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COMPARATIVE EFFICACY OF KINESTHESIA & BALANCE EXERCISES VERSUS OPEN CHAIN EXERCISES ON PAIN AND FUNCTIONAL PERFORMANCE IN KNEE OSTEOARTHRITIS

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ABSTRACT

BACKGROUND-Osteoarthritis is most commonly encountered disease of the musculoskeletal system.Few studies have been done to compare the efficacy of Kinesthetic and balance and open chain exercises in Osteoarthritis knee.

METHODOLOGY-Comparative Study done on osteoarthritic patients of both genders with age limit of 45 and 65. subjects (N=30) were randomly allocated in two groups Group A (N=15) And Group B (N=15). Group A was given kinesthesia & Balance exercises And Group B was given open chain exercises for three weeks. Pre and Post intervention outcome measures was VAS & WOMAC Scale.

RESULT-There was significant improvement in pain and function within group A and within group B for both VAS and WOMAC. There was also significant difference between both groups A and B, for both the outcome measures VAS and WOMAC.

CONCLUSION- the study concluded that open chain exercise was more effective in reducing pain and improving functional performance in Osteoarthritis knee.

KEYWORDS : Osteoarthritis knee, Kinesthesia and Balance exercise, Open Chain exercise, WOMAC.

INTRODUCTION

Osteoarthritis (OA) is primarily a cartilage disease as it is characterized by the progressive loss of hyaline articular cartilage. Ultimately, the articular cartilage degenerates with fibrillation, fissures, ulceration, and full thickness loss of the joint surface.[1] Common sites developing OA include the knee, hand, hip, spine and foot. Among these, the knee is the most commonly affected joint, and knee OA patient present with a combination of inflammation, pain, stiffness, muscle atrophy and deformity.[2]

The worldwide prevalence estimate for symptomatic OA is 9.6% among men and 18% among women[3].Osteoarthritis is the second most common problem and it is the most frequent joint disease with a prevalence of 22% to 39% in India.[4, 5]In India, the prevalence of OA knee is relatively more as compared to western population which could be related to excessive squatting in a day- to –day activities, especially among females.[6] The prevalence of OA increases with age. Men are affected more commonly than women before 50 years whereas after 50 years of age the prevalence in women is 2-3 times greater than men.[7]

Common signs and symptoms of knee OA include knee pain, joint stiffness, decreased muscle strength, and proprioceptive deficits. Clinically, OA knee is characterized by pain during weight bearing, tenderness, and limitation of knee movement, crepitus, occasional effusion, and variable degrees of local inflammation.[8]Impaired proprioception also has been reported for the patients suffering from knee osteoarthritis[9] where reduced proprioception is responsible for initiation and perpetuation of degeneration of the knee. In addition, individuals with knee OA often have poor neuromuscular control, slower walking speed, decreased functional ability and increased susceptibility to falling.[10]

OA of knee is mainly diagnosed radio graphically by the Kellgren and Lawrence score, which grades the severity of the disease from 0 to 4 by the appearance of osteophytes, joint space loss, sclerosis and cysts. These criteria were adopted by the World Health Organisation (WHO) to define radiographic OA in epidemiologic studies.[11-13]

Applied physical therapy for OA mainly consists of cold, heat, ultrasound and shortwave therapy, instruction in joint use and maintenance of range of motion, supplying patients with canes or orthotic devices, open chain exercises and Kinaesthesia Balance prevent muscle atrophy.[15]Three basic types of therapeutic exercises exist: isotonic, isometric, and isokinetic.[16]Various measures are available for the treatment of OA knee such as conservative management including Pharmacotherapy and Physiotherapy, or surgical management in the form of resurfacing of joint or replacement surgeries.[17]The Osteoarthritis Research Society International (OARSI) recommended non pharmacological methods including patient education programs, weight reduction, coping strategies, and exercise programs for treatment of knee OA.[18]

OKC exercise plays an important role in isolating individual muscle groups.[19]isometric exercise is a mode of speed constant exercise. The patient contracts the muscle at various isometric hold angles in the range of motion, as present..Isokinetic exercise is a form of dynamic exercise in which the velocity of muscle shortening or lengthening and the angular limb velocity is predetermined and held constant by a rate-limiting device known as an isokinetic dynamometer.13 isotonic exercise is a mode of speed-variable exercise. The tension is generated by the muscle in response to both the concentric and eccentric direction. The isometric muscle strengthening exercise program consisted of 5repititions of concentric/eccentric at the maximum velocity.[20]

