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Comparative study of Open-chain v/s Close- chain kinematics exercises to enhance proprioception and functional knee flexion range in-patients with knee osteoarthritis.

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INTRODUCTION

Osteoarthritis is ancient, chronic degenerative joint disease[1].Knee osteoarthritis is a form of arthropathy, characterized by the progressive deterioration of the articular cartilage or of entire joint including cartilage, the synovium, the ligaments and the subchondral bone and formation of osteophytes at the margin of the joint[2].

Osteoarthritis is a dynamic phenomenon: it shows features have the both destruction and repair. Cartilage softening and disintegration accompanied to form the hyperactive new bone formation – osteophytosis and remodeling[3].

It is one of the prevalent common forms of musculoskeletal condition, which causes physical disability therefore affecting the quality of life[4].

A recent survey 2007 in India reported that prevalence of OA in older adults more than the 64 years of age was 32.6%. OA is likely to become the 8thmost common cause of disability in women according to **WORLD HEALTH ORAGANISATION** report on burden of disease [5]. A survey in 2016 OA is the 2nd most common rheumatologic problem and is the most frequent joint disease with a prevalence of 22% to 39% in India; OA is more common in women than men. Nearly 45% of women over the age of 65 years have symptoms while radiological evidence is found in 70% of those over 65 years [6].

Osteoarthritis affects the knee joint most and it could be primary or secondary, Primary OA "wear and tear" arthritis or age related arthritis is leading cause of disability with symptomatic knee OA is likely to increase because of the ageing of population and the obesity epidemic. Secondary OA is an underlying primary disease of the joint which leads to the degeneration of joint often may year later, it may occur at any age and its predisposing factors are: (a) congenital maldevelopment of joint ;(b) irregularity of joint the surface from previous trauma; (c) previous disease producing a damaged articular surface;(d) internal derangement of the knee, such as a loose body; (e) malaignment (Bow legs) and (f) obesity and excessive weight7. Knee OA affects the 3 compartments medial, lateral and patellofemoral joint and it develops slowly over 10-15 years[8]. The cause of OA is multifactorial including family history, age, obesity, diabetes, synovitis, systemic inflammatory mediators, innet immunity, lower limb alignment (Genu-valgus & Genu-varas), trauma, metabolic disorders[9,10].

However, several factors increase the risk of developing significant arthritis at an earlier age. non –modifiable risk factor included ; Genetic mutation, congenital abnormalities and modifiable risk factor are overweight. Several factors for developing knee OA are -

a. **Age** -The ability of cartilage to heal decreases as a person gets older.

b. **Weight**- Weight increases pressure on all the joints, especially the knees. Every pound of weight you gain adds 3 to 4 pounds of extra weight on your knees.

c. **Heredity** - This includes genetic mutations that might make a person more likely to develop osteoarthritis of the knee. It may also be due to inherited abnormalities in the shape of the bones that surround the knee joint.

d. **Gender** - Women ages 55 and older are more likely than men to develop osteoarthritis of the knee.

e. **Repetitive stress injuries** - These are usually a result of the type of job a person has. People with certain occupations that include a lot of activity that can stress the joint, such as kneeling, squatting, or lifting heavy

weights (55 pounds or more), are more likely to develop osteoarthritis of the knee because of the constant pressure on the joint.

f. **Athletics** - Athletes involved in soccer, tennis, or long-distance running may be at higher risk for developing osteoarthritis of the knee. That means athletes should take precautions to avoid injury. However, it's important to note that regular moderate exercise strengthens joints and can decrease the risk of osteoarthritis. In fact, weak muscles around the knee can lead to osteoarthritis.

g. **Other illnesses** - People with rheumatoid arthritis, the second most common type of arthritis, are also more likely to develop osteoarthritis. People with certain metabolic disorders, such as iron overload or excess growth hormone, also run a higher risk of osteoarthritis[11].

Symptoms of osteoarthritis of the knee may include

Symptoms can vary on the causes and most common symptoms of knee OA is pain, swelling, stiffness, decrease in mobility of knee range of motion, gridding or popping sounds may report muscle weakness, locking &giving way of the knee common problem may causes walking difficulties, stairs climbing, sitting upright as well as psychological impact all can lead to decreases quality of life[12].

