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COMPARISON OF CLOSED KINEMATIC CHAIN EXERCISES AND PILATES EXERCISE ON PAIN, BALANCE AND FUNCTIONAL PERFORMANCE IN OSTEOARTHRITIS KNEE

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ABSTRACT

Objective: Osteoarthritis is one of the major public health problems which causes pain, functional impairment that reduces the quality of life. In India osteoarthritis is the second most common with prevalence rate of 22% to 39%. Both closed kinematic chain exercise and Pilates exercises have been proved effective on reducing pain, improving balance and functional performance. But there is a lack of literature regarding the effect of closed kinematic chain exercises when compared to Pilates exercises. Hence the need of the study arises.

Materials and methods: Pre-test and post-test experimental study design.30 subjects with mean age of 40 -65 years of age having a clinical diagnosis of knee osteoarthritis were randomly allocated into two groups. In group I (n=15) subjects were treated with closed kinematic chain exercises, where as in group II (n=15) subjects were treated with Pilates exercises. Participants were given intervention were thrice a week for 8 weeks. The outcome measures of this intervention were measured in term of VAS for pain, Berg Balance scale for balance and WOMAC for functional performance.

Results: Statistical analysis of the data revealed that within group comparison both groups showed significant improvement in all parameters. Where as in between group comparison closed kinematic chain exercise showed better improvement compared to Pilates exercises.

Conclusion: After 8 weeks of intervention both closed kinematic chain exercise and Pilates exercises showed significant improvement on reducing pain, improving balance and functional performance. However closed kinematic chain exercises were found to be more effective when compared to pilates exercises.

Keywords: Knee osteoarthritis; VAS; WOMAC; closed kinematic chain exercises; Pilates exercises.

INTRODUCTION

Osteoarthritis is a degenerative joint disease involving the cartilage and surrounding tissues. It results in damage and loss of articular cartilage, remodelling of subarticular bone, osteophyte formation, ligamentous laxity, weakening of periarticular muscles and synovial inflammation. The word osteoarthritis originated from the Greek word “osteo” meaning “of the bone”, “arthro” meaning “joint”, and “itis” meaning inflammation, although the “itis” of osteoarthritis is somewhat of a misnomer-inflammation is an inconspicuous feature, the disease limits everyday activities, such as getting in and out of bed, dressing and climbing stairs.5

Osteoarthritis generally can be subcategorized into Primary (idiopathic) and Secondary osteoarthritis. Primary OA: This occurs in a joint de novo (from the new). It occurs in old age, mainly in the weight bearing joints (knee and hip). In a generalised variety, the trapezio - metacarpal joint of the thumb and the distal inter-phalangeal joints of the fingers are also affected. Primary OA is commoner than secondary OA.19

Secondary OA: In this type, there is an underlying primary disease of the joint which leads to degeneration of the joint, often many years later. It may occur at any age after adolescence, and occurs commonly at the hip. The predisposing factors are: congenital development of the joint, irritability of the joint surfaces from previous trauma, internal derangement of the knee, malalignment, obesity and excessive weight.19

The main pathogenesis is characterised by destruction of the articular cartilage, repeated weight bearing on such a

cartilage leads to its fibrillation.20 The cartilage gets abraded by the grinding mechanism. With further "rubbing" the subchondral bone becomes hard and glossy, meanwhile, the bone at the margins of the joint hypertrophies to form a rim of projecting spurs known as osteophytes. A similar mechanism results in the formation of subchondral cysts and sclerosis. The loose flakes of cartilage incite synovial inflammation and thickening of the capsule, leading to deformity and stiffness of the joint Risk factors associated with Osteoarthritis includes age, genetic susceptibility, obesity, low bone mineral density, repetitive knee trauma, meniscal injuries, muscle weakness, mechanical forces, joint laxity, joint hyper mobility, due to Syphilis, diabetic mellitus, leprosy and repetitive joint overuse.20

Historically, the diagnosis is based on history and clinical examination . X- Rays may confirm the diagnosis of knee radiographs which are commonly graded by kellgren & Lawrence grading system, whereas MRI has the capability to visualize all the structures within the knee joint, including soft tissue and cartilage and subchondral bone marrow lesions. Other investigations used for detecting underlying causes are serological tests, ESR, Serum uric acid and arthroscopy.6

Guidelines for managing OA recommended a combination therapy of physiotherapy and pharmacological treatments. The effect of quadriceps home exercises when compared to NSAIDS's shows exercises have slightly better effect in knee OA than NSAIDS's. The goals of treatment is to alleviate the signs and symptoms of the disease and if possible to slow progression. The therapeutic spectrum ranges from general measures to physiotherapy, orthopaedic aids, pharmacotherapy and finally surgery and rehabilitation.27

The primary goal of OA is to relieve pain, improve functional status, maintain strength, range of motion, minimize deformity, and instability. Physical agents to control both acute and chronic pain. Exercise and physical agents can reduce pain and improve function and health status of the patients with knee OA. Pharmacological management includes symptomatic slow-acting drugs for osteoarthritis, analgesics / anti- inflammatory drugs, glucocorticoids and opioids. Surgeries for osteoarthritis knee are total knee replacement, Uni- compartmental knee replacement and osteotomy and arthroscopic debridement.

