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Original Research Article

Effectiveness of Functional Task Exercises versus Agility and Perturbation Training in Osteoarthritis Knee Subjects

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ABSTRACT

Purpose:-Traditionally both agility and perturbation training and functional task exercises are being used for osteoarthritis knee pain. This study was conducted to compare functional task exercises with agility and perturbation training with in treating osteoarthritis knee pain.
Methods: - 60 subjects with a mean age of 57 years having clinical diagnosis of Osteoarthritis of knee were randomly allocated to two groups; first group received functional task exercises. The second group received agility and perturbation training thrice a week for 4 weeks. The outcome of this intervention was measured in terms of VAS and WOMAC score,
Results: - Mann-Whitney U test is used for statistical analysis to study different groups. At the end of four weeks, it was found that subjects treated with functional task exercises showed significant improvement in terms of VAS scores and WOMAC scores($p<0.01$) and patients treated with agility and perturbation training showed significant improvement in terms of VAS scores and WOMAC scores ($p<0.01$). When compared between Groups the VAS and WOMAC scores showed no significant differences in improvement rates. ($p>0.05$)
Conclusion: - It was concluded that both groups were found equally effective in terms of relieving pain and improving function of the knee joint. Statistically there is no significant difference between two groups

Key Words: Agility, Perturbation Exercises, Functional Task Exercises, Knee Osteoarthritis.

INTRODUCTION

Osteoarthritis (OA) has been defined by the American College of Rheumatology (ACR) as a heterogeneous group of conditions which lead to joint symptoms and signs associated with defective integrity of the underlying bone and joint margins (Altman et al, 1996). As there is no evidence of synovial thickening or inflammatory infiltration, in uncomplicated conditions, the term "Osteoarthrosis" is preferred to OA. [1]

Worldwide the prevalence rate of OA is 20% for men and 41% for women and it causes pain or dysfunction in 20% of the elderly. In India, OA is the 2nd most common and has a prevalence rate of 22 to

39 %.Osteoarthritis of the knee typically affects women more than men and has a prevalence between 10-15% at age 35 and 35-45% at age 65. [2]

This degenerative joint disease etiology is multifactorial, with inflammatory, metabolic, and mechanical causes but commonly through wear and tear of joints. A number of environmental risk factors, such as occupation and trauma, may initiate various pathological pathways. [2,3] It is classified into two types primary and secondary. Primary type cause is idiopathic, occurs in old age. Secondary type cause is any underlying primary disease of joint which leads to degeneration. [4]

The condition can range from mild to severe. It generally affects joints under considerable strain. The pathophysiology behind this is deterioration of articular cartilage, remodeling of subchondral bone, formation of osteophytes and formation of subchondral cysts ultimately to pain. [3]

Pain is the most dominant symptom of OA that often makes the patient with OA to seek medical treatment. [2] However, depending on the severity and stage of the disease, the OA patient may also present with such symptoms as limitation of joint motion due to decrease space joints, muscle atrophy due to quadriceps arthrogenic muscle inhibition which is an impairment of central nervous system leads to decreased strength. It has been established that proprioceptive acuity i.e. the awareness of joint position joint movement (kinesthesia and sense of resistance). [5] Decline both with age and as result of knee OA. [6] These proprioceptive deficits may contribute to reduced dynamic knee stability, progressive functional limitation decreased agility and perturbation associated disability. [7]

Goals of managing osteoarthritis include controlling pain, maintaining and improving range of movement and stability of affected joints and limiting functional impairment by pharmacological management of osteoarthritis involve Analgesics, Non-steroidal anti-inflammatory drugs (NSAIDS), Glucosamine and intra-articular hyaluronate injections (Marie R. Griffin 1995). 9surgeries in osteoarthritis are: Patellectomy, Joint debridement and total knee Replacement. [8]

Physiotherapy Management plays a major role in conservative many which Joint Protection, Chronic Pain management by use of either electro modalities(Transcutaneous electrical nerve stimulation, Thermal modalities, Diathermy, Ultrasound, Cryotherapy, Exercise and biofeedback) and manual therapy (Manipulation & mobilization) Bracing. [9,10]

