

Comparative effects of Muscle Energy and Mobilization with Movement Techniques on Knee Pain, Range of Motion and Functional Disability in Patients with Knee Osteoarthritis

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Abstract;

Background: Knee osteoarthritis is a progressive degenerative joint disease characterized with severe pain, stiffness, functional disability and various degree of inflammation.

Objective: To evaluate the comparative effects of muscle energy and mobilization with movement techniques for knee pain, Range of motion and functional disability in patients with knee Osteoarthritis.

Methodology: A randomized clinical trial was conducted at Physiotherapy Department of Bakhtawar Amin College of Rehabilitation Sciences, Multan. Patients of age 40-60 years with active pain for more than 3 months diagnosed with Grade I, II and III of knee osteoarthritis by orthopedic surgeon according to Kellgren and Lawrence Scale and on basis of radiograph were included. Patients with knee osteoarthritis of grade IV, history of fracture dislocation or radiating pain were excluded. Sixty-eight (68) patients were equally divided in two groups Mulligan group and METs group. Pain intensity was measured with NPRS, functional disability was

measured with WOMAC score, and knee flexion and extension were measured with universal goniometer. Patients were treated 3 times a week and for total 04 weeks. Data were collected at base line, middle of treatment and after treatment. 4 Patients from METs group and 6 from Mulligan group discontinued the treatment plan without giving any reason. The data of 28th patients of Mulligan's group and 30th of MET's were analyzed through SPSS version 24.

Results: The data were normally distributed at baseline in both groups. Two groups Mulligan and METs were compared at base line, after 2nd week and 4th week. Pain intensity was 0.19 ($p < 0.01$), WOMAC score was 0.007 ($p < 0.01$) Knee flexion was 0.110 ($P < 0.995$) and Knee extension deficit score was 0.087 ($P < 0.998$). Coefficient alpha for within group subject effect for pain, functional disability and knee flexion and extension deficit is ($P \leq 0.05$).

Conclusion: Both techniques post isometric relaxation technique of METs and mobilization with movement technique of Mulligans significantly reduced pain, functional disability and symptoms

severity and are equally effective in patients with knee osteoarthritis.

Key words: Knee Osteoarthritis, Post Isometric Relaxation, Mobilization with Movement, Muscle Energy Technique,

I. INTRODUCTION

Osteoarthritis (OA) is characterized as a slowly progressive degenerative joint disease symptomized as pain, stiffness, difficulty in performing ADLs and IADLs and limited range of motion (ROM).[1] It most commonly affects weight bearing joints. The disease rate is higher in the knee than other weight bearing joints, ankle and Hip. Almost 27.8% population above age 45 years is presented with severe pain and disability due to knee osteoarthritis.[2]

Severe pain and disability are the reason to seek medical attention, rehabilitation and cause of work absenteeism. If the disease left untreated, pain, stiffness gradually increase and its result will be a loss in functioning and self-independence. The presence of osteoarthritis related knee pain has been also associated with the increase in risks of physical disability in the community.[3] Psychological manifestation such as emotional disturbance, depression and anxiety is also observed with chronicity of OA.[4] Physical trauma contributes as major disability causing factors.[5]

The progression of disease causes damage in articular cartilage and abnormal tissue response in tissues surrounding the knee. Hamstring strain and tightness is non-articular source of knee pain apart from articular source of pain in knee osteoarthritis. Abnormality in non-articular source also limits the normal movements.[6, 7] The osteoarthritis is classified in 4 grades according to Kellgren and Lawrence grading system. [8]

Quadriceps activation contributes in accurate functioning of knee. It triggers the central command, spinal reflexes and hamstring to modulate the amount of activity through reciprocal inhibition. In knee osteoarthritis (KOA) quadriceps strength is impaired by pain and reduces the knee stability.[9]

Mobilization with movement (MWM) restored the normal biomechanics of knee joint by overcoming positional fault and abnormal muscle response.[10] It corrects the neurophysiological response of nerve and muscle, biomechanical shift in joint and pain-free activities. The gliding repositioned the joint for pain free active movement.[11]