Recently closed kinematic chain exercise and Pilates exercise have drawn much attention in the management of Osteoarthritis knee. Studies suggested that these exercises are more effective on reducing pain, improving balance and functional performance in subjects with knee osteoarthritis

Pilates is a physical wellness framework created in the mid-20th century by joseph Pilates after whom it was named. Pilates called his technique "Contrology". Pilates enhances adaptability, assembles quality creates control and perseverance in whole body. The Pilates are known to have immense toning and strengthening benefits even if done at a moderate level, though they are practiced at low level. The Pilates strategy is an extensive body moulding technique that is coordinated to improve both the body and mind of the individual.23

Closed kinematic chain exercise was proposed by STEINDLER (1955) is a environment in which the distal segment meets "considerable" external resistance that restrains free motion. A system is considered closed when neither the proximal nor the distal segment can move and movement at one segment produces movement or affects motion at all other joints in that kinetic chain in a predictable manner.REVIEW OF LITERATURE

PREVALENCE

About 13% of women and 10% of men aged 60 years and older have symptomatic knee OA. The proportions of people affected with symptomatic knee OA is likely to increase due to the aging of the population and the rate of obesity or overweight in the general population. During a one year period, 25% of people over 55 years may demonstrate persistent episode of knee pain, in whom about one in six have to consult their general practitioner about it in the same time period. About 10% of people aged over 55 years have painful disabling knee OA of whom one quarter are severely disabled. Prevalence of knee OA in men is lower compared with women .This was shown in a meta analysis of males and females in which the incidence of knee osteoarthritis.27

CLASSIFICATION

The first formalized attempts at establishing a radiographic classification scheme for OA were described by Kallgren and Lawrence (KL) in 1957 . 15

They proposed a five-grade classification scheme and examined plain radiographs of eight joints including the distal interphalangeal joint (DIP), metacarpophalangeal joint (MCP), first carpometacarpal joint (CMC), wrist, cervical spine, lumbar spine, hips, and knees to calculate the inter- and intra observer reliability of each .15

Kallgren and Lawrence Radiological grading

GRADE 1:Doughtful narrowing of joint space and possible osteophyte lipping

GRADE 2:Definite osteophytes and possible narrowing of the joint space

GRADE 3: Moderate Multiple osteophytes, definite narrowing of joint space and some sclerosis and possible deformities of bone ends.

GRADE 4: Large osteophytes, Marked narrowing of joint space, severe sclerosis and definite deformity of bone ends.13 CLINICAL MANIFESTATION:

The symptoms of osteoarthritis vary from joint to joint but there are three principal features :

Pain

Loss of movement

Altered function7

Pain is the main presenting symptom. Initially, the pain occurs usually during or after weight-bearing activity, or at the end of the day. Later on, it becomes continuous, occurring even at rest.
The patient has mild swelling of the knee joint and complains of early morning stiffness.
Minimal tenderness and coarse crepitus can be elicited.
If there are loose bodies in a joint, the patient gives history of locking or giving away.
Terminal movements of the knee are restricted.
Genu varum deformity may be seen in very advanced cases.
Minimal effusion maybe present.7
On examination, there is swelling due to synovial thickening and/or effusion, muscle wasting and prominence of the articular margins due to osteophytes. Movements are painful and restricted. Crepitus is felt on passive joint movement. In the late stages of the disease, loose bodies may develop in the joint, causing recurrent joint effusion, pain, swelling and locking of the joint.
Radiographic examination reveals the following main features14
Narrowing of joint space, often limited to a part of the joint e.g., may be limited to medial compartment of tibia-femoral joint of the knee.
Subchondral sclerosis – dense bone under the articular surface
Subchondral cysts
Osteophyte formation
Loose bodies knee OA in males aged <55 years was lower than females
Deformity of the joint14

NEED FOR THE STUDY:

Meenakshi C et al., stated,
Comparison of Pilates exercises and closed kinematic chain exercise on pain, muscle strength and functional performance in subjects with knee osteoarthritis.
The present study concluded that six weeks of Interventions of Pilates exercises and Closed Kinematic Chain exercises were shown statistically improvement on Reducing Pain, Improving Muscle strength and Functional performance. However more Percentage of improvement was found in subjects receiving Pilates exercises when compared to Closed Kinematic Chain exercises.
This study used 6 weeks of intervention, whereas in the present study, the duration of the study is increased by 8 weeks of interventions of closed kinematic chain exercises and Pilates exercises which is given thrice weekly.
For the gender distribution, This study involves both male and female, whereas the present study, involves only female subjects with knee osteoarthritis
: Closed Kinematic Chain Exercises
Closed kinematic chain exercise is the resistance, which is placed through the distal aspect of the extremity and remains fixed to the extremity. This concept was introduced by Franz Reuleaux in 1875, where he proposed that the rigid, overlapping segments were connected through joints and in 1995, Dr. Arthur Steindler adapted Reuleaux theory and included the analysis of human movement9.
: Pilates Exercises
Pilates method is not merely a physical fitness regimen of mindlessly repeated exercises, but rather a holistic approach to well being and a life long process of refinement. There are three higher principles such as completely coordinate the body, mind and spirit. Achieve the natural inner rhythm associated with all subconscious activities. Apply the natural laws of life to everyday living24.
3.6 RELEVANT LITERATURES
Vahid Mazloum et al ,(2018).Concluded that Pilates training was more effective than the Conventional therapeutic exercise to improve pain and Disability in individuals.
Nadia Saleem et al,(2022).Concluded that Pilates exercise were found to be more effective in the treatment of patients with knee osteoarthritis
Nahid Karimi et al, (2021). Concluded that Pilates and suspension training can be used in medical centres as a complementary rehabilitation method among female osteoarthritis knee subjects to improve dynamic and static balance, ROM and performance.