Diagnosis and measurements of knee proprioception

The most frequent radiographic grading system described by kellegren and Lawrence. In this Grade 1- doubtful joint space (JNS) narrowing and possible osteophytic lipping. Grade 2- definite osteophytes and possible JSN narrowing on anterioposterior weight bearing radiograph.Grade 3- joint space narrowing, sclerosis and bony deformity. Grade 4 – large osteophytes, marked JSN, severe sclerosis and definite body deformity [13].

Other imaging studies MRI, CT or Bone scan, blood test for kind of OA, C- reactive protein, RA factor[14]. Patients with knee OA causes decrease muscle strength and proprioception are affected by pain and swelling in the joint, swelling triggers the spinal inhibitory mechanism of quadriceps motor neuron causes reduction in the muscle flexion range or functional activity of the muscle thereby decreasing in the knee proprioception[15,16]. Quadriceps weakness after 30 months patients without pain with knee OA had 76% reduction in quadriceps strength[17].

Therefore knee proprioception measurement is Important measure in this method which is **Joint position sense** method proprioception was assessed using **Reproductive test measurements** - knee of the patients should be moved either actively or passively by patient or by therapist towards an pre-assumed angle. After a few seconds knee is returned to the original position. After few seconds knee is returned to the original position. Than subject has to reproduce that previous angle with the same or contralateral knee. In this test visual as well as auditory cues can be eliminated [18].

Proprioception

It is a conscious, unconscious and semiconscious perception of sense about joint position in space[19,20]. Proprioception is the perceived sense that issued from the central processing of information and coming from proprioceptive receptors and motor cortical areas[21]. Perceptions of body kinematics exercises occur by processing of such information in the somatosensory cortical area[22], Principally sensation of proprioception is taken from mechanoreceptors in the muscles, joint capsule, tendon, ligaments and skin. Stimulation of proprioceptors lead to contraction of muscle that protects joints from mechanical insults[23].

Proprioceptive model dysfunction

DiGiovanna (1991) explains due to trauma or immediate change in resistance leads to shortening of one muscle around joint and the antagonist is hyper shortened. Due to sudden stretching of the shortened muscle leads to reflex contraction in that already shortened muscle[25].

Knop et al.'s Review that four major factors which cause proprioceptive impairment in the knee joint, these impaired articular mechanoreceptors, decrease muscle spindle activity and gamma γmotor neuron activation with reduce muscle spindle sensitivity, degenerative joint inflammation and effusion. Injuries in ACL or meniscus and OA related muscular weakness[26]. (Dig -1)

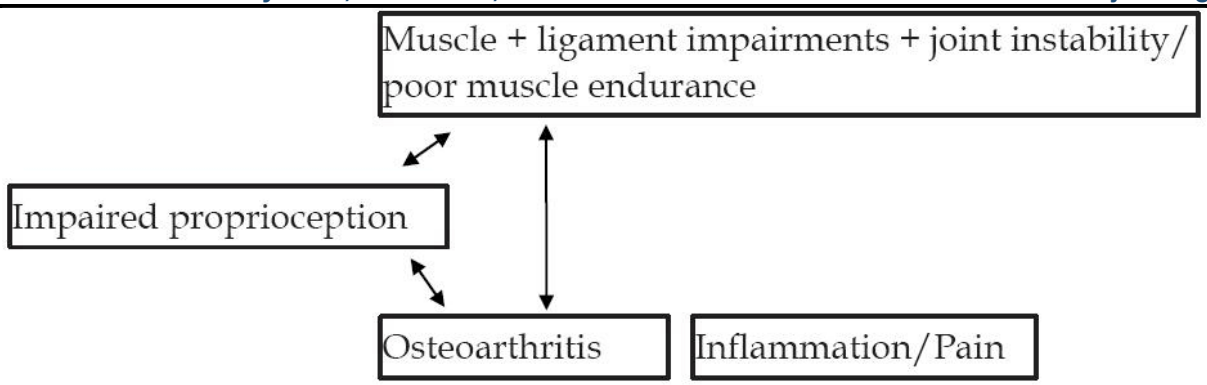

Diagram1:Proprioceptive model of dysfunction

Previous studies show that proprioceptive defects may be associated with the onset and progression of knee osteoarthritis ,leading to pain and disability and result in pain and disability, Furthermore studies have shown that proprioceptive acuity reduces in patients with knee OA when compared to age, gender and BMI[27] . (Dig-2)