Muscle energy technique (MET) is a manual procedure of osteopathy that is used to control, voluntary isometric contractions of a targeted muscle and group of muscle. Post isometric stretching technique produces

significant change in range of motion and muscle extensibility than ballistic or static stretching technique, immediately after treatment and as a long-term effect.[12]

Manual therapy is the first line treatment of choice to encounter the symptoms severity. MWM usually used to address the symptoms of KOA. Post isometric muscle energy technique is used for lengthening, strengthening and stability of muscle. There is need to address the comparative effects of muscle energy and mobilization with movement techniques on knee pain, range of motion and functional disability in patient with knee osteoarthritis. Therefore, the current study is designed to collect ample evidence for this purpose. We hypothesized that, is significant difference in the effects of muscle energy and mobilization with movement techniques on knee osteoarthritis patients' outcomes.

II. METHODOLOGY

This randomized clinical trial was conducted at Physical Therapy department Bakhtawar Amin Memorial Trust Hospital, Multan. The sample of n=68 was recruited through non probability convenient sampling technique. Sample size was calculated by using pain as outcome measure. It was 28 in each group after adding 20% dropout the sample size was

28+6=34. [2] Total n=68 patients meeting the eligibility criteria were randomly divided in 2 equal groups through (n=34 in each group). Randomization was performed through online randomization (<https://www.randomizer.org/>) web service. The Sample formula is discussed in Figure: 1 .

The Sample eligibility criteria were following; **Inclusion Criteria:** Both male and female, Age 40-60 years with active knee pain from more than three month and evidence of grade I, II and III OA confirmed by radiograph (Kellgren and Lawrence Scale).[1],[11], Patient diagnosed and referred with knee osteoarthritis (OA) by orthopedic surgeon. **Exclusion Criteria:** Patient using walking aid for more than 3 months, Pain radiating from back (Lumbar Radiculopathy, Sciatica, herniated lumbar disc, spondylolisthesis, and lumbar foramen stenosis), Patient with active history of knee joint dislocation, fracture, tumor, sports injury, spinal surgery and osteomyelitis, Rheumatoid arthritis, Osteoporosis, Constitutional symptoms (fever, malaise, weight loss and high blood pressure)

Outcome Measures

Pain: Pain intensity was measured by Numeric Pain rating scale. It was 11 items rating scale, 0 for no pain, 1-3 for mild

pain, 4-6 for moderate pain, 7-9 for severe pain and 10 for worst pain.[13] The NPRS scale is presented in Figure:2. **Range of Motion (ROM):** Knee flexion and extension were measured by universal goniometer (UG) by organizing proximal and distal segments of UG according to anatomical landmarks of joint. It had high intra and inter examiner reliability $r= 0.24$ to 0.96 .[14]

Knee Flexion: Patients were lying supine with both legs flat on the table. The fulcrum of goniometer was aligned along the lateral epicondyle of femur. The stationary arm was aligned along line between greater trochanter and midline of femur, the moving arm was aligned along line between lateral malleolus and midline of fibula. Normal knee flexion is 135° .

Knee Extension: Patients were lying prone with both legs flat on table. The fulcrum of goniometer was aligned with the lateral epicondyle of femur. The stationary arm was aligned along line between greater trochanter and midline of femur, the moving arm was aligned along line between lateral malleolus and midline of fibula. Normal knee extension is $0-10^\circ$. The universal goniometer is labeled in Figure: 3.

Functional Disability: Western Ontario and McMaster Universities Arthritis Index (WOMAC) were used to measure the

outcome of hip and knee osteoarthritis. These 24 items had been divided in 3 subscales, 5 for pain, 2 for stiffness and 17 for physical functional status. [15]

Data Collection Procedure: Eighty patients diagnosed with knee osteoarthritis were assessed for eligibility. Twelve patients were not meeting the eligibility criteria and excluded. Six patients were come with grade IV osteoarthritis, 04 patients refused to participate and 2 were reported history of spinal surgeries. After taking written informed consent 68 patients of knee osteoarthritis diagnosed by orthopedic surgeon on the basis of radiograph and symptoms severity were enrolled in this study. Patients were randomly allocated according to computer generated random number table in 2 equal groups. Group A received routine physical therapy with Post Isometric Relaxation technique of muscle energy technique (PIR-METs). Group B received routine physical therapy with Mulligan Mobilization with Movements (MWM). All patients were treated 3 times a week on alternate days for total 04 weeks. Data were collected at base line, after 2nd week and after 4th week. 04 Patients of group A and 06 of group B discontinued treatment without giving any reason.