FS Hossain ,S et al, (2013).Concluded that the performance based knee function score is a reliable dimension specific tool to detect change in musculoskeletal function(WOMAC).
Ahmad Alghadir et al,(2018) Concluded that all three scales had excellent test-retest reliability ,where VAS was the most reliable, with the smallest error in the measurement of OA knee pain
Arzu Razak Ozdinclee et al, (2005). Concluded that comparison of 2 groups found significantly better in the closed kinematic chain exercises than in pre group of the therapy to improve muscle strength and functional performance
Matthew W Rogers et al, Concluded that osteoarthritis knee subjects, both interventions efficiency of kinaesthesia,

balance agility exercise training appear to improve function and knee stability among persons with symptomatic knee osteoarthritis
M Adouni et al,(2009).Concluded that effective management of knee joint disorders demand appropriate rehabilitation programs to restore function while strengthening muscles.
A Aghajani et al,(2017).Concluded that the effect of 8 weeks exercise on balance indexes in elderly patients, it is an effective method to improve balance and to prevent falling down in patients with knee osteoarthritis.
Hakan Nur et al, (2018).Concluded that in the management of women with knee osteoarthritis strengthening of weak knee muscles, improving limited flexion ROM ,pain management, weight loss and improving anxiety should be considered as a priority and performance based and self reported measures should be used together for a comprehensive evaluation of physical functioning.
F Salaffi et al,(2003).Concluded that Western Ontario and McMaster Universities Arthritis Index is a reliable and valid instrument for evaluating the severity of osteoarthritis knee.
Pankaj Jogi et al,(2010).Concluded that patient following hip or knee osteoarthritis the reduced version of the Berg balance scale and WOMAC provided similar information to the original version and equally responsible
J Augustsson R et al ,(2000) Concluded that the effect of training or rehabilitation interventions should not be based exclusively on tests of muscular strength rather, various forms dynamometry including 13functional performance test could be recommended

MATERIALS AND METHODOLOGY

STATEMENT OF THE STUDY
Comparison of closed kinematic chain exercises and Pilates exercises on pain , balance and functional performance in knee osteoarthritis.
OBJECTIVES
To reduce pain
To improve functional perfor
To improve balance

mance hence, aiming to give a better performance in subjects with osteoarthritis knee.
SAMPLE SIZE:
Group 1: 15 Subjects are selected for closed kinematic chain exercise
Group 2: 15 Subjects are selected for Pilates exercise.
SAMPLING TECHNIQUE:
Judgmental sampling

INCLUSION CRITERIA:
Females
Age of 40 - 65 years
Grade 1 of Kallgren and Lawrence system for classification of osteoarthritis

EXCLUSION CRITERIA:
Neurological diseases
Limb length discrepancy
Any intra articular injection to the knee
Any history of Hip, Knee, Ankle injury, Surgery prior to the study
Any local systemic infection,
Subjects in regular Medications/Intra articular injections
Fixed deformity in limb.

RESEARCH DESIGN:
Pre-Test and Post-Test experimental study design
DURATION OF THE STUDY: The study duration totally took about 5 months
DURATION OF STUDY FOR EACH PATIENT: Study for each patient took about 8 weeks (Thrice weekly 45 mins for each patient)
STUDY METHOD:
: GROUP I -CLOSED KINEMATIC CHAIN EXERCISE
: GROUP II- PILATES EXERCISES
TECHNIQUE OF THE STUDY:
Group I : Closed kinematic chain exercises

AT WEEK ONE:
Rest period is given between each exercise for 2 mins.
Each exercise is given only for once
Patient is instructed to stand with feet together in eyes-closed and training balance time without sway.
On hard ground
On soft ground (on mat)
Patient is instructed to Retro walk (25 m/ Walking backwards)
Patient is instructed to Walk on heels (25 m)
Patient is instructed to Walk on toes (25 m)
Patient is instructed to Walk with eyes closed (25 m) Standing on one extremity for 30 second (repeated in both extremities), leaning forward, backward, and to the sides on one extremity (eyes open) leaning forward, backward, and to the sides on one extremity (eyes closed) and sitting down and standing up from a high chair slowly.
Patient is instructed to climb Stairs-up and down at regular 3 steps staircase (regular stairs)
Patient is instructed to Stand with feet approximately shoulder width apart and extend arms out slightly forward and lower than the shoulder. Lift both heels off the floor and try to hold the position for 10 seconds. This was followed by climbing a regular 3 steps staircase (17 cm high and 23 cm wide) up and down.
Patient is instructed to Stand with feet side by side, hold arms in the same position as described in the previous exercise. Place one foot on the inside of the opposing ankle and try to hold the position for 10 seconds, followed by climbing a regular three steps staircase (17 cm high and 23 cm wide) up and down.