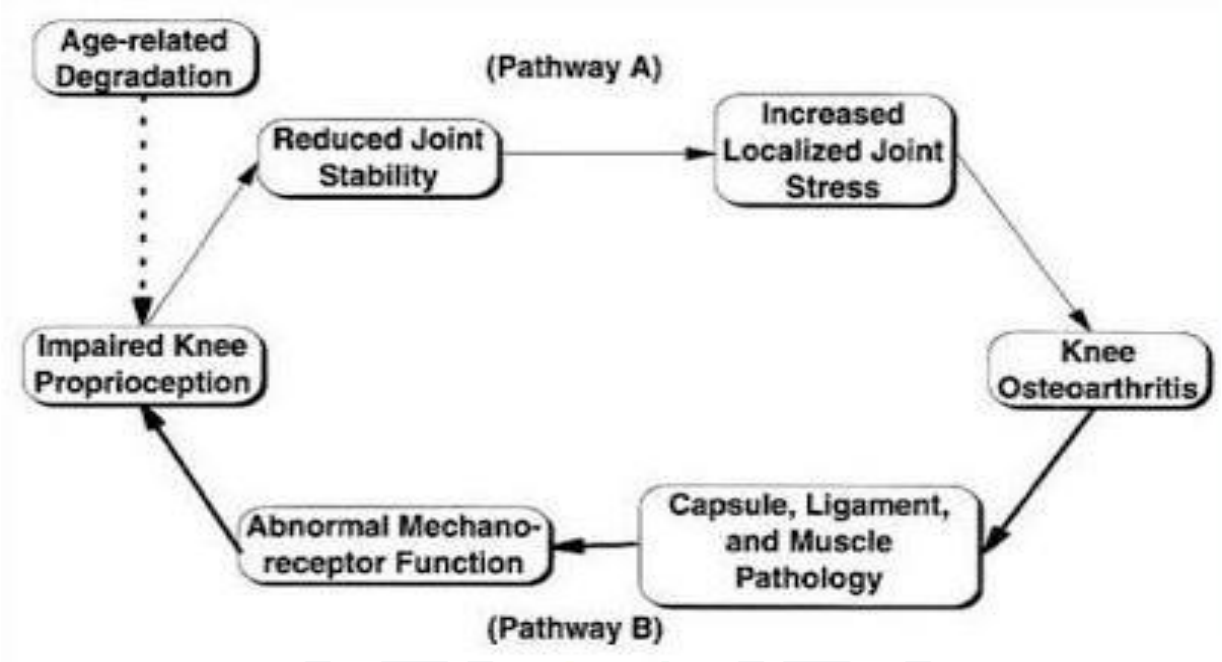

Diagram2: Impaired proprioception causes knee OA (**A postulated causal relationship between age-related degradation in proprioception and knee osteoarthritis (OA). Those with a greater age-related decline in proprioception may be at higher risk of having sensory functional impairment (broken line with arrow) that may cause the development or hastened progression of knee OA(pathway A) (thin line with arrow). It might also be possible that knee OA causes further deterioration of the knee proprioception (pathway B) (thick line with arrow).**

Knee and knee Proprioception

Dynamic knee joint stability is maintain by perception, joint position sense that coordinating the action of quadriceps, hamstring and associated muscles for the mid range perception of joint angle. Signals from muscle spindles are very important joint mechanoreceptors, such as Pancinian corpuscles, Ruffiendorgans and Golgi tendon organ receptors in the knee joints. Some other components (Tendon, joint capsule, cruciate & collateral ligaments ,meniscal attachment) important detection of stretch at extremes of joint range of motion[28]. Impaired in proprioception is one of the most common sign and symptoms of the knee OA[29].

Treatment strategies for knee osteoarthritis

A treatment strategy for knee osteoarthritis includes pharmacological, non-pharmacological and surgical interventions.in the last decades many studies evaluating non- pharmacological treatments and physical therapy interventions have been published[30].

Non- pharmacological: there are multiple therapeutic treatments and approaches Heat and cold treatment are effective pain relief method. Heat treatment enhances circulation whereas cold treatment slows circulation help to reduce swelling and acute pain[31].