Interventions

Mobilization with Movement

(MWM) Group

- Sustained manual glide with active knee flexion and extension were applied anterior, posterior, lateral, medial or rotation in supine lying.
- All patients of Group B were tested in above mention directions with sustained manual glide and active knee ROM to detect best suitable position for glide in which pain reduces and ROM improve.
- If the range of motion was found pain free then over pressure was applied at the available end range.
- The MWM treatment technique was repeated 10 times for three sets.²
- Moreover, if the supine lying position is pain free, then the glide direction for applying MWM were assessed in weight bearing position.
- If the glide direction was more beneficial in one direction, then all these glides will be repeated in the same position to identify the most effective gliding for the MWM technique.[16]
- Patients received hot pack/cold pack prior to treatment.

Muscle Energy Technique

(METs) Group

- Post isometric Relaxation technique was used for four muscles groups included Hamstring, Quadriceps, gastrocnemius and soleus in their lengthened position by stretching them till the point of first slight resistance.
- Then the patient was instructed to resist this movement for 10 seconds isometrically by minimal force 20 % and then was asked to relax.
- When the patient got fully relaxed a gentle release of muscle was obtained and muscle got lengthened by its spontaneous relaxation phenomena and a new end position were obtained then for 30 second stretching.
- The technique was repeated for 4 times for each muscle.[17]
- Patients received hot pack/cold pack prior to treatment.

Data Analysis Procedure

The data were analyzed by using SPSS Version 24. The normality of data were analyzed by Shapiro wilk test. The data were normally distributed. The numerical descriptive variables were presented in the form of mean \pm SD. Categorical Data were presented in the form of frequency (Percentage). Repeated measurement

ANOVA was used to compare the outcome of different follow ups. P- Value of less than and equal to 0.05 was considered significant.

Results

Total 80 patients were screened for eligibility. Sixty-eight (68) meeting the

eligibility criteria were equally divided in two groups MWM and METs Groups. Both groups were treated parallely for routine physical therapy.

Table 1; Demographic Variables

Demographic variable	Description	Mulligan Group n (28)	METs Group n(30)
Age (Mean \pm SD)	In Years	54.5 \pm 7.9	57.2 \pm 3.55
Gender	Male	12(42.86%)	11(36.67%)
	Female	16(57.14%)	19(63.33%)
BMI	Kg/m ²	27.25 \pm 5.16	24.51 \pm 4.41
Duration of symptoms (Month)	Month	46.39 \pm 68.26	43.89 \pm 52.98
Stages of knee OA	Grade 2	17(60.71%)	16(53.33%)
	Grade 3	11(39.29%)	14(46.67%)
Side involved	Right	9(32.14%)	11(36.67%)
	Left	8(28.57%)	7(23.33%)
	Bilateral	11(39.29%)	12(40%)
Occupation (If retired at time of retirement)	Housewives	10(35.72%)	14(46.67%)
	Office work	12(42.86%)	11(36.67%)
	Labor / Field work	6(21.43%)	6(20%)

Table 1: n= number of patients, %= Percentage, BMI= Body Mass Index, SD= Standard deviation, Kg= kilogra