Recent trends show that exercise therapy includes balance exercises which consist of Agility and Perturbation training and Functional task exercises. Agility training includes quick stops and sudden change in direction lateral movements and Perturbation training includes single leg stance or use of roller boards simple exercise progressed to complex helps protect the joint from painful loads and helps to restore the muscle power and ligament and damaged tissues around joint, lower extremity through coordination. [11]

In some studies showed evidence that programs incorporating knee stabilizing kinesthesia agility and balance exercises with traditional resistance training may reduce symptoms of knee osteoarthritis and improve function rapidly than resistance training alone. [12]

Agility and perturbation exercises training are designed to challenge neuromuscular system helps to maintain balance and improve activities of daily living function. [7,13] These agility and perturbation techniques are modified into walking rather than running activities knee osteoarthritis.

In their study impairment based exercises (Agility and Perturbation training) along with strengthening and stretching decrease pain and improves function. [13]

Functional task exercises involve interplay of cognitive perceptual and motor functions and closely linked to individual dynamic environment. [13]

Functional task exercises helps to enhance muscle strength, flexibility, or balance and to improve functional ability, mobility into the patient‘s (activities of daily living) ADL’S. This approach in the exercise treatment is specific with expected functional outcomes. [14]

Dynamic control of knee during weight bearing activities closed chain exercises with low intensity and high repetition are effective than open chain exercises for improving stability and muscular endurance and function in the knee. [10]

MATERIALS & METHODS

It was proposed to study the effect of Functional Task Exercises and Agility and Perturbation training in osteoarthritis knee subjects.

Design: Experimental design, It was convenient sampling method,, A total number of 60 patients, both men and women between the age range 50-70 years suffering with chronic osteoarthritis of knee joint and clinically diagnosed as having osteoarthritis, referred to Physiotherapy department and willing to participate in the study at G.S.L Medical hospital, Rajanagaram and also other community hospitals in and around Rajahmundry, were recruited for the study. Subjects were randomly assigned into two groups. Group 1 and group 2 with 30 subjects in each group

Participants: Inclusion criteria were: diagnosis of OA according to American college of rheumatology criteria(1986), Age:- 40- 75 years, Subjects who can walk and climb staircase, Crepitus with active ROM (squatting and weight bearing) Tenderness on palpation, No Palpable warmth, Tibio femoral osteoarthritis , Diagnosed by a clinician as Osteoarthritis grade 1 and 2 radiographical presentation. Exclusion Criteria were: Any patients not fulfilling the inclusive criteria are excluded, Traumatic injury to the knee joint within 6 months of study, Existence of CNS/PNS Disorders Pacemaker, Epileptics, Mental disorders, Peripheral vascular diseases, Tumors / Malignancies, Metallic implants in the lower limbs, Existence of any surgical procedures around knee

OUTCOME MEASURES:

Pain intensity: Measured by means of Visual Analogue Scale (VAS). A 10 cm line marked with numbers 0 to 10 was used where 0 symbolized no pain and 10 as maximum pain. Patient was asked to mark his pain on this line as per the severity.

WOMAC scale: WOMAC scale has 17 items divided into 3 sections (A, B, C), i.e. section A for pain and section B stiffness and section C for functional difficulty. Subjects were asked to rate their score out of 5 grades of severity, i.e. no pain, mild pain, moderate pain, severe pain and extreme pain.

PROCEDURE

All the 60 subjects with pain in knee joint clinically diagnosed of having knee osteoarthritis after finding the suitability as per the inclusion and exclusion criteria patients are randomly assigned into 2 groups, Group A and Group B with 30 subjects in each group. The subjects participating in the study were briefed about the nature of the study and the intervention. After briefing them about the study their informed written consent was taken.

The demographic data like age, sex, occupation and address was collected joint involved and duration of symptoms was noted .Initial evaluation for their pain profile

using visual analogue scale (VAS) will be taken. Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) scores were taken by asking the questions to the subjects about their pain, stiffness and functional independence.