Pharmaceutical treatment includes NSAIDS, hyaluronic acid injection and glucosamine, platelet rich plasma. Specific exercises can increase range of motion and flexibility and strength of muscles.Treatment may include weight loss , strengthening training , orthotics and osteopathy's [32].

Weight loss approaches not only reduces symptoms improve functions and reduces disease progression[33]. Electrical stimulation and assistive devices four non-operative, non-invasive modalities to reduce knee pain. Those modalities include TENS, neuromuscular electrical stimulation, insoles and bracing less than a 6 months follow-up treatment[34]. TENS uses low voltage electric current, neuromuscular stimulation use to strengthen or maintain muscle mass[35]. Using assistance devices, walking aids, cane crutches in knee pain[36]. SWD is a non pharmacological therapeutic approach that involves the application of deep heat and this treatment has been reported to have a measurable effect for patients for patients with knee OA. SWD frequencies approved by the federal communication's (FCC) are 13.56 MHZ, 27.12 MHZ of which the 27.12 MHZ most common used[37]. Psych educational interventions , acupuncture, Low level LASER therapy for reduction pain and improve function[41]. Rehabilitation approaches are aquati, Tai Chi, aerobic and hydrotherapy are current interventions in management of osteoarthritis[38]. Surgical OA treatments include – Arthroscopic surgeries and debridement , cartilage repaired technique, osteochondral transplantation techniques, autologous chondrocyte implantation, osteotomies around the knee, joint arthroplasty, total knee arthroplasty, minimal invasive surgeries, implantations . Based on the result of these studies, it was observed that proprioceptive exercises are beneficial in improving the joint position sense in patients with knee osteoarthritis as well as total knee replacement[39]. The quadriceps muscle strengthing patient who with osteoarthritis of knee has also been seen to be consistency lower due to disuse atrophy secondary to joint pain, quadriceps inhibition, delayed activation of quadriceps onset and muscle impaired proprioceptive activity. Decline in the mass and strength in one prominent characteristics of natural ageing. Strength loss can limit the activities of daily living and increase the chance of falling[40].

Previous study shown that the effect of exercises on knee OA, none have specifically examined the effectiveness of proprioceptive training for the population [41]. **Therefore purpose of this study to compare the close chain kinematics exercises v/s open chain kinematics exercises to enhance proprioception and functional knee flexion range in patients with knee osteoarthritis.**

Muscles can be strengthened through resistance training, which can be divided into open kinetic chain (OKC) and closed kinetic chain (CKC) exercises.

Open chain kinematicexercise occurs when the movement allows the distal part of the limb to move freely while the proximal part is fixed. OKC exercise plays an important role in isolating individual muscle groups. It tends to generate more distraction and rotational forces and is often used with concentric muscle contraction[42].

NEED OF THE STUDY

Several studies have enhanced the effects of muscle strengthening using open chain kinematics exercises and close chain kinematics exercises programs but few studies have examined which exercises enhance the proprioception thereby improving the neural control over the knee joint thereby reducing the chance of injury and risk of fall, therefore this study has been designed as **To compare the close chain kinematics exercises(combined kinesthesia and balance training) v/s open chain kinematics exercises (muscle strengthening) to enhance proprioception and functional knee flexion range in patients with knee osteoarthritis.**

METHODOLOGY

3.3 Hypothesis

3.3.1 Null Hypothesis [Ho]

- There will be no significant effect of close-chain kinematics exercises in-patient with knee osteoarthritis.
- There will be no significant effect of open-chain kinematics exercisesin-patient with knee osteoarthritis.
- There will be no significant difference between close-chain and open chain kinematics exercises to enhance Proprioception and functional knee flexion in knee osteoarthritis patients.
- There will be no significant difference of both close-chain and open chain kinematics exercises to enhance Proprioception and functional knee flexion in knee osteoarthritis patients

3.3.2 Alternative Hypothesis[H1]

- [H1] There will be significant effect of close-chain exercises in-patient with knee osteoarthritis.
- [H2]There will be significant effect of open-chain exercises in patient with knee osteoarthritis

- [H3]There will be significant difference in between close-chain and open-chain kinematic exercises to enhance proprioception and functional knee flexionrange in knee osteoarthritis patients
- [H4]There will be significant difference in both close-chain and open-chain kinematic exercises to enhance proprioception and functional knee flexionrange in knee osteoarthritis patients

3.4 STUDY RESEARCH DESIGN

The study was experimental in design, simple randomization in nature which include 2 groups Group A and Group B

Group A- Close chain kinematic exercises group.

