RESEARCH ARTICLE

EFFECT OF KNEE JOINT MOBILIZATION ON HAMSTRING MUSCLE LENGTH IN PATIENT WITH KNEE OSTEOARTHRITIS

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ABSTRACT

Background: Knee osteoarthritis is a common disease of old age which causes difficulty in activities of daily living. The hamstring muscle tightness is often associated with grade 1 and 2 knee osteoarthritis. The treatment of knee osteoarthritis includes stretches, strengthening and mobilization of joints, these may also improve the hamstring muscle length. **Objectives**: To determine effects of knee Joint Mobilization on hamstring muscle length in Patient with Knee Osteoarthritis. **Methodology**: A randomized clinical trial study was conducted at Benazir Bhutto Hospital Rawalpindi from September 2020 to December 2020. A total of n=44 participants were included male and female of age between 40-65 years after screening for pain more than 3 on Numeric Pain Rating Scale (NPRS) for more than 3 months, 20% hamstring length shortening in degree, grade I &II osteoarthritis according to Kellgren and Lawrence Classification system also satisfying American College of Rheumatology for clinical classification of Knee OA. The Hamstring screening was done using Active knee extension test (AKET), 90-90 test and sit and reach test. They were randomly allocated in group A received post isometric relaxation (PIR) and group B Kaltenborn mobilization and traction (KM+KT) group. Each participant received three sessions per week for 4 weeks. The data was collected at baseline, post 1st session and after 12th session by using Numeric pain rating scale (NPRS) for pain, Active knee extension test (AKET) for hamstring flexibility and WOMAC scale for functional disability. Data analysis was done through SPSS-21. **Result**: The mean age of the study participants was 48.15±9.70 years. Both groups have shown statistically and clinically ($p<0.001$) improvement regarding pain, muscle length and functional disability after treatment duration till 12th session. When comparing the groups KM+KT group showed more significant improvement with large effect size ($p<0.05$) regarding pain, hamstring muscle length and functional disability as compared to PIR group at the end of 12th session. **Conclusion**: Kaltenborn mobilization and traction group has shown significant improvement in pain, muscle length and functional status as compared to the PIR group.

Keywords: Active knee extension test, Hamstring flexibility, Kaltenborn mobilization, Muscle length, Osteoarthritis.

INTRODUCTION

Knee osteoarthritis (OA) is multifactorial degenerative and disabling disease that cause biomechanical changes in knee joint[1,2] Globally, knee (OA) has ranked as 11th highest contributor in disability[3] and estimated 5.4 million people were affected with Knee (OA) in 2020 and this rise is expected up to 6.4 million till 2035[4].

The tibiofemoral joint bears 60-80 % of total intrinsic knee loading during movement[5]. The pattern and magnitude of joint movement is based upon the flexibility and strength of muscle that are attached to the joint [2]. The physical inactivity and aging promote the risk of joint injury to the knee joint. It has been observed hamstring muscle shortening is a major risk of [6]Knee joint stiffness[7,8] due to increase in Patellofemoral compression forces, muscle dysfunction and cartilage deterioration[9,10]. Furthermore, it compromise the functional performance with increase in pain of knee (OA) patient[11,12].

Multiple therapeutic soft tissue techniques are in practice to deal with hamstring flexibility issues[13,14,15]. For joint arthritis, Joint mobilization techniques are widely accepted to decrease pain, joint stiffness and muscle inhibition[16,17]. The joint traction and mobilization at end range activates the mechanoreceptors by 1b afferent fibers sending signals to spinal cord which in return exhibit inverse myotatic reflex causing increase in muscle extensibility The Kaltenborn Unilateral Posterior Anterior Glide (UPA) is found to be effective in increasing Lumber spine ROM and hamstring muscle flexibility by activation of Golgi tendon organs (GTOs)[18] .

According to above mentioned research Kaltenborn joint mobilization indirectly increases the hamstring muscle flexibility when applied on lumber spine. So, it was important to assess the effect of knee joint

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mobilization with direct effect on hamstring flexibility. Up to our literature search no study found the direct effect of Kaltenborn joint mobilization on hamstring muscle flexibility [26] with clinical feasibility in knee (OA) patient. So the objective of the current study was to determine the effects of knee Joint Mobilization on hamstring muscle length, pain and functional disability in Patient with Knee Osteoarthritis.