MEASUREMENTS PROCEDURE

For recording of pain intensity by using Visual Analogue Scale (VAS), the subjects were asked to mark their intensity of pain on a 10 centimeter long line marked with numbers 0-10 where 0 indicated no pain and 10 was for maximum pain.

WOMAC score was calculated after asking the questions to the subjects on 3 sections (A, B, C), i.e. section A for pain and section B stiffness and section C for functional difficulty. Subjects were asked to rate their score out of 5 grades of severity, i.e. no pain, mild pain, moderate pain, severe pain and extreme pain by marking the grade on a line representing for the 5 grades.

GROUP A: - FUNCTIONAL TASK EXERCISES (ANNEXURE-I)

Unilateral balance, Squat with arms forward, Lateral squats ,Forward or backward leans , Squat with diagonal reach, Walk around obstacle, Rotation Lunges, Lunge and chop, Stair climbing

GROUP B: -AGILITY AND PERTURBATION TRAINING (ANNEXURE-II)

Side stepping, Lateral cross over steps ,Front and back cross over steps during forward ambulation, Shuttle walking, Multiple change in direction during walking on therapist command, Double leg foam balance activity ,Tilt board balance training, Roller board

Statistical Analysis

All the statistical analysis were performed by using SPSS software version 20.0 and MS excel 2007. Discripitive statistical analysis is presented in the form of mean +/- standard deviation and percentages. Mann-Whitney U test is performed to assess the mean significance difference between various discrete variables. For all statistical analysis ($p<0.05$) was considered as statistically significant.

Age Distribution:

Age of the subjects in this study was between 40to 75 years (Table –1)

Table 1: Age Distribution

Age (Yrs)	Group A (Functional task exercises)	Group B (Agility and Perturbation)
50-59	21	18
60-69	8	11
70-80	1	1

Average age of the subjects in group A is 57.07

The average age of the subjects in group B is 57.50

Table 2: Sex Distribution:

GENDER	Group A	Group B
Male	13	19
Female	17	11
Total	30	30

Table 3: Distribution of Means of Demographic profile: Age, height, Body weight and BMI

Group	No. Of patients	Age (Yrs)		Height (Mts)		Body weight (Kgs)		BMI (kg/m2)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Group A (FTE)	30	57.07	4.563	1.581	.0648	62.23	12.221	25.450	3.719
Group B (A+P)	30	57.50	5.576	1.575	.0795	63.23	7.749	25.465	2.240
P VALUE		0.743		0.777		0.706		0.985	

Age of subjects in this study was between 50-70 years. The average age of subjects in group A (FTE) was 57.07 and in group B (A+P) was 57.50.

Height of the subjects in this study was between 147 cm - 174 cm. The average height of the subjects in group A (FTE) was 1.5810 and in group B (A+P) was 1.5757.

There was no significant difference between the heights of the subjects in the two groups ($p > 0.05$).

Body weight of the subjects in this study was between 45-85 kgs. The mean body weight of the subjects in group A (FTE) was 62.23, in group B (A+P) was 63.23.

There was no significant difference in body weights between the two Groups ($p > 0.05$).

BMI (Body mass index) of the subjects in this study was between 19.08-31.25 kg / m2.

The average BMI of the subjects in group A (FTE) was 25.4503 and in group B (A+P) was 25.4657.

There was significant difference between the BMI of the subjects in the two groups ($p>0.05$).

Table no 4: Pain Relief (Mean changes in VAS Score):

Group	Pre Treatment		Post Treatment		P Value	Inference
	Mean	SD	Mean	SD		
GroupA (FTE)	6.80	1.186	3.07	1.015	0.000	Highly Significant
GroupB (A+P)	6.63	1.189	2.97	.999	0.000	Highly Significant

Pain relief was recognized by reduction in VAS score. For this VAS score was noted on the first day and after 4 weeks of the treatment for all the subjects. However the difference between the 2 scores was considered for analysis of difference between the two groups.

The average VAS score in group A (FTE) on 1st day was 6.80, which were reduced to an average of 3.07 after 4 weeks of treatment.

There was highly significant difference between the VAS Scores in the subjects in the two groups ($p<0.01$).