Group B- Open chain kinematic exercises group.

3.5 STUDY SET UP

The study was conducted in OPD of Department of Physiotherapy, MYH hospital, MGM Medical collage, Govt. Autonomous society, Indore [M.P.]

3.6 SAMPLING METHOD

In the Department of Physiotherapy, MGM medical collage,a total no of 67 patients were diagnosed with knee osteoarthritisin which only 50 patientswere selected randomly using probability sampling simple random sampling (Lottery -method) method for this study fulfilled the inclusion and exclusion criteria. In the end because of certain reason, 10 drop the treatment than only 40 patients remaining and 20 patients were divided into 2equal groups i.e.

Group (A): - Close-chain kinematic exercises

Group (B): - Open-chain kinematic exercises

3.7 SAMPLING SIZES

Total 40 subjects were selected, randomized in 2 groups in age group between 47 to 74 years with mean age of 62.7±8.5 years, i.e. Group-A (n=20), Group-B (n=20).

3.8AGES AND SEX OF THE SAMPLE

Included male and female patient's age between 47 to 74 years group most commonly affected with osteoarthritis mean age of 62.7±8.5 years and with osteoarthritis impaired of proprioception, limited Knee flexion ROM, Patients with at least one knee assigned a K/L grade ≥2.

3.9 STUDY DURATION

The study duration was 8 month; from February to September 2018 Exercises were performed 4 days in a week of total 3weeks exercise programme duration of thirty 30 minutes.

3.10 SUBJECT SELECTION CRITERIA

INCLUSION CRITERIA

- Patient with knee OA age between 47-74 years.
- Primary OA
- Patients with single limb right or left knee osteoarthritis.
- Patients with at least one knee assigned a K/L grade ≥2.
- VAS scale:- pain: 6-10.
- Limited knee ROM flexion
- Impaired proprioception of the knee joint.

- Aim of the study and procedure consent was taken from subjects who agree to participate.

EXCLUSION CRITERIA

- Rheumatoid arthritis or other systemic inflammatory arthritis.
- Avascular necrosis.
- Periarticular fracture.
- Paget's disease.
- Chronic knee joint infection.
- Gout.
- Total knee replacement or other surgery in either knee.
- Intra-articular corticosteroid injection within the previous 6-months.
- Hip or spine disease as the major source of disability.
- Patients with neurological disorders.
- PIVD.

- Limb length discrepancy.
- Patient receiving knee OA physiotherapy treatment in the month before study.
- If having any history of trauma, surgery, acute infection, malignancy and any systemic disorder, CVA disease, neurological disease, recent steroid infiltration.
- Uncooperative patient were excluded.

3.11 OUTCOME MEASURES

- Proprioception in the knee assessed by using reproductive test measurement (JPS) by Electronic goniometer in different angles of knee flexion ROM (40º and 60º) Pre-assumed active and passive measurement angles
- Knee flexion ROM measurement using an Electronic goniometer.
- Pain is measured by VAS (visual analogue scale) on the pain rating scale.

3.12 MATERIAL AND EQUIPMENTS

1. Electronic-Goniometer
2. Pen
3. Pencil
4. Timer
5. Wobble board with supporting ropes
6. Stopwatch
7. Towel roll

Electronic-Goniometer

Wobble board with supporting ropes

Stopwatch

3.13 STUDY TOOLS:

1. VAS (0-10) pain rating scale
2. K/L classification is uses as clinical tool for the radiographic diagnosis of OA.

3.14 ASSESSMENT TOOLS

- 0-10 VAS scores for pain.
- Reproductive test measurement (JPS): ELECTRONIC GONIOMETER
- Knee flexion joint : ELECTRONIC

KNEE PROPRIOCEPTION

Instrumentation to measure proprioception: Reproductive test measurement(JPS)

In the first proprioception measurement method which is joint position sense test- Subject were positioned in prone lying on a couch with knee in full extension and knee of the patient should be moved either actively or

passively by the examiner toward an pre assumed (40º & 60º) angle of knee flexion . After a few seconds knee is returned to the original position. After this, subject has to reproduce that previous angle with the same or contralateral knee. The subject's perception of the angular position was recorded and compared with the actual angle of knee flexion.