METHODOLOGY

A randomized clinical trial (NCT04574700) study was conducted at Benazir Bhutto Hospital Rawalpindi (No.PD/BBH/2020/334), after getting ethical approval from ethical research committee of Riphah College of Rehabilitation & Allied Health Sciences i.e. (REC#00771) from January 2020 to December 2020. The patients were selected through nonprobability purposive sampling technique. The sample size was calculated using Open-Epi calculator with 95% confidence interval power 80% using mean and standard deviation of the Hamstring muscle length as primary outcome measure on the basis of literature and the calculated sample size was n=44[19].

Both male and female patients of age between 40-65 years were included after screening for unilateral knee pain more than 3 on Numeric Pain Rating Scale for more than 3 months, 20% hamstring length shortening in degree, grade I &II osteoarthritis according to Kellgren and Lawrence Classification system[20] also satisfying American College of Rheumatology for clinical classification of Knee OA[21]. The Hamstring screening was done using Active knee extension test, 90-90 test and sit and reach test. Participants those having any systemic comorbidities, spinal surgery, long term medications like steroids, hamstring contracture, recent trauma were excluded from the study.

The Patients who met the inclusion criteria and gave consent for participation were randomly allocated to Group A (Post Isometric Relaxation) and Group B (Kaltenborn traction and mobilization). The randomization was done using sealed envelope method.

Both the groups received Transcutaneous Electrical Nerve Stimulation (TENS) with pulse duration of (0.9ms) and frequency of 150 Hz around knee in sitting position for 20 minutes along with strengthening open chain exercises for quadricep muscle (quadricep setting, cycling in air, straight leg raising, straight leg raising with weight, full arc extension) 10 Repetitions of each exercise was done in each session except full arc and air cycling. 2 minutes continuous cycling was done for one bout while three bouts of 10 repetition of full arc were performed [22, 23].

After the above-mentioned protocol, Group A received post isometric relaxation (PIR) technique on hamstring muscle. The duration of each hold in PIR was 8-10 second, three repetition of PIR were performed in single session and intervention was given for three session per week for four weeks[24] . While Group B received 10 repetitions of Kaltenborn grade III mobilization with traction three sets in each session. Each participant received three session per week for four weeks[25,26].

The demographics data and history included name, age, involved side, pain onset, tenderness and bony changes. The outcome measures were the Numeric Pain Rating Scale (NPRS) for pain intensity. Reliability validity of this scale is (Cronbach's α=0.95-0.96). Active Knee Extension Test (AKET) was used to assess the flexibility of hamstring muscle. The patients were asked to lay down in supine position while flexing hip at 90-degree patient was asked to hold other leg down with couch and leg to be tested with both hands. The Goniometer was placed at knee and patient actively extended knee holding hip flexion at 90 degrees. Cut off value for this test was 160 degrees. The universal goniometer was used to measure ROM of a knee joint as well as hamstring muscle length. The Goniometer was placed on the lateral side of knee stationary axis was directed towards greater trochanter while moving arm was directed towards lateral malleolus. The Patient was asked to fully extend knee and knee extension angle was measured. The reliability of universal goniometer is (Cronbach's α=0.94-0.99) [27].

The 24 items Western Ontario and McMaster Universities Arthritis Index (WOMAC) was used in the evaluation of Hip and Knee Osteoarthritis. It is a self-administered questionnaire consisting of 24 items divided into 3 subscales including Pain (5 items), Stiffness (2 items) and Physical Function (17 items). The test questions are scored on a scale of 0-4, which correspond to: None (0), Mild (1), Moderate (2), Severe (3), and Extreme (4). The scores for each subscale are summed up, with a possible score range of 0-20 for Pain, 0-8 for Stiffness, and 0-68 for Physical Function[28].

The outcome measures were recorded at baseline, immediately after 1st session and at end of 4th week. Data was analyzed using SPSS 21. The assumption of parametric test were not met for NPRS and AROM, so the non-parametric Mann Whitney U test was applied for between group comparison and Freidman Test with Wilcoxon sign rank test for within group pairwise changes from baseline to each level of assessment. The total score of WOMAC scale fulfills the assumption of parametric test so for comparison Independent t test and within group changes RM-ANOVA with pairwise Bonferroni correction was used. The effect size used from Mann Whitney U test and Wilcoxon sign rank test was the correlation (r) while the effect size for Independent t test., paired sample t test and RM-ANOVA was Cohen's d and partial eta square respectively.