Kinaesthesia, Balance & Agility Exercise(KBA) techniques are designed to improve dynamic joint stability using a series of physical activities which challenge a participant's neuromuscular system to maintain balance and coordination. Most frequently, KBA is used to rehabilitate and prevent anterior cruciate ligament ruptures[21-24]and ankle sprains[25-27]among athletes. KBA is designed to decrease proprioceptive impairment by using agility and balance exercises to activate, challenge, and adapt the nervous system's proprioceptors. Decreasing proprioceptive deficit would thereby increase dynamic knee stability and improve activities of daily living function. In addition, joint instability and frontal plane joint laxity has been cited as a probable causative factor in both the development of knee OA and the further erosion of articular cartilage among persons with knee OA.[28-30]

Pain in the affected joint is the most common symptom of OA and contributes to significant declines in functional ability including getting up off the floor and going up and down stairs.[31,32]The pain VAS is a continuous scale comprised of a horizontal (HVAS) or vertical (VVAS) line, usually 10 centimetres (100 mm) in length, anchored by 2 verbal descriptors, one for each symptom extreme.[33-36]

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used measure of symptoms and physical disability originally developed for people with osteoarthritis (OA) of the hip and/or knee.[37,38]The most widely used condition-specific instruments for the assessment of hip or knee OA is the WesternOntario and McMaster Universities (WOMAC) OA Index.[39,40]which is recommended by the Outcome Measures in Rheumatoid Arthritis Clinical Trials (OMERACT).[41-45] There are less comparative studies of kinaesthesia & balance exercises versus open chain exercises on pain and functional performance in knee osteoarthritis. So need of the study is to find out better treatment strategy to reduced pain and increased functional performance in knee osteoarthritis (OA).

HYPOTHESIS: Null Hypothesis (H0)stated that**,** There was no significant difference between kinaesthesia & balance exercises and open chain exercises on pain and functional outcome in osteoarthritis knee patient.

METHODOLOGY:

Study design was Comparative study. Population consisted of elderly individual of 45 to 65 years of age with osteoarthritis knee.Sampling technique was Purposive sampling .Study duration was 12 month.Sample size was 30, calculated with G power 3.19.2 version with effect size 1.1, $\alpha = 0.05$ and power 0.80. Allocation in two groups was done randomly by chit method. Study setting included SPB physiotherapy OPD. Source of data was SPB physiotherapy OPD and other OPD's in Surat.Inclusion criteriaconsisted of ,Age group between 45-65 years, Primary osteoarthritis,Patients with a clinical diagnosis of Osteoarthritis of knee Grade 1, 2 Radiologically (Kellgren & Lawrence), Symptoms more than 3 months, Bilateral involvement, Knee pain on most of the previous month. [Average pain >3 cm on a 10-cm Visual Analogue Scale (VAS)], Patients able to walk on heel and on toes, Patients able to walk 100 feet without an assistive device.Following were excluded,Any history of knee, hip, ankle surgery within 6 months, Peripheral vascular disease, Any local or systemic infections, Any deformity in lower limbs, Limb length discrepancy, Any intra articular injection to knee joint within 6 months, Any neurological signs and symptoms.

Outcome measures: were Functional outcome measured using WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) scale.[45](Gujarati version)**and** Visual Analogue Scales (VAS).[46]

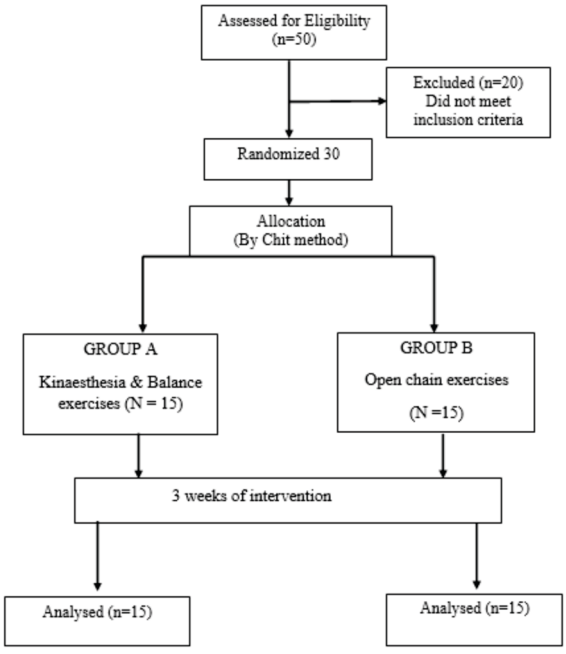


Figure 1: The Flow Diagram shows the progress of participants at each stage of the study