AT WEEK TWO:
Patient is instructed to Exercise with Wobble board
Patient is instructed to Sit down and stand up from a low chair slowly. Plyometric exercise (crossing a height of 15cm by jumping).
Patient is instructed to Walk slowly in a wide circle of 10 meter radius Patient is instructed to Walk quickly in a wide circle of 10 meter radius Patient is instructed to Walk slowly in a narrow circle of 5 meter radius Patient is instructed to Walk quickly in a narrow circle of 5 meter radius.9 AT WEEK THREE (IN ADDITION TO EXERCISES DURING TWO)
Patient is instructed to Walk heel-to-toe along a 3m line marked on a Polyfoam mat.
Position: Standing with the knee straight but not hyper extended, execute single (relatively small) leg raises to the front, then back. This was continued alternating front to back.
Plyometric exercise (crossing a height of 15 cm by jumping).

AT 4 - 8 WEEKS
*The exercises performed on the third week were repeated all through rest of the weeks
GROUP II: PILATES EXERCISES

WEEK 1:
EXERCISE: The exercise is named as Hundred
POSITION: SUPINE
Patient is instructed to Inhale- Bring both knees over hips into a table top position, shins parallel to the ceiling.
Patient is instructed to Exhale- Head, neck and shoulders are lifted, abdominal muscles curl up until the base of the shoulder are the first contact on the mat.
Patient is instructed to extended their arms just a few inches off the ground with a slight bend in the elbows and finger tips are reaching towards the wall in front of you.
This is the table top position. Hold this position throughout the whole exercise.
Patient is instructed to Inhale- Begin to move their arms up and down for a 5 second count
Patient is instructed to Exhale- Continue moving their arms up and down for another 5 second count
Patient is instructed to Continue you this for ten count cycle until they reach 100 Or a total of 10 cycles of breathing.16


DURATION: 5 Repetitions
FREQUENCY: thrice weekly
2: EXERCISE: Hundred + One leg stretch, Double leg stretch
POSITION: SUPINE
ONE LEG STRETCH
Patient is instructed to Lie on a mat in tabletop position. Knees are bent and shins are parallel to the ceiling.
Patient is instructed to inhale

Patient is instructed to Exhale, while raising their head neck and shoulder blades off the mat, belly button curled toward their spine. Extending their right leg straight in front of you, with left leg remaining bent in the starting position with both hands around the top of the shin.
Patient is instructed to Inhale, switch legs. Straightening the left leg in front of you and right leg returns to the bent knee position with both arms around the top of the shin.24

DOUBLE LEG STRETCH
Patient is instructed to Lie on their back with their knees bent up in the Pilates Rest Position.
Have their legs a hip width apart, shoulders drawn down and in and their neck long. Centre engaged.
Float their legs one at a time into the table top position and lifting both arms to the ceiling. Breath in to prepare.
Breath out and lower both arms overhead. Simultaneously, reaching their left leg forwards and upwards diagonally.
Breath in and circle their arms outwards and downwards. Simultaneously, folding the left leg back into tabletop.
Repeat alternating legs16.

DURATION: 6 Repetitions
FREQUENCY: thrice weekly
WEEK 3:
EXERCISE: Hundred + One leg stretch, Double leg stretch + Clams
POSITION: Side lying
Patient is instructed to lie on her side with the target hip up. Keep both legs stacked and knees bent to ninety degrees.
Flexing their hips to roughly sixty degrees.
Rolling forward slightly so that their belly button approaches the ground.
Rais the top knee up while keeping their ankles together and their trunk rolled forward.
Hold the top knee at the highest point you can achieve for 2 to 3 seconds before lowering back down.16

DURATION: 7 Repetitions FREQUENCY: thrice weekly WEEK 4:
EXERCISE: Hundred + One leg stretch, Double leg stretch + Clams + One leg kick

POSITION: Prone lying
Patient is instructed to Lift her upper body so that you are supported on their forearms. Keep their shoulders and shoulder blades down and their chest broad.

Their elbows will be directly under their shoulders. Hands can be clasped together on the floor in front of you or flat.
Inhale, Exhale and bend their right leg to a 90-degree angle. Then, pulse it twice toward their butt with the foot lightly pointed. Use two sharp exhales to pulse the leg
Protecting their knees by keeping the hamstrings engaged and not kicking too hard. Inhale to switch legs, extending the right leg as you bend the left.
Exhale, performing two kicks with the left leg.24

DURATION: 7 Repetitions FREQUENCY: thrice weekly WEEK 5:
EXERCISE: Hundred + One leg stretch, Double leg stretch + Clams + Double leg kick
POSITION: Side lying
Patient is instructed to Lie on her side and line up their ears, shoulders, hips, knees, and ankles.
Prop their head on their hand, lifting their ribs away from the mat so their back and neck stay in alignment. You can modify this position by reaching their bottom arm straight above their head, resting their head on it, if this feels more comfortable.
Their other hand rests, palm down, on the mat in front of their chest. Use this hand to help stabilize their body, but don't depend on it. Rely on their abs instead.
Move their legs slightly forward of their hips. This will help their balance and protect their lower back.
Engage their abdominal muscles so they are pulled in and up.
Lengthening even more through the top leg, kick up toward the ceiling smoothly. Use their abs for better control.
Keeping their hip bones stacked, making sure the pelvis does not tilt to the back in order to let their leg raise up.
Pulling their abdominals up as you control the lowering of their leg.24