Table 2; Comparison of outcome measures

Outcome Measures	Follow up	Mulligan n (28)	METs n (30)	Covariance ($P \leq 0.05$)	
		Mean \pm SD	Mean \pm SD	F	P
Pain	Base Line	5.50 \pm 1.43	5.43 \pm 1.46	0.19	1.00
	Middle	3.40 \pm 0.96	3.40 \pm 0.93		
	After treatment	2.21 \pm 0.82	2.11 \pm 0.83		
Disability	Base Line	46.79 \pm 18.01	44.03 \pm 18.15	0.007	1.00
	Middle	32.04 \pm 14.66	30.43 \pm 14.84		
	After Treatment	18.89 \pm 8.76	18.17 \pm 8.64		
Knee Flexion	Base Line	108.21 \pm 15.11	110.23 \pm 15.30	.110	0.995
	Middle	118.32 \pm 11.46	119.16 \pm 11.11		
	After Treatment	127.50 \pm 9.18	128.77 \pm 8.68		
Knee Extension	Base Line	23.57 \pm 17.79	22.60 \pm 17.07	.087	0.998
	Middle	12.64 \pm 8.85	12.30 \pm 8.25		
	After Treatment	5.86 \pm 4.61	5.73 \pm 4.10		

Table 2: n= number of patients, F= Affect Size, $P \leq 0.05$, SD= Standard deviation

Table 3; Rate of recovery with in group

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	P≤0.05	Epsilon
				Greenhouse-Geisser
Pain Intensity	.347	58.25	.000	.605
Functional Disability	.497	38.41	.000	.666
Flexion	.421	47.60	.000	.633
Extension	.088	133.71	.000	.523

Table 3: n= number of patients, F= Affect Size, P ≤ 0.05, SD= Standard deviation,

III. DISCUSSION

In this study, pain, functional disability, knee Flexion and knee extension lack were managed by post isometric relaxation (PIR) technique of MET and mobilization with movement (MWM) technique of Brains mulligan. Outcome measures were effectively and managed by both techniques. Symptoms severity was significantly reduced at every follow up in both groups. Patient with grade 2 and 3 knee osteoarthritis (KOA) were in 5th or 6th decade of life. It commonly affects obese person, housewives and bilateral involvement.

In this study NPRS was used to measure the pain intensity. Patient relearned the treatment procedure when treatment techniques were given repeatedly. Every physical therapy intervention was found to be effective and it showed marked effects as these treatments are cost effective and they have marked effects in functional activity of joints, as these mobilization techniques are easily applicable, they can show immediate effects and these effects are depicted as decrease in pain. As pain is relieved patient is able to do many functional activities with greater efficacy and as movement increases

there occurs increase in range of motion of joints.

Both the techniques are considered of prime importance in treating and amelioration of symptoms due to many musculoskeletal disorders. The use of MET in patient with knee OA increases the flexibility of muscles passing through knee joint and as a result movement occurs i-e pain free movement occurs. The patient easily moves his joints and this enhances quality of life.

As MET and MWM shows effects on same parameters and same outcome measures were assessed after treated with both of these techniques it is well mentioned that both of these techniques should be adopted as treatment of pain and improving quality of life in the patients with knee OA. Recent studies support the evidence that these measures should be taken and selected as priority as these are cost effective procedures with maximum beneficial effects and no side effects. In contrast if conservative treatments of choice are adopted i-e knee replacement therapy is selected it will cost too much and have serious side effects. Moreover, the use of steroids is also harmful and should be bypassed. Keeping in view of all the cons of the conservative treatment of treating knee OA MET and MWM must be

opted and should be implicated under the supervision of expert physiotherapist. It should be encouraged on mass level and should tell and guide the sufferings about its wide range of therapeutic effects.

Osteoarthritis is characterized as loss of cartilage and leads the severe pain and functional disability affects 9.6 % of men and 18% of women's over age of 60 years.[18] There are multiple mechanisms through which the obesity increases the risks of knee osteoarthritis (KOA). Although overweight increases the joint loading that results as deleterious effects on knee a major weight-bearing joint, over load with increase age cause wear and tear in weight bearing joints especially knee which causes the proprioceptive loss. [8]

It is evident and support the results of our study suggests that manual therapy is safest treatment approach for management of arthritic pain, physical fitness function. It is complementary and alternative treatment of choice.[19] Manual physiotherapy treatment is beneficial over usual care, with one year long follow ups. Exercise physiotherapy is also beneficial for physical performance over usual care. [20]