The ability to replicate target knee joint angles was assessed using an electronic goniometer. The test subjects were positioned in prone lying and made to wear headphones and dark glasses to eliminate auditory and visual cues from the testing apparatus. They wore shorts to negate any extraneous skin sensation from clothing touching the knee area. An Electro -goniometric scale was fastened to the lateral side of the knee with fixed arm pointing towards greater trochanter of femur, movable arm pointing to lateral malleolus and fulcrum at the joint line (Figure 1). Skin stretch was checked while fastening the arms with adhesive tape. A trial was allowed at each angle before testing. The knee was positioned in full extension. The subject was then asked to flex the knee joint to a pre-determined target angle of 40º and 60º(Figure 2, 3,4). The therapist constantly provided auditory feedback during trial. Hold time was 5 seconds at each targeted angle. After returning to the starting position and having remained there for 10 seconds, the subject was asked to flex the knee again to reach the target angle. At every angle (40°and 60°) 2 readings were taken, mean was calculated and recorded as the patient's joint position sense. Although the validity and reliability of position matching tests have rarely been evaluated, it is well accepted that the magnitude of accuracy can be a useful indicator of proprioceptive acuity. Precisely those individuals who are prone to making large position matching errors are thought to be, at least in some way, proprioceptive deficient.

Torres et al support this, who stated that the testing protocols for proprioception measurement usually comprise defined target position that is identified and appreciated by the subjects, which are blindfolded. Then, the target position is reproduced passive or actively to the best of subject's ability.

Fig.1 **Reproductive test measurement-(JPS) :** starting position

Fig.2 **Reproductive test measurement-(JPS) :** passive knee flexion at 40º

Fig.3**Reproductive test measurement-(JPS) :** active knee flexion at 40º

Fig.4 **Reproductive test measurement-(JPS) :** active knee flexion at 60º

INTERVENTION

Total 40 patients with knee osteoarthritis met the inclusion- exclusion criteria are divided into two equal halves of size 20 by designed as group A and group B. Group A received close-chain kinematic exercises and Group B received open-chain kinematic exercises

The close-chain Group A participated in **kinesthesia and balance exercises** while the open-chain Group B received only **strengthening exercises**. Prior to the exercises, patients in both groups were informed about knee osteoarthritis and protective recommendations for the knee. The exercises were performed 4 times in a week at duration of thirty minutes under supervision. Isometric and isotonic strengthening exercises were applied to quadriceps and hamstring muscles. Isometric exercises were applied with 10 seconds contractions with 10 repetitions and a rest period of 5 seconds.

GROUP-A

The participants in the close-chain exercise group carried out the following kinesthesia and balance exercises:

At week one

1. Standing with feet together in eyes-closed and training balance time without sway.

a. On hard ground

b. On soft ground (on a mat)

2. Retro walking (10 m)
3. Walking on heels (10 m)
4. Walking on toes (10 m)
5. Walking with eyes closed (5 m)
6. Standing on one extremity for 30 second (repeated in both extremities) and sitting down and standing up from a high chair slowly
7. Stair-up and -down a regular 3 steps staircase

At week two (in addition to exercises during week one)

1. Exercise with wobble board
2. Sitting down and standing up from a low chair slowly

Fig.5 Wobble Board Exercises

3.(a) Walking slowly in a wide circle of 10-meter radius.
(b) Walking quickly in a wide circle of 10-meter radius.
(c) Walking slowly in a narrow circle of 5-meter radius.
(d) Walking quickly in a narrow circle of 5-meter radius.

At week three (in addition to exercises during week two)

1. Walk heel-to-toe along a 3 m line marked on a the floor.
2. With the knee straight but not hyperextended, execute single (relatively small) leg raises to the front, then back. This was continued alternating front to back.

The all exercises performed on the every week were repeated all through rest of the weeks.