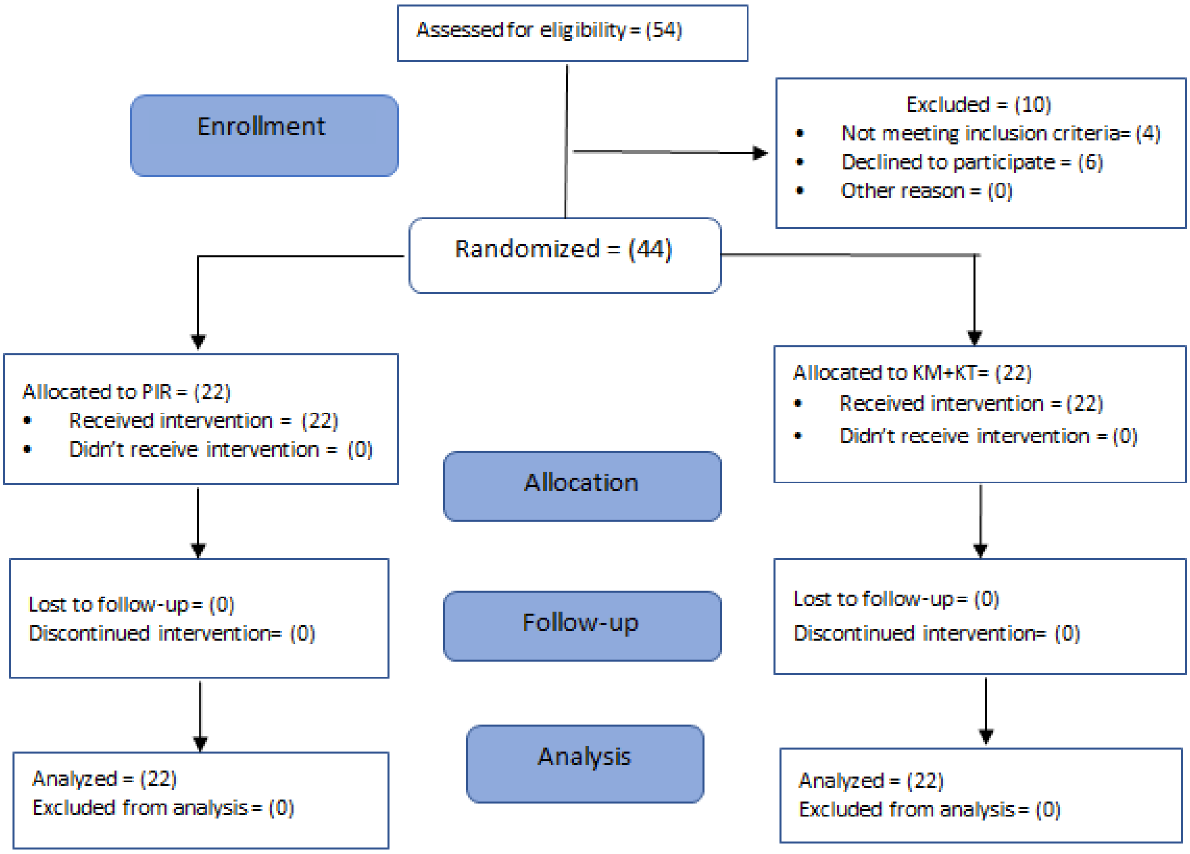


Figure 1: CONSORT flow diagram

RESULTS

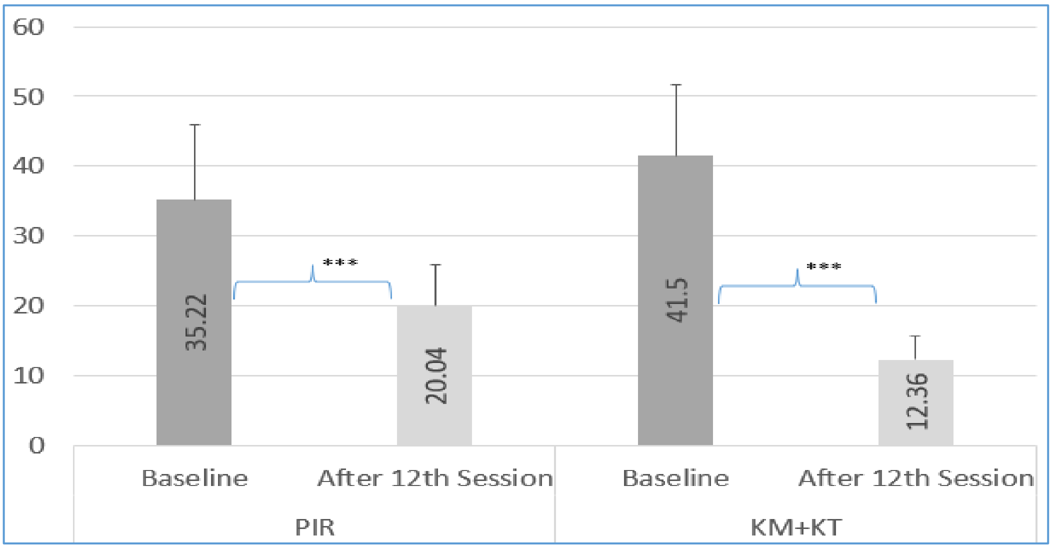
The mean age of the study participants was 48.15±9.70 years. Most of the patients n= 30 were referred, n=14 direct access to physical therapy department. A total of n=18 were male and remaining n=26 were female participated in the study. The involvement of the Right knee was found in n=28 participants and left in n=16 respectively.

The Friedman test with Wilcoxon sign rank test showed that the pain on NPRS and active knee extension ROM was significantly improved (p<0.001) with large effect size from baseline to after 1st session and at the end of intervention after 12th session in post isometric relaxation (PIR) group and Kelton born mobilization plus traction (KM+KT). Table 1.

Table 1: with-in group changes (NPRS & AKET)

Group		PIR						KM+KT					
		Median	IQR	MR	Z/X²(df)	p-value	r/W	Median	IQR	MR	Z/X²(df)	p-value	r/W
NPRS	Baseline	6	2	3	-4.52	0.00***	0.96	7	2	3	-4.35	0.00***	0.92
	After 1st Session	5	2	2	-4.27	0.00***	0.91	5	2	2	-4.14	0.00***	0.88
	After 12th Session	3	2	1	44(2)	0.00***	1	1	1	1	44(2)	0.00***	1
AKET	Baseline	135	10	1	-4.12	0.00***	0.87	135	10	1.02	-4.04	0.00***	0.86
	After 1st Session	141	8.25	2	-4.11	0.00***	0.87	145	6.75	1.98	-4.11	0.00***	0.87
	After 12th Session	160	5.5	3	44(2)	0.00***	1	171.5	3	3.00	43.51(2)	0.00***	0.98

[a]Baseline to. After 1st session, [b]After 1st session to after 12th session & [c]baseline to after 12th session