DURATION: 8 Repetitions FREQUENCY: thrice weekly WEEK 6:
EXERCISE: Hundred + One leg stretch, Double leg stretch + Clams + One leg circle

POSITION: Supine
Patient is instructed to lie down on the Mat with the Right Leg Up to the Ceiling at a 90* from the Hip
Inhale to take the right leg straight across the body, keeping both hips firmly on the mat. Activate the left side of the Abdominals to keep the left side of the back on the mat.
Exhale and circle the leg around and back to 90*. Keep both hips and shoulders evenly weighted on the mat by keeping the left Obliques pulling up and in toward the spine and engaging the spine rotators on the right side of the back16.

DURATION: 10 Repetitions FREQUENCY: thrice weekly WEEK 7 & 8
EXERCISE: Hundred + One leg stretch, Double leg stretch + Clams + One leg circle

POSITION: Supine
These exercise on the 6th week is repeated for the rest of the weeks.
DURATION: 10 Repetitions
FREQUENCY: thrice weekly
DURATION OF TREATMENT:
8 weeks of training programme which includes Pilates exercises and closed kinematic chain exercises .and the entire study took about 5 months.
STUDY SETTING:
The study was conducted at Naresh Pincha Ortho clinic, Ashtabujam road,choolai, Chennai.
TOOLS USED:
Pain intensity (VAS): The VAS scale. The VAS scale is a reliable, valid, responsive and frequently used pain outcome measure. The instrument used consisted of horizontallines, 10 cm long with anchor points of 0 (no pain) and 10 (severe pain). The severity of Knee Pain was evaluated by VAS
WOMAC: This Questionnaire is used to assess the health status of Osteoarthritis patient introduced in 1988. It is consisted of 33 items which evaluates the health and function of the patient from various aspects including: Clinical symptoms (5 questions), Severity of joint stiffness (2questions), Degree of pain (9 questions) and Activity of daily living (17 questions). Each question has five subscales where best situation score as neveror none and the worst one names as extreme or always. Here higher scores are representative of better situation and less pain.
Berg Balance scale: The berg balance scale is used to assess balance in patients with osteoarthritis knee. It is a 14 item list with each item consisting of a five- point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete. It does not include theassessment of gait. A score of 56 indicates functional balance, A score of < 45 indicates individuals may be at greater risk of falling.

4.16. STATISTICAL ANALYSIS
Changes within Group I and Group II are found using paired t test
The formula for the paired t- test is given by

$$T = \frac{\sum D/N}{\sqrt{\frac{\sum D2 - (\sum D)^2}{N}}{(n-1)(n)}}$$

Where, d is differences per paired value
n is the number of sample

Difference between two Groups I and II is identified by independent t test

where x1 is the mean value of Group I x2 is the mean value of Group II n1 is the size of Group I
n2 is the size of Group II s is the standard deviation
Difference between two groups I and II is given by degree of progression

$x1-x2$

$\overline{x2}$

x1 is the mean value of Group I pre test x2 is the mean value of Group II post testMwhere x1 is the mean value of Group I pre test x2 is the mean value of Group I post test

DATA PRESENTATION

TABULATION
VARIABLES MEASURED IN EXPERIMENTAL GROUP I (CLOSED

S.NO	PAIN		BALANCE		FUNCTIONAL PERFORMANCE	
	PRE	POST	PRE	POST	PRE	POST
1	9	5	46	51	48	60
2	8	4	42	50	49	72
3	10	3	48	54	40	74
4	8	2	50	55	60	85
5	7	1	40	50	53	90
6	9	3	52	55	48	88
7	9	2	39	50	60	90
8	6	1	41	51	50	75
9	8	2	33	49	55	83
10	7	2	35	50	49	92
11	9	3	38	51	42	89
12	9	4	40	53	53	92
13	8	2	39	51	62	89
14	8	3	50	55	39	69
15	9	2	51	56	40	85

KINEMATIC CHAIN EXERCISEVARIABLES MEASURED IN EXPERIMENTAL GROUP II (PILATES EXERCISES)

S.NO	PAIN		BALANCE		FUNCTIONAL PERFORMANCE	
	PRE	POST	PRE	POST	PRE	POST
1	9	7	40	42	46	60
2	8	6	39	45	48	58
3	8	7	33	40	48	60
4	7	6	35	41	80	87
5	7	5	45	47	53	60
6	9	7	46	48	48	52
7	9	7	42	45	42	70
8	9	8	50	52	47	59
9	8	6	49	51	65	75
10	6	5	51	53	80	85
11	8	6	47	50	45	55
12	7	6	48	49	82	85
13	8	6	50	52	60	65
14	9	7	39	49	51	54
15	9	8	30	42	53	59