GROUP-B

The lower extremity isometric and isotonic strengthening programs were carried out as follows:

At week one

1. 5-min fixed bike exercise without resistance.
2. Range-of-motion and passive stretching exercises applied to hamstring and quadriceps muscles hold time 10 sec and maximum 10 repetition with 5 sec rest period.
3. Quadriceps isometric strengthening exercise.
4. Hamstring muscles isometric exercise.

At week two (in addition to exercises during week one)

1. Short-arc terminal extension exercise for the knee joint.
2. Isometric exercise for the abductor and adductor muscles of the hip joint.

At week three (in addition to exercises in week two)

1. Short-arc terminal extension exercise with resistance for the knee joint.
2. Isometric strengthening exercise with resistance for the hamstring muscles.

The all exercises performed on the every week were repeated all through rest of the weeks.

PREPARATION AND ORGANIZATION OF THE DATA

Patient with knee osteoarthritis had impaired proprioception; limited knee flexion range of motion and at least one knee assigned a K/L grade ≥2 that further met the inclusion-exclusion criteria chosen for study during specified schedule.

A total of fifty-eight knee osteoarthritis patients had screened for the study and out of them 50 had fulfilled the inclusion criteria found to be deemed fit as sample. However, fourty sample selected randomly by using simple random sampling technique (Lottery method) from a total of 50 patients with knee osteoarthritis for the study.

Fourty patients with knee osteoarthritis were available acted as a sample for the study and later divided into two equal halves of size 20 by using lottery method (simple random sampling technique) that constituted two groups and further designated as “group A” and “group B”. The patient with knee osteoarthritis of group “A” received close chain kinematic exercises while rest other patient with knee osteoarthritis of group “B” received open chain kinematic exercises.

However, the main aim of this study is to compare the effectiveness of close chain kinematic (kinesthesia and balance exercise) and open chain kinematic (Muscle strengthening) to enhance proprioception and functional knee flexion in knee osteoarthritis patients

Pre assessments (pre-test) of parameters among patients with knee osteoarthritis had carried out at sampling stage one. However, at sampling stage one the data for pain, for proprioception knee flexion ROM measured with two assumptions, of flexion of 40º and 60º and joint range of motion had obtained prior to intervention of selected physiotherapies in groups designated as baseline observations.

At sampling stage two, the data had re-collected at 3rd week after intervention of selected intervention in groups and for further statistical analysis utilized as post-intervention observations. After necessary instructions and information about the study, the samples had explained about the complete study procedure in his/her own language and his/her willingness to participate in the study had recorded in a consent form dually signed by him/her.

The patient with knee osteoarthritis of groups, A and B had analyzed before and after intervention of selected physiotherapy exercises in order to evaluate the pain on VAS scale, knee proprioception using reproductive test measurement knee flexion ROM measured for two assumptions of flexion of 40º and 60º and the joint range of motion to confirm the effectiveness between administered close chain kinematic exercises and open chain kinematic exercises.

STATISTICAL TECHNIQUE

A total of 40 patients with knee osteoarthritis screened for the study and the collected data for all fourty samples were entered into the computer database. The responses of frequencies were calculated and analysed by using both, descriptive and inferential statistics.

However, the descriptive statistical analysis had used to project the main features and characteristic of the patients with knee osteoarthritis that analyzed for their respective pain, knee flexion ROM measured for two

assumptions of flexion 40º and 60º and the joint range of motion. However, the inferential statistics is used to identify the test of significance.
Results on continuous measurements are presented using Mean ± Standard Deviation (Min-Max) whereas results on categorical measurements are presented in numbers (%). The demographic information of patients with knee osteoarthritis such as age and sex was collected as baseline stage (pre-test).
However, age, sex, pain statuses on visual analogue scale, knee flexion ROM assessed by using reproductive test measurement (Joint Positioning Sense Test) by electronic goniometer measured for two assumptions of flexion of 40º and 60º and the knee flexion joint range of motion had noted among studied patient with knee osteoarthritis.
This was assumed that the observations on sample recorded for continuous variables had followed a normal distribution and overall assuming the normality of the gathered data. Therefore, a parametric test, paired t-test used to identify the significance of mean differences of pain statuses, knee flexion ROM measured for two assumptions of flexion of 40º and 60º and the knee flexion joint range of motion of patients with knee osteoarthritis between pre and post intervention of exercises in groups (group A and group B) while independent sample t-test is used to observe the significance of mean differences between group A and group B. Independent sample t-test is also used to know the significance of mean differences between age, weight and height of patients with knee osteoarthritis of group A and group B in order to confirm the non-biasedness with respect to age, weight and height in the present study.
The probability value, $p>0.05$ was considered as statistically insignificant but the probability value from $p<0.08$ to $p<0.06$ was considered as suggestively or poorly significant.
However, the probability value from $p<0.05$ to $p<0.02$ was considered as statistically significant while from $p<0.01$ to $p<0.001$ was considered as statistically highly/strongly significant.