Significance Level: p<0.05, p<0.01**, p<0.001***.*
Correlation coefficient (r) for Wilcoxon Sign Rank test's effect size
Kendall's Coefficient of Concordance (*W*) *for Friedman Test's effect size*



Significance Level: p<0.05, p<0.01**, p<0.001***.*

Figure 2: WOMAC total score (with-in group changes)

The paired t-test showed that WOMAC total score was also significantly reduced with large effect size in PIR groups (p<0.001, Cohens'd=6.89) and KM+KT group (p<0.001, Cohens'd=9.41) after 12th session.

When comparing the groups, Mann Whitney U-test showed that both variables NPRS, AKE and WOMAC total score were not significantly (p≥0.05) different at the baseline between the PIR and KM+KT group. There is no significant difference between the group regarding pain (p=0.706) immediately after the 1st session but after 12th session KM+KT (MR=12.59) showed significant improvement as compared to PIR group (MR=32.41), (p<0.001, r=0.80) with large effect size. The results also showed that active knee extension was significantly improved after 1st session (MR=16.57 ver MR=28.43, p=0.002, r=0.46) with medium effect size as well as after 12th session with large effect size (MR=33.50 ver MR=11.50, p<0.001, r=0.86) in KM+KT group as compare to PIR group.(table 2)

The result of independent t-test showed that WOMAC total score was significantly reduced after 12th session (12.36±3.33 Ver 20.04±5.87, p<0.001, Cohens'd=4.77) with large effect size in KM+KT group as compared to PIR group. (Figure 3).