Procedures of study

Ethical clearance was taken from institutional ethical committee. The purpose of this study was explained and a written informed consent and demographic details was obtained from all the subjects. Subjects was preliminary screened based on the inclusion and exclusion criteria. They were allocated in to two groups A and B, by chit method. On the first day of first week and last day of third week, pre-test and post-test measurements of pain was taken by VAS Scale and functional outcome was taken by WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) scale. Description of groups are as follows:

Group A: Kinaesthesia & Balance exercises and Group B: Open chain exercises

Procedure of blinding:Subjects were blinded on either type of intervention and to which group they belonged. Throughout the treatment sessions, subjects from both the groups were not allowed to have any interaction to each other and the subject were not aware of what kind of treatment they received and its effects.

Group A: Kinaesthesia & Balance exercises[47]

1. Week

1. Modified Romberg exercise (Standing in balance with eyes closed)
   - a) On hard ground
   - b) On soft ground (on a mat)
2. Retro walking (25 m)
3. Walking on heels (25 m)
4. Walking on toes (25 m)
5. Standing on one extremity for 30 seconds (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)

2. Week (in addition)

1. Exercise with "rocker-bottom" balance Board
2. Sitting down and standing up from a low stool slowly
3. Figure 8 exercise
   - a) Walking slowly, wide circle
   - b) Walking quickly, wide circle
   - c) Walking slowly, narrow circle
   - d) Walking quickly, narrow circle

3. Week (in addition)

1. Exercise with "BAPS (biomechanical ankle platform system) board" balance board
   - a) Balance with 2 legs, eyes open, Multidirectional
   - b) Balance with 2 legs, eyes closed, Multidimensional
   - c) Balance with one leg, eyes open, unidimensional
   - d) Balance with one leg, eyes closed, Unidimensional
   - e) Balance with one leg, eyes open, Multidimensional
   - f) Balance with one leg, eyes closed, Multidimensional
2. Minitrampoline exercise (jumping and jogging)
3. Carioca crossover maneuver

Group B: Open chain exercises[48]

1 week

1. Quadriceps setting (10 repetitions)
2. Cycling in the air (2 min for a bout)
3. Straight leg raising with weight (new 10 RM)

2 week

1. Quadriceps setting (10 repetitions)
2. Cycling in the air (2 min for a bout)
3. Straight leg raising with weight (new 10 RM)

3 weeks

1. Quadriceps setting (10 repetitions)
2. Cycling in the air (2 min for a bout)
3. Straight leg raising with weight (new 10 RM)
4. Full arc extension (with new 10 RM as weight)

1. Quadriceps setting (10 repetitions)-

The subject were asked to lie supine and relax completely. The therapist stands at side of couch and give commands to patient to press on the small pillow below her knee and hold this position for a 5 second and do this exercises for 10 repetitions.

2. Cycling in the air (2 min for a bout)

The participant in supine lying position on the gym mat raised his legs with the hip joints flexed to about 90 degrees and knees bent to about 900 in the air. With slow and steady balance, he then performed the cycling movements of the lower limbs in the air continuously for a period of two minutes [53]. During the air cycling of the legs, the hands were placed along the sides of the body and resting on the gym mat. This exercise was for the entire twelve week.

3. Straight leg raising with weight (new 10 RM)

The participant in a supine position isometrically contracted his quadriceps (quadriceps setting) and lifted the lower extremity up to achieve about 45° of hip flexion while maintaining the knee in extension. He held the position to a count of 10, and then lowered the limb; repeating the exercise 10 times. The contralateral knee and hip were flexed to about 900 and 45° respectively to avoid undue stress on the low back 13. From second week SLR with weight was commenced by strapping an ankle weight equivalent to his/her 10RM to the ankle region, the Participant then lifted the lower extremity to about 45° of hip flexion while maintaining the knee in extension. The contra lateral knee and hip were also each flexed to 45°13, 52.

4. Full arc extension (with new 10 RM as weight)
The participant in a high sitting position had a weight corresponding to his 10RM strapped to the leg of the affected lower extremity just above the ankle. The popliteal space was protected with a roll of towel. He then lifted the load slowly through the range of 90° to 0° of knee flexion (full extension). He held the position for a count of 5 and then lowered the load 13. He/she performed three bouts of ten repetitions of this exercise per session.