Mobilization with movement (MWM) is beneficial for widespread pain physical function, gait stability, gain of knee

flexion, extension and extension strength gain for at least with 2 days treatment. [21] It has immediate effects on pain modulation and restoration of normal biomechanics and suggesting it as a potential component of early management of symptoms in patient with knee OA.[22]

A previous RCT concludes that mobilization with movement (MWM) technique of Mulligan's has wide spread analgesic effects. It is also effective for improvement of knee flexion and increases the strength of knee flexor and extensors.[2] it is effective for management of pain , and increase physical health status of knee osteoarthritis patients.[23]

Muscle energy technique effectively increased the active range of motion (AROM) and passive range of motion (PROM) in knee patient of knee osteoarthritis.[24] in our study we applied the post isometric relaxation muscle energy technique on quadriceps, hamstring, gastrocnemius and soleus. A published research concluded the PIR muscle energy technique applied on gastrocnemius had beneficial effects on pain and activities of daily living in knee osteoarthritis.[25] However the limited literature support the use of muscle energy technique for

osteoarthritis. METs are found beneficial for pain management

However, the effects of conventional therapy can't be ignored. It included the application of thermotherapy, stretching and strengthening exercise interventions. Multiple studies have shown significant impact in routine clinical practice. Application of TENS had short term effects on pain. stretching and strengthening had better outcomes than any of other modalities.[26]

IV. CONCLUSION

Muscle energy technique (MET) and movement with mobilization (MWM) both are effective for pain, range of motion and functional disability in patients with grade II and III knee osteoarthritis. Both techniques have equal effectiveness no one has superior effects over other.

V. LIMITATIONS

One of the limitations of this study was that short- and long-term effects of following modulation on pain, range of motion and functional limitation after a single intervention have not been investigated. All the patients of both groups were encountered by single physiotherapist that generalizes the effects. As these interventions were not stand-alone interventions to manage the severity of symptoms of knee osteoarthritis

other intervention including hot moist pack, TENS and conventional physical therapy were used for management of knee OA. Effects of reciprocal inhibition technique of muscle energy technique on mechanical shift and neuromuscular response are needed to establish.

Ethical Consideration: This study was conducted after taking written ethical approval from institutional review board (IRB) of The University of Lahore, Lahore. (Ref No: IRB-UOL-FAHS/891/2021). Data were collected after taking written informed consent from each participant after assuring the confidentiality of information. All the patients were informed about potential benefits and any possible side effect.

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Figure 1: Sample Size Calculation

Sample Size For Comparing Two Means			
Input Data			
Confidence Interval (2-sided)	95%		
Power	80%		
Ratio of sample size (Group 2/Group 1)	1		
	Group 1	Group 2	Difference*
Mean	6.5	5.7	0.8
Standard deviation	1.2	0.9	
Variance	1.44	0.81	
Sample size of Group 1		28	
Sample size of Group 2		28	
Total sample size		56	

