_1$-$PROM_2$		$PROM_0$-$PROM_2$	
				t value	p value	t value	p value	t value	p value
GROUP-A	126 ±6.65	130.33 ±5.78	131.9 ±5.28	-9.025	0.00	-6.808	000	-9.769	0.00
GROUP-B	120 ±16.02	125.8 ±13.47	128.67 ±13.8	-5.29	0.00	-6.013	000	-8.153	0.00

b) Between Group Comparison:- There was statistically significant difference between the post-treatment reading at the end of 3rd weeks (ROM_1) and at the end of 6thweek (ROM_2). The mean difference of PROM1 score between Group-A vs B at the end of 3rd week is (GrA, $NPRS_1$-GrB, $NPRS_1$) is 2.87±5.28. The mean difference of PROM2 score between Group-A vs B at the end of 6th week is (GrA, $NPRS_2$-GrB, $NPRS_2$) is 3.06±3.51. Group-A has shown more improvement than group-B. (TABLE- 7.5).

TABLE -7.5: Between group comparison of Range of motion

	Group-A Mean± SD	Group-B Mean± SD	A vs.B p value
$PROM_0$	126.07 ± 6.66	120.94 ± 16.02	0.307
$PROM_1$	131.34 ± 3.68	128.47 ± 3.51	0.054
$PROM_2$	134. 00 ±1.41	130.9 ± 3.31	0.004

1) KNEE EXTENSOR MUSCLE STRENGTH:

a) Within Group Comparison:- In both groups, i.e. Group-A, & Group-B there was a statistically significant difference between MS_0-MS_1, MS_1-MS_2 and MS_0-MS_2 comparison ($p<0.05$). All the groups had shown statistically significant improvement in knee extensor muscle strength post treatment and in follow up. The mean improvement in Group-A (MS_O-MS_1) is 2.73±1.09, (MS_1-MS_2) is 1.34±0.49, (MS_0-MS_2) is 4.07±1.03; Group-B (MS_O-MS_1) is 1.27±0.46, (MS_1-MS_2) is 0.21.00±0.65, (MS_0-MS_5) is 1.62.27±0.6. (TABLE 7.6)

TABLE -7.6: Within group comparison of Muscle Strength

	MS_0 Mean ± SD	MS_1 Mean ± SD	MS_2 Mean ± SD	MS_O-MS_1		MS_1-MS_2		MS_0-MS_2	
				t value	p value	t value	p value	t value	p value
GROUP-A	9.19 ±1.02	10.68 ±1.23	11.91 ±1.21	-7.36	0.00	-6.73	0.00	-9.09	0.00
GROUP-B	8.65 ±1.46	11.64 ±1.49	13.16 ±1.14	-11.87	0.00	-8.192	0.00	-15.168	0.00

b) Between Group Comparison:- There was statistically significant difference between the post-treatment reading at the end of 3rd weeks (MS_1) and at the end of 6th week (MS_2). The mean difference of PROM1 score between Group-A vs B at the end of 3rd week is (GrA, MS_1-GrB, MS_1) is 1.17±2.16. The mean difference of MS2 score between Group-A vs B at the end of 6th week is (GrA, $NPRS_2$-GrB, $NPRS_2$) is 1.74±1.69. Group-A has shown more improvement group- B. (TABLE- 7.7).

TABLE -7.7: Between group comparison of Muscle strength

	Group-A Mean± SD	Group-B Mean± SD	A vs. B p-value
MS_0	9.19± 1.02	8.65±1.46	0.291
MS_1	11.22±1.05	10.04±1.56	0.054
MS_2	12.83±0.72	11.09±0.1.45	0.001

1) FUNCTIONAL STATUS (WOMAC SCORE):

a) Within Group Comparison: - In both groups, i.e. Group-A, & Group-B there was a statistically significant difference between WOM_0-WOM_1, WOM_0-WOM_2 and WOM_1-WOM_2 comparison ($p<0.05$). All the groups had shown statistically significant improvement in WOMAC score post treatment and in follow–up. The mean improvement in Group-A (WOM_O-$WOM4_1$) is 13.38±6.92, (WOM_1-WOM_2) is 6.4±4.2, (WOM_0-WOM_2) is 19.78±6.68; Group-B (WOM_O-WOM_1) is 10.23±6.68, (WOM_1-WOM_2) is 2.74±2.12, (WOM_0-WOM_2) is 12.95±5.92. (TABLE 7.8)

TABLE -7.8: Within group comparison of WOMAC

	WOM_0 Mean ± SD	WOM_1 Mean ± SD	WOM_2 Mean ± SD	WOM_0-WOM_1		WOM_1-WOM_2		WOM_0-WOM_2	
				t value	p value	t value	p value	t value	p value
GROUP-A	58.62 ±6.9	36.13 ±4.17	30.48 ±6.68	7.485	0.00	5.94	0.00	11.47	0.00
GROUP-B	55.45 ±4.82	45.22 ±5.7	42.5 ±4.7	5.92	0.00	4.99	0.00	8.468	0.00

b) Between Group Comparison: - The post treatment reading at the end of 3rd week ($WOMAC_1$) was found to be statistically significant between the two groups ($p<0.05$). The follow up data also showed statistically significant difference ($WOMAC_2$). There was statistically significant difference between the post-treatment reading at the end of 3rd weeks ($WOMAC_1$) and at the end of 6th week ($WOMAC_2$). The mean difference of WOMAC1 score between Group-A and B at the end of 3rd week is (GrA, $WOMAC_1$-GrB, $WOMAC_1$) 1.17±2.16. The mean difference of WOMAC2 score between Group-A and B at the end of 6th week is (GrA, $WOMAC_2$-GrB, $WOMAC_2$) 1.74±1.69. Group-A has shown more improvement than group- B. (TABLE 7.9)