All the exercises were conducted for one session for 6 days in a week for three week.

STATISTICALANALYSES:
All the test and calculation were performed using SPSS software version 15. Shapiro-Wilk test was applied to check the normality of the data. All the quantitative data of this study followed the normality ($p \geq 0.05$). Baseline characteristics were compared to check homogeneous between intervention groups. Independent t-test was used for all the demographics and outcome measures like Age, BMI, OA Grade, VAS, WOMAC. Paired t-test was used to analyse the differences between pre and post treatment within each group and independent t-test for between group comparisons. Confidence interval was kept 95% and the level of significance for all the statistical data was set at $p \leq 0.05$. patients .

RESULTS:
Total 50 patients were assessed for eligibility. 30 patients were enrolled in the study and randomized to one of the treatment group (15 in Kinaesthesia & Balance exercises group and 15 in Open chain exercises group).The group were homogenous at baseline in their demographic details and outcome scores with p-value>0.05.

The baseline characteristics were similar between groups. All the parameters showed no significant difference (P>0.05) before intervention (Table - 5.1)

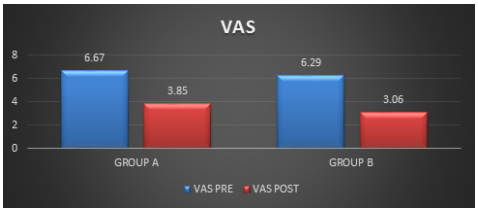
TABLE 5.1: Patient's Baseline characteristics

VARIABLE	GROUP A	GROUP B	P VALUE
	MEANSD	MEANSD	
AGE (YEAR)	55.53±4.58	56.20±4.60	0.69
BMI (KG/M2)	23.88±0.96	23.22±1.31	0.12
OA GRADE	1.73±0.45	1.66±0.48	0.70
PRE VAS	6.67±0.70	6.29±0.66	0.14
PRE WOMAC	55.86±2.18	55.97±2.56	0.89

TABLE 5.2Within group Comparison of Pre-and Post VAS and WOMAC in Group A and Group B

OUTCOME	GROUP	MEANSD		P VALUE
		PRE	POST	
VAS	GROUP A	6.67±0.70	3.85±0.88	.000
	GROUP B	6.29±0.66	3.06±0.36	.000
WOMAC	GROUP A	55.86±2.18	32.95±2.06	.000
	GROUP B	55.97±2.56	31.81±1.94	.000

Graph 5.1: Within Group comparison of mean of Pre and Post VAS in Group A and Group B



Graph 5.2: Within Group comparison of mean of Pre and Post WOMAC in Group A and Group B

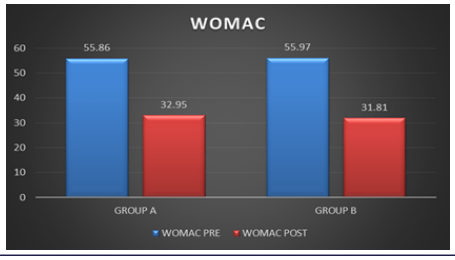
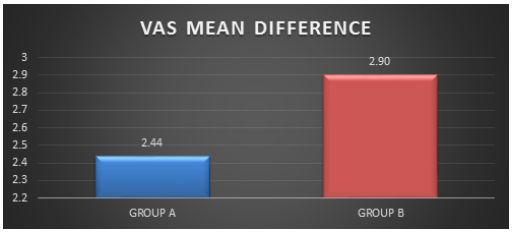


Table 5.2 shows Within group Comparison of Pre-and Post VAS and WOMAC in Group A and Group B. There is significant difference between pre and post VAS in group A and Group B. There is significant difference between pre and post WOMAC in group A and Group.