TABLE I COMPARISON OF PRE AND POST TEST MEAN VALUES OF EXPERIMENTAL

GROUP I

S.NO	VARIABLE	DAYS	MEAN		T- VALUE	LEVEL OF SIGNIFICANCE
			PRE	POST		
1	PAIN	Day 1 & 56	8.26	2.6	22.549	P <0.05
2	BALANCE	Day 1 & 56	42.93	52.06	8.516	P <0.05
3	FUNCTIONAL PERFORMANCE	Day 1 & 56	49.86	82.2	13.06	P <0.05

TABLE II COMPARISON OF PRE AND POST TEST MEAN VALUES OF EXPERIMENTAL GROUP II

S.NO	VARIABLE	DAYS	MEAN		T- VALUE	LEVEL OF SIGNIFICANCE
			PRE	POST		
1	PAIN	Day 1 & 56	8.06	6.46	7.322	P <0.05
2	BALANCE	Day 1 & 56	42.93	47.06	11.142	P <0.05
3	FUNCTIONAL PERFORMANCE	Day 1 & 56	56.53	65.6	0.3916	P < 0.05

TABLE III COMPARISON OF POST TEST MEAN VALUES BETWEEN EXPERIMENTAL GROUP I AND II

GROUPS	EXPERIMENTAL I (MEAN)	EXPERIMENTAL II (MEAN)	t VALUE	LEVEL OF SIGNIFICANCE
VAS	2.6	6.46	22.28	P <0.05
BBS	52.06	47.06	14.87	P < 0.05
WOMAC	82.2	65.6	19.05	P <0.05

TABLE IV RATE OF PROGRESSION BETWEEN DAY 1 AND DAY 56
\GROUP I

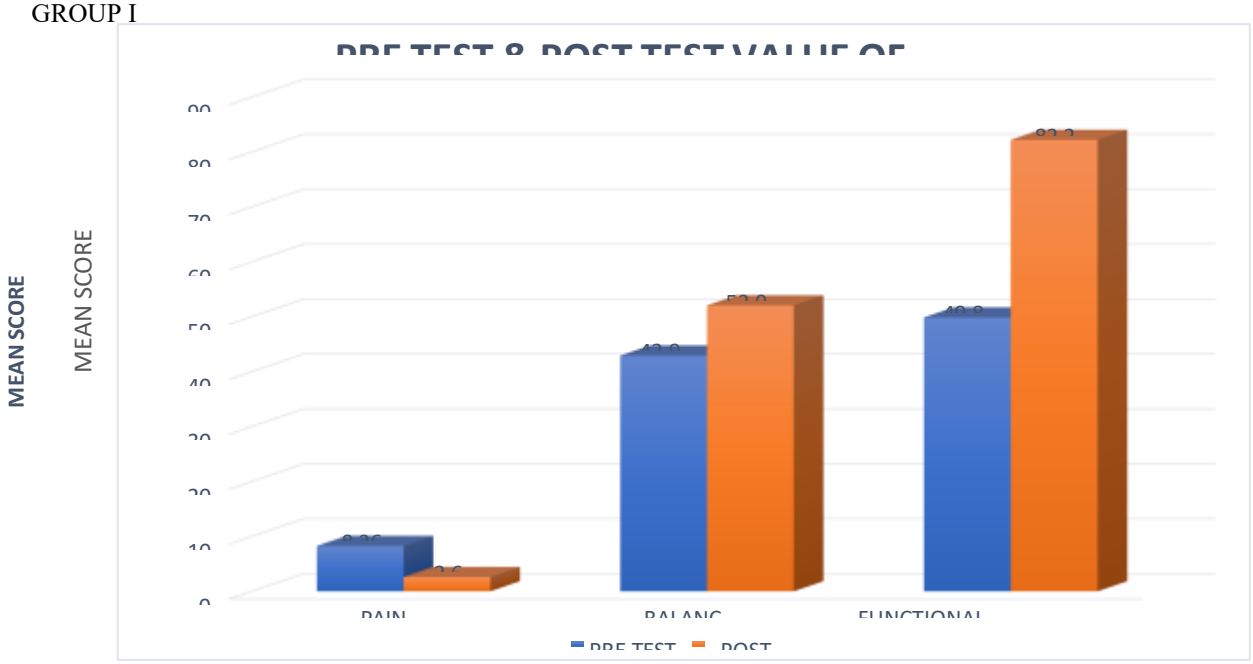
S.NO	VARIABLES	MEAN		PERCENTAGE OF PROGRESSION
		PRE TEST	POST TEST	
1	BALANCE	42.9	52.06	17.6
2	FUNCTIONAL PERFORMANCE	49.9	82.2	39.29