Table 2: Comparison between PIR and KM+KT

		PIR			KM+KT			U-test	p-value	r
		Median	IQR	MR	Median	IQR	MR			
NPRS	Baseline	6	2	18.98	7	2	26.02	164.5	0.06	0.28
	After 1st Session	5	2	23.20	5	2	21.80	226.5	0.706	0.05
	After 12th Session	3	2	32.41	1	1	12.59	24	0.00***	0.80
AKET	Baseline	135	10	21.25	135	10	23.75	214.5	0.506	0.09
	After 1st Session	141	8.25	16.57	145	6.75	28.43	111.5	0.002**	0.46
	After 12th Session	160	5.5	11.50	171.5	3	33.50	000	0.00***	0.86

Significance Level: p<0.05, p<0.01**, p<0.001***.*

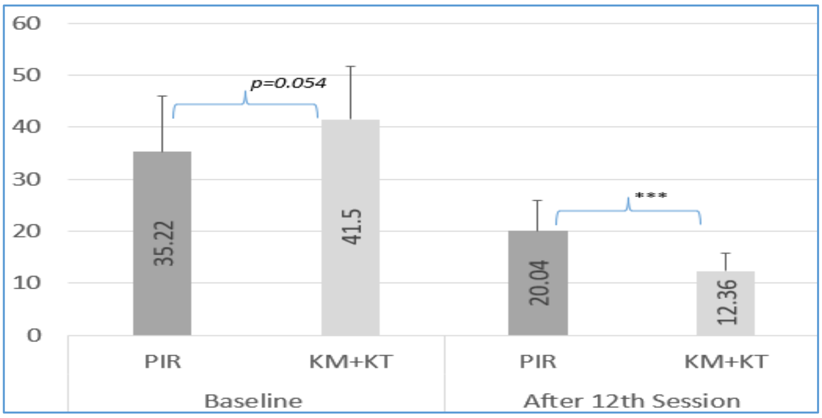


Figure 3: Comparison between PIR and KM+KT (WOMAC total score)

DISCUSSION

The aim of the study was to determine the effects of Kaltenborn knee joint mobilization and traction (KM+KT) on hamstring length compared to post isometric relaxation (PIR). The present study indicates both techniques are effective in improving the hamstring muscle length, pain, and functional disability but KM+KT had more significant results.

According to the results of the study KM and KT technique had significant increase in reducing pain and increasing flexibility of hamstring muscle. Previous evidence indicates Joint mobilization is one of the techniques that is used in manual therapy that may be used to mechanically elongate connective tissues and to fire muscle and joint receptors. The significance of using joint mobilization is to modulate pain and increase range of motion (ROM)[29 30.] This is done by the stimulation of mechanoreceptor activation for modification of nociceptor-generated pain impulse transmission[30]. This stimulation therefore inhibits the nociceptive input to the central nervous system[30]

Under some circumstances, the application of Joint Mobilization may contribute to a reflexive increase in muscle tone by facilitating the activation of motor units.[31] Under other circumstances, Joint Mobilizations may promote muscle relaxation, thereby increasing joint ROM[30]

The results of the present study indicate significant increase in active knee extension at the end of 12th week in the KM+KT group.

The results of present study are supported by a study in 2019, which showed significant improvement in decrease in WOMAC score with mechanical traction group at 20 sessions of intervention[32]. The results of current study indicate significant improvement of physical function by reduction in WOMAC score in the KM+KT group.

The limitations of the study were SOPs for Covid-19 were followed during session which caused difficulty in treatment. Weight, BMI, muscle strength was not recorded in this study to rule out confounding variables which can affect study results.

CONCLUSION

The study concludes that Kaltenborn mobilization and traction group was more effective in terms of decreasing pain, increasing hamstring muscle flexibility and functional status of knee in patients with knee OA as compared to the PIR group.

Future studies should include equal number of male and female participants to assess the effects on different variables. Treatment should be given to all participants at same time and in same environment. Follow up should be done. Strength of quadriceps must be evaluated to determine effect of strengthening exercises on AKET.