The average VAS score in group B (A+P) on 1st day was 6.63, which were reduced to an average of 2.97, after 4 weeks of treatment.

There was highly significant difference between the VAS Scores in the subjects in the two groups ($p<0.01$)

Table No 5: WOMAC index (Mean changes of pre and post treatment in Knee pain stiffness and functional difficulty) –

Group	Pre Treatment		Post Treatment		P Value	Inference
	Mean	SD	Mean	SD		
Group A (FTE)	50.17	9.745	28.33	11.24	0.000	Highly Significant
Group B (A+P)	50.17	9.484	27.40	10.34	0.000	Highly Significant

WOMAC index:

Reduction in the pain and stiffness and improvement in functional abilities was indicated in terms of reduction on in WOMAC score. For that initial and final score was noted on 1st day and after 4 weeks of treatment of all the subjects. However the difference between two scores was considered for analysis of the difference between the two groups.

In the group A (Functional task exercises), the average WOMAC score on 1st day was 50.17 and after four weeks were 28.33.

There was highly significant difference between the WOMAC Scores in the subjects in group A ($p<0.01$).

In the group B (agility and perturbation training), the average WOMAC score on 1st day was 50.17 and after 4 weeks were 27.40.

There was highly significant difference between the WOMAC Scores in the subjects in group B ($p<0.01$).

Table No 6: – Comparison between Mean and SD changes in VAS and WOMAC scores between group A and group B.

		GROUP A	GROUP B	P VALUE	INFERENCE
VAS	MEAN	3.07	2.97	0.686	NS
	SD	1.015	.999		
WOMAC	MEAN	28.33	27.40	0.888	NS
	SD	11.247	10.341		

Comparison between the mean of two groups, functional task exercises and agility and perturbation training groups with respect to VAS and WOMAC scores showed that both the treatments are equally effective.

The average VAS scores in group A were 3.07 and in Group B were 2.97.

So, comparison between the Groups showed no significant difference between the VAS Scores in the two Groups ($p>0.05$).

The average WOMAC scores in group A were 28.33 and in Group B were 27.40

So, comparison between the Groups showed no significant difference between the WOMAC Scores between the two Groups ($p>0.05$).

RESULTS

The results of this study were analyzed in terms of pain relief indicated by decrease in knee pain on VAS, decrease of pain, stiffness and improved functional ability by WOMAC index and comparison done between 1st and last readings.

Comparison was done both within each group as well as in between the two groups. So as to evaluate the within group and between group effectiveness of Functional Task Exercises and agility and perturbation training which are under in the present study.

DISCUSSION

Aim of the study was to evaluate the effectiveness of Functional Task Exercises (Group A) and Agility and Perturbation training (Group B) on pain and function in subjects with knee osteoarthritis.

In this study subjects were assessed for knee pain and function using VAS and WOMAC. In the present study VAS is used to assess intensity of pain overall knee pain, stiffness and physical function. Since there is reliability and validity is already established .There is significant difference in VAS and WOMAC score in all subjects after 4 weeks treatment with Functional Task Exercises and Agility and Perturbation.

The results showed that Functional Task exercise p values (0.00) of VAS pre test and post test are highly significant within group. Stimulation of mechanoreceptors associated with mylienated alpha beta and alpha delta at spinal level and high centers releasing endorphins.

This impulse stimulated by group a exercises block pain impulse and break the pain cycle by activating the pain gate, which consequently lessened suffering in daily activities, pain with specific tasks and difficulty in prolonged standing going to toilet. patient pain intensity is revealed with VAS and The results has similar findings Neil et al 2005 who concluded that functional task exercises is effective in reduction in pain and improving function in subjects with knee osteoarthritis showing significant reduction in post treatment in WOMAC scores. [15]

There was highly significant p(<0.00) WOMAC pretest and post test. Rationale behind the improvement in WOMAC knee

pain stiffness and function is reveled with womac that is due to improvement noted torque because complex neural activation and vast muscle mass involvement of multiple joint exercises, neural adaptations and then muscular strength , similar findings are seen by Paul et al in his study The closed chain exercises (squat) which gives high stability by co contraction of quadriceps and hamstrings provide minimal stress on knee joint in functional range, it is effective and safe exercise method. [16]