TABLE -7.9: Between group comparison of WOMAC score

	Group-A Mean± SD	Group-B Mean± SD	A vs. B p-value
WOM_0	58.68±6.9	55.45±4.82	0.190
WOM_1	36.13±4.17	45.22±5.7	0.00
WOM_2	30.48±6.68	42.5±4.7	0.00

DISCUSSION

This study attempted to focus our attention towards the efficacy of Kinesio taping in the management of knee osteoarthritis

In this study, subject's pain intensity, range of motion, muscle strength and physical function improved in the majority of subjects with both kinds of treatment. The data showed an improvement in both the groups, but the improvement was statistically significant in Group A than in Group B in terms of pain intensity, range of motion, muscle strength and physical function. Moreover, the follow-up data showed that the results were sustained even after three weeks of completion of treatment.

Pain intensity; With respect to pain intensity on Numeric pain rating Scale (NPRS), both groups showed statistically significant reduction after 3 weeks of treatment with statistically significant difference when compared between the groups. However, both the groups i.e., Group-A & Group-B showed better results but Group-A shows superiority. The improvement in Group-A could be attributed to the rationale that Knee taping is believed to relieve pain by improving alignment of the patellofemoral joint and/or unloading inflamed soft tissues. Knee taping often allows pain free exercise by decompressing and derotating the patella. [5,18,19]

Lan et al (2010), in a study concluded that the greatest reduction in pain occurred after the initial Kinesio tape application. Pain relief afforded by kinesio tape would be associated with improvements of disability level. [5,12]

The reduction of pain in Group-B is in accordance with the studies of Miyaguchi et al (2003) who reported that strengthening exercise is clinically effective for the reduction of pain in knee OA. According to them a significant increase in muscle strength. Deyle et al. suggested that exercise may provide a "stimulus to connective tissue" which may result in pain relief (Deyle etal.,2000). Neither rationale nor scientific empowerment was provided for this hypothesis. Cochrane et al. stated that mechanical forces may "modulate morphology and structure of skeletal tissue, including ligament and tendon" (Cochrane et al.,2005). An "increased flexibility" was put forward by Penninx et al. as a pathway to explain the preventive effect of exercise on the occurrence of disability in activities

of daily living (ADL) in patients with OA knee (Penninx 2001).

Range of Motion; The data of this study shows that the range increased in both the groups post treatment and in follow-up compared to baseline. In this study both the groups showed significant improvement in increasing ROM ($p \leq 0.05$) but Group-A showed greater improvement than Group-B.

The intent of kinesio taping is to restore pain free motion at joints that have painful limitation of ROM. The exercise program was effective in increasing knee joint range of motion in agreement with Mikesky et al, Gur et al, Wyatt et al, and Hopman-Rock. This finding related to stretching exercises which increased flexibility and also strengthening exercises. Also, the improvement in Group-B could be attributed to range of motion exercise included in the supervised exercise program. [5,16,18]

Muscle Strength; One rationale for the kinesio taping approach to OA is that the reduced pain and stiffness associated with the kinesio taping intervention allows patients to participate more successfully in the exercise program and activities of daily living. Knee OA symptoms may result from restricted mobility and adhesions due to recurrent inflammations of both intra-articular and periarticular tissues. In the present study, the exercise intervention focused over the stretching of hamstring and quadriceps which have decreased the tightness and increased the muscle strength by including strengthening exercise and range of motion exercise. These exercise helped in overcoming the weakness of quadriceps muscle. Some researchers in Japan have claimed that the effect of quadriceps exercise is due to something other than knee stabilization, based on the observation that pain relief preceded increase in muscle strength. [5,18]

Functional status (WOMAC Score); The improvement in functional disability for knee osteoarthritis patients in this group could be attributed to analgesic effect of kinesio taping which leaded to decrease pain and improve knee functions. It may also attributed to the ability of Kinesio taping to correct lateral tracking of patella that otherwise lead to symptoms such as pain, stiffness, or weakness. [5]

Subjects treated with kinesio taping along with supervised exercise program showed highest reduction in WOMAC score. This could be due to pain relief, reduction in the stiffness and increased extensibility of the tissues, increased lubrication of the joints, gain in the strength of weak muscle, correct mechanical loading and improved joint stability and thereby increased quality of movements, psychological effects and increased self–confidence and motivating factor. For many patients with osteoarthritis of the knee it is suggested that pain relief is accompanied by improvements of functioning (Jansen M et al, 2011)

The patient's functional activities improved as the pain decreased and knee ROM increased. In addition, the exercise program aimed to increase individuals' confidence in the use of their knee and overcome the fear of physical activity. [20]

Correct mechanical loading and improved joint stability, improvement in strength of weak muscles therefore increased quality of movement, psychological effects, increased self-confidence and motivating factor all contributes to significant improvement in kinesio taping group. [13]

Kinesio taping is well accepted and recognized methods of treatment of subjects with knee osteoarthritis. In the present study Group A had shown significant changes in pain and functional activities and range of motion than Group B which indicated that combination of kinesio taping along with supervised exercise program was helpful in reduction of pain, range of motion, increasing strength and functional status of subjects with knee osteoarthritis. So this treatment could be used as effective management for pain relief, improving range of motion, muscle strength and physical function.

Limitations of the study: Sample size was small.

Suggestions: Further studies are recommended with large sample size.

CONCLUSION

The present Pre test – post test group study design concludes by rejecting the null hypothesis, the effectiveness of kinesio taping along with Supervised Exercise Program may be significantly better as compared to Supervised Exercise Program only on pain, muscle strength, range of motion and physical function in subjects with Knee Osteoarthritis.

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