TABLE V RATE OF PROGRESSION BETWEEN DAY 1 AND DAY 56 GROUP II

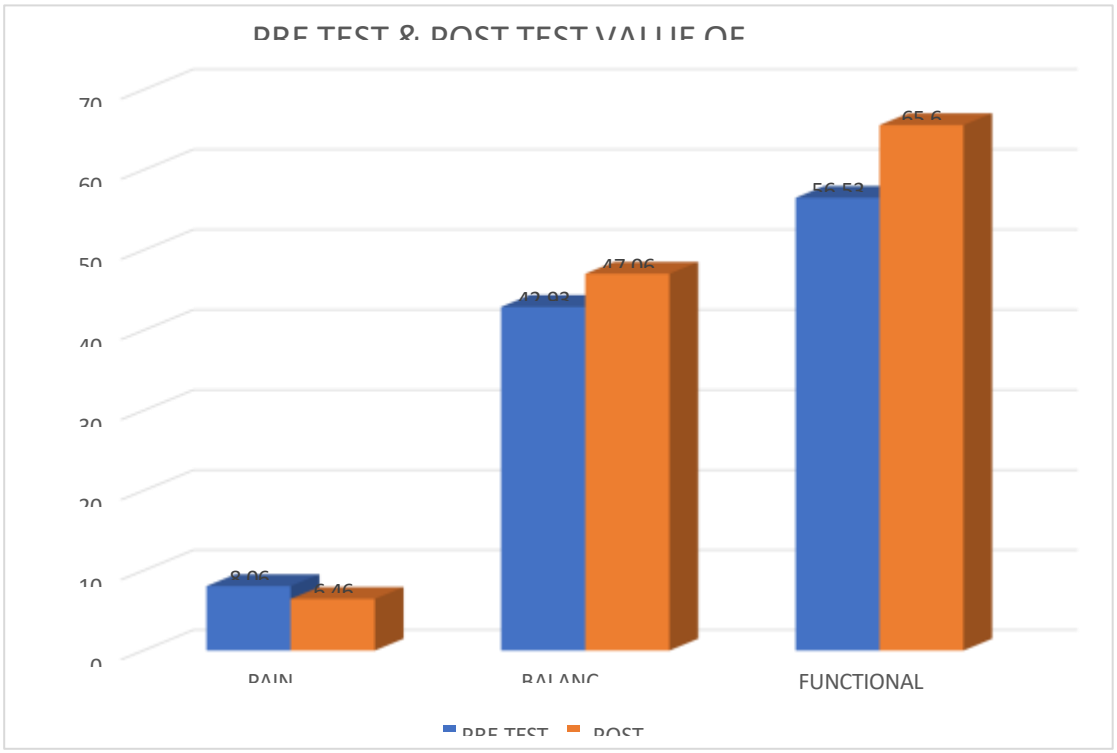
S.NO	VARIABLES	MEAN		PERCENTAGE OF PROGRESSION
		PRE TEST	POST TEST	
1	BALANCE	42.93	47.06	8.77
2	FUNCTIONAL PERFORMANCE	56.53	65.6	13.82

GRAPHICAL REPRESENTATION

GROUP I



GROUP II



DATA ANALYSIS AND RESULTS

From the table I, the descriptive statistics mean, standard deviation, t- value has been obtained using t-test of pre-test VAS and post-test VAS. The statistical results support the application of Closed Kinematic Chain Exercise is effective.

From the table I, the descriptive statistics mean, standard deviation, t- value has been 0btained using t-test of pre-test BBS and post-test BBS. The statistical results support the application of Closed Kinematic Chain Exercise is

effective.
From table I, The descriptive statistics mean, standard deviation, t- value has been obtained using t-test of pre-test WOMAC and post-test WOMAC. The statistical results support the application of Closed Kinematic Chain Exercise is effective.
From table II, the descriptive statistics mean, standard deviation, t-value has been obtained using t-test of pre-test VAS and post-test VAS. The statistical results support the application of Pilates is effective.
From table II, the descriptive statistics mean, standard deviation, t-value has been obtained using t-test of pre-test BBS and post-test BBS. The statistical results support the application of Pilates exercise is effective.
From table II, The descriptive statistics mean, standard deviation, t-value has been obtained using t-test of pre-test WOMAC and post-test WOMAC. The statistical results support the application of Pilates exercise is effective.
From III, The descriptive statistics of post test values of VAS, BBS and WOMAC and both groups in this t-test values VAS (22.28), BBS(14.87) and WOMAC (19.05). P value VAS
<0.05, BBS <0.05 and WOMAC <0.05 with the mean value and standard deviation value.
From table IV, the descriptive status mean, rate of progression has been obtained using percentage of progression test of pre-test BBS and post test BBS. The statistical result support the application of closed kinematic chain exercise is effective.
From table IV, the descriptive status mean, percentage of progression has been obtained using rate of progression test of pre-test WOMAC and post test WOMAC. The statistical result support the application of closed kinematic chain exercise is effective.
From table V, the descriptive status mean, percentage of progression has been obtained using rate of progression test of pre-test BBS and post test BBS. The statistical result support the application of Pilates exercise is effective.
From table V, the descriptive status mean, rate of progression has been obtained using percentage of progression test of pre-test WOMAC and post test WOMAC. The statistical result support the application of Pilates exercise is effective.
Changes within experimental Group I and II are analysed using paired t test and differences among two are analysed using independent t test and the percentage of progression are analysed using rate of progression test.

GROUP I PAIN

Mean value of pre test is 8.26 and post test is 2.6. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145. Calculated t value is 22.549 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in balance in group I.

BALANCE

Mean value of pre test is 42.93 and post test is 52.06. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145.Calculated t value is 8.516 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in balance in group I.