REFERENCES

1. Hayami T. Osteoarthritis of the knee joint as a cause of musculoskeletal ambulation disability symptom complex (MADS). Clin Calcium. 2008;18(11):1574-80
2. Ghazwan A, Wilson C, Holt CA, Whatling GM. Knee osteoarthritis alters peri-articular knee muscle strategies during gait. PLoS One. 2022;17(1):e0262798. doi: 10.1371/journal.pone.0262798.
3. Murray CJ, Abraham J, Ali MK, Alvarado M, Atkinson C, Baddour LM, et al. The state of us health, 1990-2010: Burden of diseases, injuries, and risk factors. Jama. 2013;310(6):591-606.doi: 10.1001/jama.2013.13805
4. Cui A, Li H, Wang D, Zhong J, Chen Y, Lu H. Global, regional prevalence, incidence and risk factors of knee osteoarthritis in population-based studies. EClinicalMedicine. 2020;29-30:100587. doi: 10.1016/j.eclinm.2020.100587.
5. Sasaki K, Neptune RR. Individual muscle contributions to the axial knee joint contact force during normal walking. J

Biomech. 2010 Oct 19;43(14):2780-4. doi: 10.1016/j.jbiomech.2010.06.011

6. Fatima G, Qamar MM, Hassan JU, Basharat A. Extended sitting can cause hamstring tightness. Saudi J. Sports Med. 2017;17(2):110-114. doi: 10.4103/sjsm.sjsm_5_17
7. Izraelski J. Assessment and Treatment of Muscle Imbalance: The Janda Approach. J Can Chiropr Assoc. 2012;56(2):158
8. Oatis CA, Wolff EF, Lockard MA, Michener LA, Robbins SJ. Correlations among measures of knee stiffness, gait performance and complaints in individuals with knee osteoarthritis. Clinic biomech. 2013;28(3):306-11.doi:10.1016/j.clinbiomech.2013.01.010
9. Bennell KL, Hunt MA, Wrigley TV, Lim BW, Hinman RS. Role of muscle in the genesis and management of knee osteoarthritis. Rheum Dis Clin North Am. 2008;34(3):731-54. doi: 10.1016/j.rdc.2008.05.005
10. Luc-Harkey BA, Safran-Norton CE, Mandl LA, Katz JN, Losina E. Associations among knee muscle strength, structural damage, and pain and mobility in individuals with osteoarthritis and symptomatic meniscal tear. BMC Musculoskelet Disord. 2018 27;19(1):258. doi: 10.1186/s12891-018-2182-8
11. Jyoti S, Yadav V. Knee joint muscle flexibility in knee osteoarthritis patients and healthy individuals. Int J Health Sci Res. 2019;9(6):156-63
12. Mahant MS, Shukla YU. Correlation between hamstring tightness and time duration of disease in knee osteoarthritis: An observational cross-sectional study.doi: 10.46858/VIMSJPT.3206
13. Gunn LJ, Stewart JC, Morgan B, Metts ST, Magnuson JM, Iglowski NJ, Fritz SL, Arnot C. Instrument-assisted soft tissue mobilization and proprioceptive neuromuscular facilitation techniques improve hamstring flexibility better than static stretching alone: a randomized clinical trial. J Man Manip Ther. 2019;27(1):15-23. doi: 10.1080/10669817.2018.1475693
14. Cayco CS, Labro AV, Gorgon EJR. Hold-relax and contract-relax stretching for hamstrings flexibility: A systematic review with meta-analysis. Phys Ther Sport. 2019;35:42-55. doi: 10.1016/j.ptsp.2018.11.001
15. Farazdaghi M, Kordi Yoosefinejad A, Abdollahian N, Rahimi M, Motealleh A. Dry needling trigger points around knee and hip joints improves function in patients with mild to moderate knee osteoarthritis. J Bodyw Mov Ther. 2021;27:597-604. doi: 10.1016/j.jbmt.2021.04.011
16. Pfluegler G, Kasper J, Luedtke K. The immediate effects of passive joint mobilisation on local muscle function. A systematic review of the literature. Musculoskelet Sci Pract. 2020;45:102106. doi: 10.1016/j.msksp.2019.102106
17. Koc TA, Durante M, Bunales IA, Wint M, Marshall T. The immediate effects of knee flexion range of motion following manual therapy or self-stretching/active range of motion following a total knee arthroplasty: a case report. J Phys Ther Sci. 2019 Dec;31(12):1002-1005. doi: 10.1589/jpts.31.1002