These exercises help for voluntary muscle control in muscle retraining and provide information of muscle activity for performing task. Who compare effectiveness of closed kinematic exercises lateral squat and squat with forward arms in patients with knee osteoarthritis is effective in improving functional ability in performing tasks. [17]

Functional exercises reduce knee adduction movement i.e., femur adduction and increase femur lateral rotation which prevents medial compartment load on knee joint and stabilize pelvis and hip cause behind this is due to hip abduction and lateral rotation assists in maintaining pelvis level and act eccentrically controlling excessive femur femur adduction and medial rotation. [16]

In Agility and Perturbation training group the analysis of pain function in knee had showed highly significant VAS p values (<0.00) and womac p(0.00) highly significant when analyzed from pre to post intervention within group mechanism behind this intervention may be due to nervous system uses sensory information from three sources to produce postural control somatosensory feedback from peripheral receptors vision and vestibular system. [18]

Mechanoreceptors respond to any compression or tension in terms of loading afferent are carried from periphery to central nervous system via spinal level .These higher centers generate motor activity through afferent signals the mechanoreceptors and reflex pathways provide evidence for protective mechanism at knee .This findings are similar to the findings of (Michael et al 2010) The joint receptors modulate muscle stiffness provided by the joint receptor gamma motor responsible for stability. [18]

The postural control strategies if forward sway is induced horizontal perturbation. Then posterior muscles are recruited if backward sway induces from an horizontal perturbation then anterior muscles recruited these strategies are modified and are adaptive to circumstances of the moment provide stability and applicable in maintaining knee stability. [19]

These results showing findings are similar to findings done by Glenn et al 2008. This training improves the ability to stabilize the upright stance on tilt board or uneven surfaces .This postural exercises of ankle and knee This strategy restores body center f mass to stabilizing through body movement centered primarily around the ankle joints have significant impact on functional improvements in knee joint. [19]

They assist to return high physical function further more improved functional mobility is observed in various studies the results are similar to findings of the study done by (Rogers et al 2008) proved that agility and perturbation are effective than resistance training to reduce and improve function postural control. [20]

When compared between the groups Functional Task Exercises (p values 0.686) and Agility and Perturbation training p values (0.888) there is no statistically significant but clinical improvements are seen in Functional Task Exercises may be due to improvements in core muscles during weight-bearing, stabilization of the pelvis and trunk by way of the lumbo pelvic musculature, which is commonly known as

core, is required to control movements of the distal segments (ankle, knee, hip).

It improves core strengthening and positively influences the motor learning of the proper dynamic lower limb alignment. Thus, the purposes of this study were to verify the effects of preventative training named as stabilization training. Which decrease joint load on knee patients experience reduction of pain and improvement on daily functions, excess load on knee osteoarthritis may be due weak core muscles may keep more pressure on knee due to more BMI results showed findings are similar findings of Elizebath et al 2009. [21]

Agility and Perturbation training improve function, reduction of pain postural stability but patients experience excess joint compression loads due to repetitive load on knee which has similar findings with study of (Daniel et al 2013) perturbation exercises were poorly tolerated and are related to increase joint compression forces that closed kinematic chain exercises are thought to take place on joint repetitive loading adversely affect the viability of cartilage in knee joint. [22]

CONCLUSION

Considering the superiority of each group this study concludes none of the groups are superior to each other. So, there is no significant difference between functional task exercises and perturbation training in patients with osteoarthritis of knee.

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Annexure - I

GROUP A

Unilateral balance:-

Subjects stand on each leg for 30 seconds, using the hands for support of a chair. The spine was kept in a neutral position. Subjects were asked to avoid knee hyperextension. Progression of exercise without hands support and later with closing both eyes.

Squat with arms forward:-.