DISCUSSION
The aim of the study is to compare the effectiveness of open-chain kinematics exercises and close-chain kinematics exercises to enhance proprioception and functional knee flexion range in patient with knee osteoarthritis.
8 month experimental study conducted on 40 patient with knee OA and were randomized divided into 2 groups, the group A was involved in close-chain exercises (kinesthesis and balance exercises) and the group Was involved in open-chain exercises in form of strengthening exercises. Patient with knee OA were to evaluate the pain status on VAS, knee flexion ROM to assist proprioception assessed by using Reproductive test measurement (JPS) test by electronic goniometer measured for 2 assumption of flexion range- 40º and 60º and the knee flexion joint range of motion of patient with knee osteoarthritis and the knee flexion range of motion in patient with knee osteoarthritis between pre and post intervention of exercises in the groups.
In this study both the groups showed improvement in all 3 variables.
The comparison between outcomes of 2 interventions indicated the better efficacy of close-chain kinematic exercises as compared to open-chain exercises in enhancing proprioception and functional knee flexion ranges. Group A and Group B both demonstrated significant improvement in pain on VAS, knee proprioception using reproductive test measurement (JPS) test presumed with 400 & 600 by electronic goniometer and knee flexion range of motion using electronic goniometer. Pain on VAS mean score 1.00 after intervention in group A close –chain exercises compared to Group B, knee flexion joint range of motion mean angle difference after intervention 9.350 in Group A close-chain exercises statistically highly significant ($p<0.001$) , proprioception measurement of joint position sense test reassumed angle with 400 and 600 . At angle 400mean angle difference 6.20 points after post intervention in Group A and B. At angle 600 mean angle difference was 6.35 point in group A and group B , Group A close-chain exercises statistically highly significant ($p<0.001$) .Therefore Group A has more effective result as compared to Group B in improvement pain on VAS , reproductive test measurement for knee proprioception, and functional knee flexion range in knee osteoarthritis patients.
KNEE OA AND KNEE PROPRIOCEPTION : Dynamic knee joint stability is the contribution of perception, joint position sense (JPS) that coordinating the actions of the quadriceps hamstrings, and associated muscles. For the midrange perception of joint angle signals from muscle spindles are very important and joint mechanoreceptor, such as pacinian corpuscles, Ruffini end organs, and Golgi joint and tendon receptors in other knee joint components (tendons, joint capsule, cruciate and collateral ligaments, and meniscal attachments) are important for detection of stretch at extremes of joint range of motion. Impaired proprioception is one the most common sign and symptom of knee OA. Among persons with knee OA joint instability and frontal plane joint laxity is the probable causative factor in both the development of knee OA and the further erosion of articular cartilage. Knee proprioception plays a vital role in protecting against injurious movement. Knee proprioception can be improved by exercises through facilitation of dynamic joint stabilization, thus it can enhance patient

function and proprioception. Proprioceptive exercises including both close-chain exercises and open-chain kinematic exercises improving position sense and motion sense.

LIMITATION AND RECOMMENDATION:

- Large sample size in the different groups may reveal the result to be more statistically variable.
- To make the study statistically simpler, only right or left side knee with OA were taken as reference values.
- Further study can be done on the B/L knee osteoarthritis for future recommendation.
- Future studies can also be done on the other groups, which are prone to develop the knee OA.

CONCLUSION: The study showed that proprioceptive perception is impaired with knee osteoarthritis and that this impaired in individuals with knee osteoarthritis and that this impairment is large enough as it affects their functional performance. Both open- chain and close-chain kinematics exercises improve functional knee flexion range, reduce pain and enhance proprioception but close-chain kinematics exercises more effective treatment to enhance proprioception and improve functional knee flexion range individual with knee osteoarthritis.

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