18. Chesterton P, Evans W, Livadas N, McLaren SJ. Time-course changes associated with PA lumbar mobilizations on lumbar and hamstring range of motion: a randomized controlled crossover trial. J Man Manip Ther. 2019;27(2):73-82. doi: 10.1080/10669817.2018.1542558
19. Verma S. Comparing open kinetic chain with closed kinetic chain exercise on quadriceps strength and functional status of women with osteoarthritic knees. Sports Med Journal/Medicina Sportivâ. 2012;8(4)1989-96.
20. Kellgren JH, Lawrence JS. Radiological assessment of osteo-arthrosis. Ann Rheum Dis. 1957;16(4):494-502. doi: 10.1136/ard.16.4.494
21. Martel-Pelletier J, Maheu E, Pelletier JP, Alekseeva L, Mkinsi O, Branco J,et al. A new decision tree for diagnosis of osteoarthritis in primary care: international consensus of experts. Aging Clin Exp Res. 2019;31(1):19-30. doi: 10.1007/s40520-018-1077-8.
22. Hedya, W. M. Combined effect of using static traction in some therapeutic methods to reduce knee arthritis symptoms. International Journal of Sports Science and Arts, 2019; 03(02): 72-87. doi: 10.21608/EIJSSA.2019.87513
23. Cho I, Hwangbo G, Lee D, Lee S. The effects of closed kinetic chain exercises and open kinetic chain exercises using elastic bands on electromyographic activity in degenerative gonarthritis. J Phys Ther Sci. 2014;26(9):1481-4.doi: 10.1589/jpts.26.1481
24. Osailan A, Jamaan A, Talha K, Alhndi M. Instrument assisted soft tissue mobilization (IASTM) versus stretching: A comparison in effectiveness on hip active range of motion, muscle torque and power in people with hamstring tightness. J Bodyw Mov Ther. 2021;27:200-206. doi: 10.1016/j.jbmt.2021.03.001.
25. Maher S, Creighton D, Kondratek M, Krauss J, Qu X. The effect of tibio-femoral traction mobilization on passive knee flexion motion impairment and pain: a case series. J Man Manip Ther. 2010;18(1):29-36. doi: 10.1179/106698110X12595770849560
26. Hammad SM, Arsh A, Iqbal M, Khan W; Bilal, Shah A. Comparing the effectiveness of kaltenborn mobilization with thermotherapy versus kaltenborn mobilization alone in patients with frozen shoulder [adhesive capsulitis]: A randomized control trial. J Pak Med Assoc. 2019;69(10):1421-1424.
27. Shamsi M, Mirzaei M, Khabiri SS. Universal goniometer and electro-goniometer intra-examiner reliability in measuring the knee range of motion during active knee extension test in patients with chronic low back pain with short hamstring muscle. BMC Sports Sci Med Rehabil. 2019;11:4. doi: 10.1186/s13102-019-0116-x
28. Basaran S, Guzel R, Seydaoglu G, Guler-Uysal F. Validity, reliability, and comparison of the WOMAC osteoarthritis index and Lequesne algofunctional index in Turkish patients with hip or knee osteoarthritis. Clin Rheumatol. 2010;29(7):749-56. doi: 10.1007/s10067-010-1398-2
29. Xu J, Zhang J, Wang XQ, Wang XL, Wu Y, Chen CC, Zhang HY, Zhang ZW, Fan KY, Zhu Q, Deng ZW. Effect of joint mobilization techniques for primary total knee arthroplasty: Study protocol for a randomized controlled trial. Medicine (Baltimore). 2017;96(49):e8827. doi: 10.1097/MD.0000000000008827
30. Kahanov L, Kato M. Therapeutic effect of joint mobilization: Joint mechanoreceptors and nociceptors. International Journal of Athletic Therapy and Training. 2007;12(4):28-31.doi:10.1123/ATT.12.4.28
31. Wyke B. Articular neurology and manipulative therapy. Aspects of manipulative therapy. 1985:72-80
32. Lee DK. The effect of knee joint traction therapy on pain, physical function, and depression in patients with degenerative arthritis. The Journal of Korean Physical Therapy.2019;31(5):317-21. doi.org/10.18857/jkpt.2019.31.5.317

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