Figure 2: Numeric Pain Rating Scale

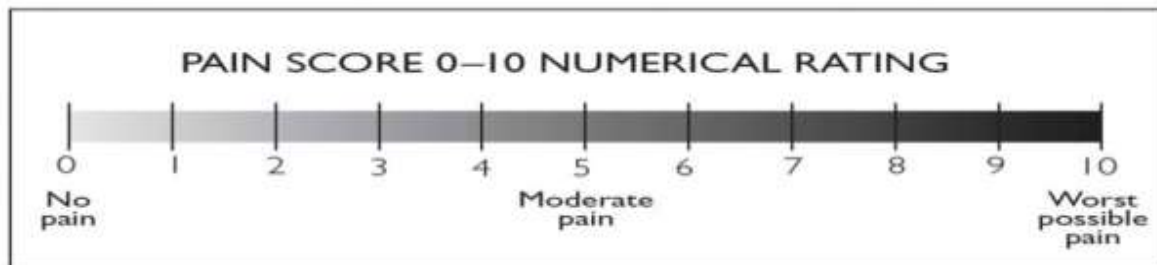


Figure 3: Universal Goniometer



Figure 4; Flow diagram

Consort diagram

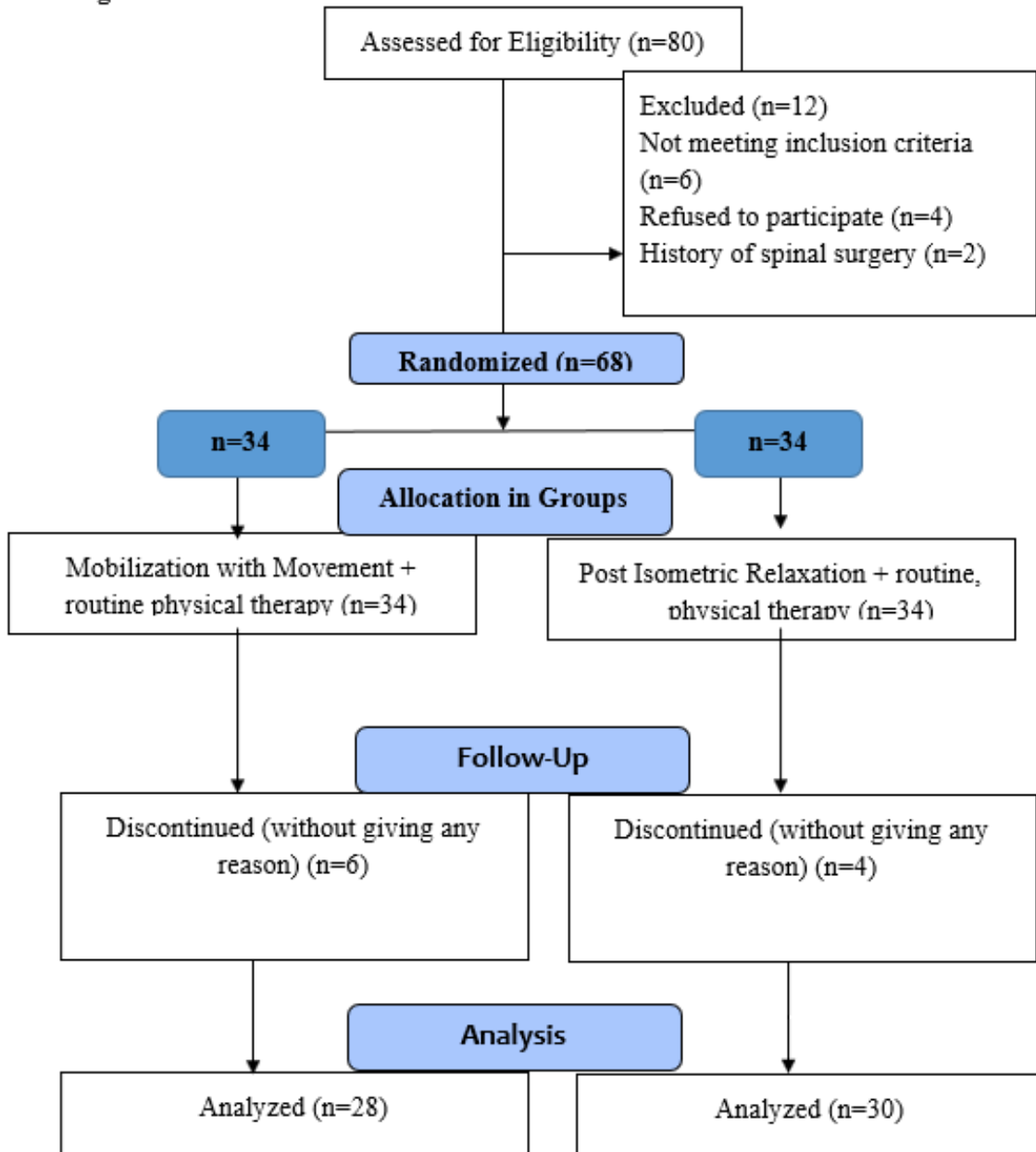
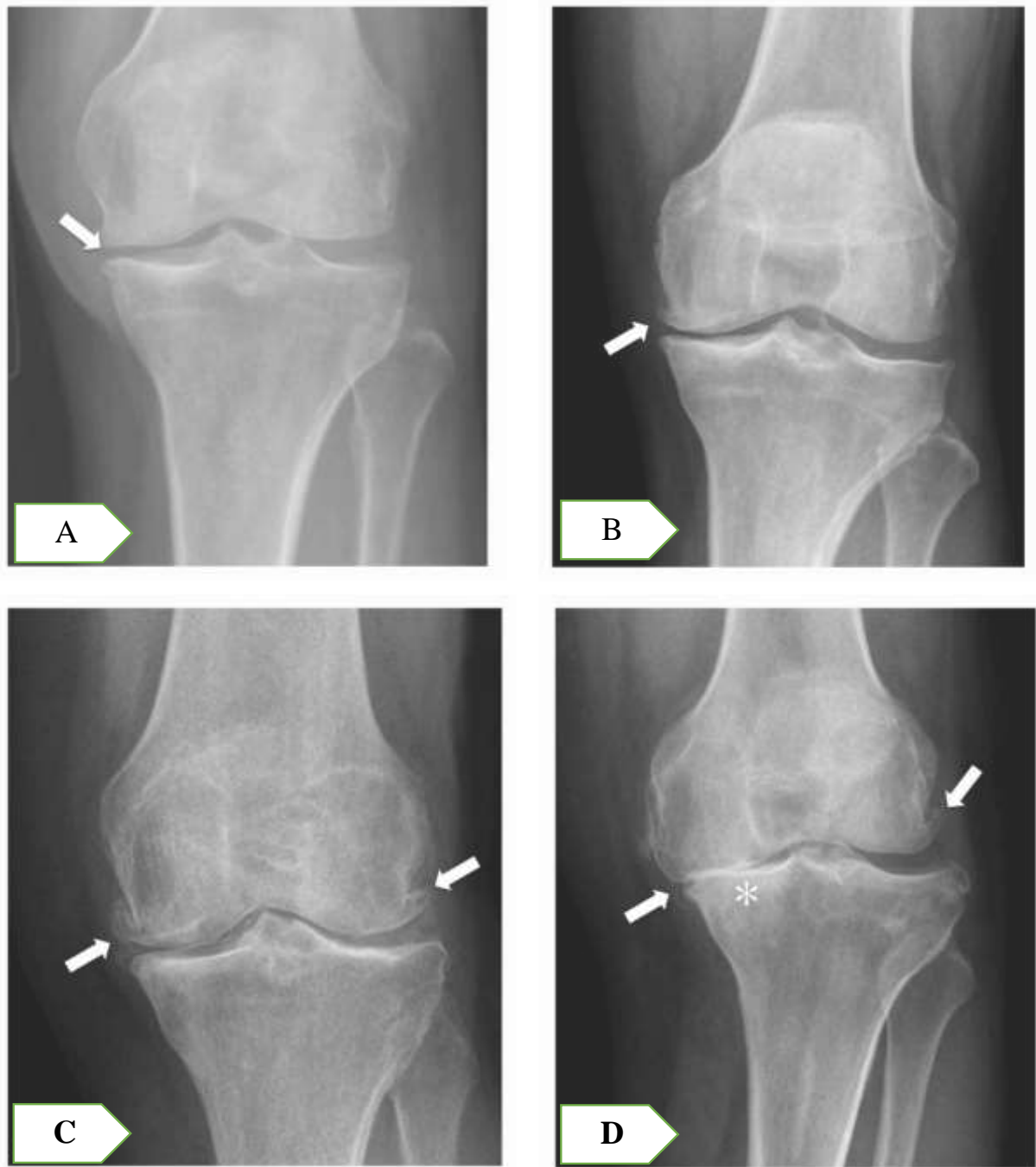


Figure 5: Radiograph for Knee OA Diagnosis



Left knee anterior-posterior (AP) radiograph; A grade 1, B grade 2, C grade 3, D grade 4 according to Kellgren and Lawrence knee osteoarthritis grading.