Standing in place, subjects squatted slowly return to standing position for 60 seconds. The arms were kept slightly forward, the knees were kept behind the toes, progression of exercise by deepening the squat, extending the arms out to be parallel to the floor and later holding a weight in front of the body with both hands

***Lateral squats*:-**

Subjects stepped sideways and squatted, while keeping their trunk aligned, and then returned to normal position. This motion was then repeated to the opposite side, alternating sides for 1 minute. Progression of exercise by shallow squats to deeper squats and by holding weights in the hands.

***Forward or backward leans*:-**

Subjects faces the wall with their arms crossed over their chest and ask them to lean toward the wall, trunk in neutral position and hold this position for 30 seconds. Come back to normal position turned backs to the wall, and performed the same exercise by leaning backward toward the wall, holding the position for 30 seconds.

***Squat with diagonal reach*:-**

Subjects stand with their feet shoulder width apart and performed squats while alternately reaching with both hands to opposite side 30 seconds. Return to starting position same exercise repeated with opposite and up past the contralateral 30 seconds progression of exercise by holding a ball.

***Walk around obstacle*:-**

With help white marker draw a line ask the subjects to walk for 1 minute on a plain surface later curved line and figure-8 pattern.

***Rotation Lunges*:-**
Draw a circle with the help of white marker, mark 4 points ask the subjects to stand in middle of circle Subjects began the exercise by facing forward and feet shoulder width apart. Ask the subject to maintain erect position, subjects rotated to the right and lunged with the right foot to touch 2nd point and later 3rd point .Subjects performed same exercise with opposite foot alternate sides for 1 minute. Later on add small hand weights.

***Lunge and chop*:-**
Subjects in partial forward lunge position and, using a bilateral grip, ball is placed on chair at the side of subject. Ask the subjects to stand straight and rotated their trunk and lift the ball with the hands to opposite side. They returned to the starting position and repeated the exercise for 30 seconds. Same exercise performed with opposite foot for 30 seconds

Stair climbing:-
Subjects climbed up and down a flight of steps for 1 minute. The height of the steps was 10 inches.

ANNEXURE - II
GROUP B

Side stepping:- subject steps sideways , moving right to left approximately 10-20 feet ,repeating 2 times in each direction for total 4 minutes . Exercise progression by increasing width of steps and speed of steps for every 1-2 sessions. The activity is done on plain surface.

Lateral cross over steps activities:- subjects combine front and back crossover steps while moving laterally during each activity subject will be moving right to left and then left to right approximately 10-20 feet repeating 2 times in each direction for total 4 times . Exercise progression by increasing the width of steps and speed of steps every 1-2 sessions.

Front and back cross over steps during forward ambulation:- Subject will cross one leg in front of other, alternating legs with each step, while walking forward approximately 10-20 feet the subject will then walk backward to start position while crossing one leg behind the other, alternating legs with each step progression of exercise by two repetitions were performed. The width of steps and speed of steps can be progressed every 1-2 sessions.

Shuttle walking:- Draw white markers are placed at 2 feet distance to one another subjects walks forward over first marker then returns to start by walking backward subject then walks to 1st 2 feet marker return to 2nd 2 feet marker walking backward then subject then walks to 3rd 2 feet marker Progression of exercise by increasing the width of steps and speed of steps every 1-2 sessions.

Multiple change in direction during walking on therapist command:- Therapist directs the subject to either walk forward backward side wards or on diagonal by asking the subject with hand signals changes in direction are cued randomly by therapist exercise progression for 30 seconds.

Double leg foam balance activity:- Subjects stand on a soft foam with feet on ground therapist attempts to perturb patient balance in random fashion. Progression of exercise 30 seconds. Progression of exercise by asking subject to catch the ball with therapist perturbating subject's balance while standing on foam

Tilt board balance training:-Subjects stands on tilt board with both feet on the board the therapist perturbs the tilt board forward and backward and side to side directions for approximately 30 seconds. Exercise progression by adding ball catching during perturbations.

Roller board:- Subjects stands with one limb on a stationary platform and other on roller board therapist perturbs roller board in multiple directions, at random and subjects attempts to resist perturbations. The activity done for 30 seconds. The activity is repeated by changing the limbs on platform and rollerboard. Exercise progression by subject semi seated position with hips resting on a chair.

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