TABLE 5.3 Between Group Comparison of Mean difference of VAS and WOMAC group A and group B

OUTCOME	GROUP	MEANSD	P VALUE
VAS	GROUP A	2.44±0.49	0.019
	GROUP B	2.90±0.51	
WOMAC	GROUP A	22.00±2.28	0.034
	GROUP B	23.76±2.04	

Graph 5.3: Comparison of mean difference of VAS between Group A and Group B



Graph 5.4: Comparison of mean difference of WOMAC between Group A and Group B

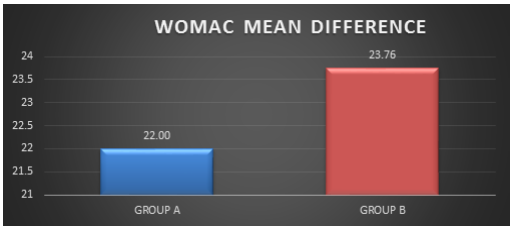


Table 5.3, shows Between Group Comparison of Mean difference of VAS and WOMAC group A and group B.men diff erence suggests thst there was more improvement in pain and function with open chain exrcise.

DISCUSSION-
Result of present study indicate that both the exercises are effective in improving pain and functional outcome after 3 week of intervention but when compared between groups it shows that Open chain exercise shows more improvement than kinaesthesia and balance exercise.

In Group A there was noticeable improvement in Pain reduction in kinaesthesia and balance exercise Group. The mechanism behind this finding could be that, pain might result in muscle dysfunction and movement control disorders, and this can reduce the muscle ability in maintaining the postural stability. This reflects that pain reduces by improvement in postural stability.[49]The reduction in pain intensity and functional disability was significantly greater in proprioceptive training group. This finding is concurring with Shakoori[50]who reported pain reduction with improvement in muscle strength and proprioceptive acuity. Decrease in pain in proprioceptive group may be due to appropriate contribution of various balance receptors and their interactions with postural and motor control.[50]

The mechanism of Kinaesthesia & Balance exercises that may have improved function, Literatures suggest that proprioceptive information is an important mediator of timely and appropriate voluntary and involuntary movements. Proprioceptive exercises cause dynamic stabilization by the synergistic and synchronous working of the muscle groups. Exercise regimens containing repetitive movements increase the ability of the person's control over joint movements in all positions. Dynamic stability helps to control abnormal joint translation that occurs during daily movements and may provide increased motor control through a reflex route.[51]many previous studies have shown efficacy of proprioceptive exercises on balance, proprioceptive perception, and gait parameters in knee osteoarthritis.[52]Literature review suggest proprioceptive exercises have better relief of pain and functional disabilities in patients with OA knee.[53]

In Group B, that there was noticeable reduction in pain and improvement in Functional out come in Open chain exercise. The mechanism of open chain exercises that may have improved function

has been suggested by Fransen et al,who in his study of randomized controlled trials in patients with knee OA showed that strengthening of the quadriceps musculature with either isometric or isotonic resistive exercise was associated with significant improvement in quadriceps strength, reduction of knee pain, and improved function.[54]Philadelphia Panel et al.reported that muscle strength training leads to increased range of motion, muscle strength, and functional ability for patients with knee OA. [55]Isometric quadriceps muscle strengthening exercise decreasing joint pain, this may be due to increased muscle strength of quadriceps and there by joint become stronger and reduced the symptoms and less knee pain and better physical function.[56]Reduction in pain and consequent improvement in function following quadriceps strengthening exercise have been attributed to increased stability of the knee joint which is enhanced by improvement in quadriceps muscle strength. [57,58]

The mechanism behind reduction of pain finding could be the Quadriceps strengthening, which may activate the pain- suppressing β-endorphin system,[59]favourably alter sensory input to the central nervous system and the gate control mechanism (regulating pain perception)[60]and as well improve blood flow and cartilage nutrition.[61]Juhl et al. in a systematic review and meta-analysis of randomized controlled trials identified quadriceps strengthening as one of the major aim and focus of optimal exercise programme for patients with knee OA.[62] Tinaka et al in their meta-analysis also affirmed that muscle strengthening exercises (with or without weight bearing) are effective for pain relief; hence it is relevant to identify the best approach to improving quadriceps muscle strength for optimal clinical benefits.[63]

Limitations of the Study-Duration of the study was short (3 weeks).Long term follow up was not taken.Blinding was not done of any assessor or therapist.

Further Suggestions-The studies can be done on a large population. The studies can be done on patients with different age group. The studies can be done with the protocol of more than 3 weeks. Further studies can be done with addition of control group.

CONCLUSION

The study's outcome indicated that Kinaesthesia & Balance Exercises and Open Chain Exercises are effective for improving Functional performance and reduce pain. However, Open Chain Exercises was more effective than Kinaesthesia & Balance Exercises to achieve better treatment outcome for reduced pain and Functional performance in Osteoarthritis knee patient.

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