FUNCTIONAL PERFORMANCE

Mean value of pre test is 49.86 and post test is 82.2. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145. Calculated t value is 13.06 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in functional performance in group I.

GROUP II PAIN

Mean value of pre test is 8.06 and post test is 6.46. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145. Calculated t value is 7.322 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in pain in group II.

BALANCE

Mean value of pre test is 42.93 and post test is 47.06. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145. Calculated t value is 11.142 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in balance in group II.

FUNCTIONAL PERFORMANCE

Mean value of pre test is 56.53 and post test is 65.6. For 14 degrees of freedom and at 5% level of significance. The table value is 2.145. Calculated t value is 0.3916 which is lesser than the table value 2.145. Since alternate hypothesis is accepted there is no improvement in functional performance in group II.

INDEPENDENT t-TESTFOR PAIN,BALANCE AND FUNCTIONAL PERFORMANCE BALANCE

Value of independent t test is 14.87 which is greater than the table value 2.145. Since alternate hypothesis is accepted there is improvement in balance.

FUNCTIONAL PERFORMANCE

Value of independent t test is 19.05 which is greater than the value 2.145 .Since alternate hypothesis is accepted there is improvement in balance.

RATE OF PROGRESSION GROUP I BALANCE

The result shows that there is 17.6% of progression when comparing balance, pre test values of day 1 and post values of day 56.

FUNCTIONAL PERFORMANCE
The result shows that there is 39.29 % of progression when comparing functional performance, pre test values of day 1 and post test values day 56.
GROUP II BALANCE
The result shows that there is 8.776 % of progression when comparing pain, pre test values of day 1 and post test values of day 56.
FUNCTIONAL PERFORMANCE
The result shows that there is 13.82 % of progression when comparing pain, pre test values of day 1 and post test values of day 56.

DISCUSSION

Aim of the study was to evaluate the effectiveness of closed kinematic chain exercise (group I) and Pilates exercise (group II) on pain, balance and functional performance in knee osteoarthritis. In this study the subjects were assessed for knee pain, balance and functional performance using VAS, Berg Balance Scale AND WOMAC respectively.
In this study subjects were assessed for knee osteoarthritis underwent either closed kinematic chain exercises or Pilates exercises which are performed for 8 weeks the parameters were assessed before and after exercise training.
There are several possible studies shows positive outcomes of closed kinematic chain exercise training improves functional performance. SADHANA VERMA(2012) concluded that closed kinematic chain exercises is more effective in Improving the strength and functional activity of quadriceps muscle in subject with osteoarthritis.
NADIA SALEEM (2022) the study concluded that pilates exercise were found to be more effective in the treatment of patients with knee osteoarthritis on reducing pain, improving knee range of motion and functional disability.
Group I is effective for the following reasons
Promoting increased joint stability.
Promoting simulation of functional movement patterns
Improving functional performance
Chandni shah (2014)shows ultimate rehabilitation in improving the pain and functional disability it shows improvement in their activity like stair climbing, squatting and walking.
Group II is effective for the following reasons
Improving physical and mental conditioning
Improving flexibility and balance
Improving postural awareness

Akodu AK (2017) is found to be an efficacious in the reduction of pain intensity and functional disability and improving knee range of motion in patients with osteoarthritis knee. The result
of the study showed significant improvement in physical function, energy role in limitation of pain and severity of osteoarthritis at the post rehabilitation period.
Changes within experimental Group I and II were analysed using paired t test and differences among two are analysed using independent t test and the percentage of progression are analysed using rate of progression test.
The result shows that Group I which underwent closed kinematic chain exercise had shown significant improvement in improving pain, balance and functional performance among osteoarthritis patient. Group II which underwent Pilates exercise had shown significant improvement in pain, balance and functional performance. But GROUP I is more significant improvement than group II in improving pain, balance and functional performance among osteoarthritis subjects.

SUMMARY AND CONCLUSION

Osteoarthritis of the knee is an active disease process involving cartilage destruction subchondral bone thickening and new bone formation. This study shows evidence in improving pain, balance and functional performance among subjects with osteoarthritis of knee. This study uses closed kinematic chain exercise and Pilates exercise in reducing pain, improving balance and functional performance. Pre test and post test values were taken using independent t test and the rate of progression were analysed. From this study it is concluded that closed kinematic chain exercise is effective in reducing pain, improving balance and functional performance in subjects with knee osteoarthritis.

LIMITATIONS AND SUGGESTIONS

Age group were selected between 40-65 years. Hence age group above 65 or below 40 can be selected.
Duration of the study was 8 weeks. Duration can be longer.
Only two methos of training are given. Other methods of intervention conventional therapeutic exercise, suspension

training and Otago exercise can be compared.
No longer follow up of subjects. Longer follow up can be done.
To analyse the effectiveness of pain, visual analogue scale were used. Analysis of pain can be done with numerical pain rating scale and Mc Gills Questionnaire.
To analyse the effectiveness of balance, berg balance scale were used. Analysis of balance can be done with dynamic balance test and functional reach test.
To analyse the effectiveness of functional performance, WOMAC were used. Analysis of functional performance can be done with knee injury and osteoarthritis outcome score.

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