ORIGINAL ARTICLE

Effect of hip joint mobilisations and strength training on pain, physical function and dynamic balance in patients with Knee Osteoarthritis: A randomized controlled trial

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Abstract

Objective: To determine the effects of hip joint mobilisations and strengthening exercises on pain, physical function and dynamic balance in patients with knee osteoarthritis.

Method: The single-blind three-arm parallel randomised controlled trial was conducted at Sindh Institute of Physical Medicine and Rehabilitation, the outpatient department of Dow University of Health Sciences' Ojha Campus, Rabia Moon Memorial Welfare Trust and the Civil Hospital, Karachi, from January to July 2021. The sample comprised patients aged at least 50 years having knee osteoarthritis grade 1-3. The patients were randomised into 3 equal groups, with group A receiving hip mobilisations along with strengthening exercises of hip and conventional knee exercises, group B receiving strengthening exercises of hip along with conventional knee interventional exercises, and group C receiving conventional knee exercises only. Pain, physical function and dynamic balance were assessed using visual analogue scale, knee injury osteoarthritis outcome score and four-step square test, respectively, at baseline and after 18th session. Data was analysed using SPSS 21.

Results: Of the 74 subjects assessed, 66(89.2%) were included; 22(33.3%) in each of the three groups. The sample had 19(28.8%) male subjects and 47(71.2%) female. The mean age in groups A, B and C were 55.64±3.56 years, 53.64±4.65 years and 54.91±4.30 years, respectively. There was significant difference among groups post-treatment (p<0.001). Significant improvement was also found in inter-group analyses of all outcomes (p<0.001).

Conclusion: Addition of hip joint mobilisations provided better results compared to the other two groups.

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Introduction

Knee osteoarthritis (KOA) is considered to be one of the leading causes of global disability.[1] More than 250 million people are reportedly suffering from KOA worldwide.[2] The Asian population has the highest KOA prevalence.[3] According to a study, 3.6% rural and 3.1-4.6% urban population of Pakistan has been diagnosed with KOA.[4] Also, KOA is more common in females compared to males.[5]

KOA patients also show involvement of hip joint muscles, while quadriceps, hamstrings and gluteus medius muscles become weak in KOA.[6]

Despite the evidence, it most studies focussed on strengthening the quadriceps muscle only instead of hip abductors in the KOA subjects. Besides, studies also discussed the slow progression of KOA in patients with strong ipsilateral abductors of the hip because adequate strength of hip abductors may control weight-shifting and maintain the lateral pelvic stability during the single-leg stance phase of gait.[7-9] A few studies focussed on the strengthening of abductors. Among those, one study showed no significant change or minimal short-term change between experimental and control groups[9] and another one showed significant difference, but with a small effect size.[10] Despite little change with respect to pain scores, the effect of strengthening on decreasing load on the medial joint is still not clear. It points out towards the inclusion of any technique other than strength training to decrease the load on the hip joint.[9]

One of the most common interventions recommended is the mobilisation of joint.[11] Mobilisation helps in restoring the normal arthro-kinematics of a joint. Clinical practice guidelines recommended mobilisations along with exercises to increase mobility and range of motion (ROM), and improve physical activities of daily life (ADLs).[12] Stronger hip adductors have been seen in subjects with KOA when compared with age-matched controls; more

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severe KOA possess even stronger adductors than the less severe parts. It has been proposed that the increased strength may have been due to excessive use of the hip adductors to lower the knee adduction moment.[9] Use of joint mobilisations can be an effective technique to decrease the load and increasing the mobility of the hip and the knee joint.[11]

The current study was planned to examine the effects of hip mobilisations and hip strength training on KOA compared to conventional knee exercises combined and individually.

Patients and Methods

The single-blind three-arm parallel randomised controlled trial (RCT) was conducted at the Sindh Institute of Physical Medicine and Rehabilitation, the outpatient department (OPD) of Dow University of Health Sciences (DUHS) Ojha Campus, the Rabia Moon Memorial Welfare Trust and the Civil Hospital, Karachi, from January to July 2021. After approval from the institutional ethics review board of DUHS, the sample size was calculated using Power Analysis and Sample Size (PASS) version 11 at 95% confidence interval, 80% power, mean visual analogue scale (VAS) scores on the basis of literature.[8,9] The required sample size was 27 subjects per group.

The sample was raised using non-probability purposive sampling technique. Those included were patients aged at least 50 years having unilateral or bilateral KOA, palpable bony enlargement around patella, crepitus sound on knee motion, morning stiffness lasting not more than 30 minutes, grade 1-3 of Kellgren and Lawrence grading system for the classification of OA based on radiological findings.[13] Those excluded were individuals with a history of spinal surgery, arthroplasty of lower extremity, bony deformities and severe joint contractures of lower extremity, lower extremity amputation, any trauma to lower extremity recently, injection of cortisone to the hip/knee within the preceding 30 days, sciatica or lumbosacral radiculopathy, advanced hip OA, and rheumatoid or systemic arthritis.[13]

An independent statistician prepared the computer-generated sheet to randomise the patients into 3 equal groups. Informed consent had been taken. Group A received hip mobilizations (anterior posterior glide, posterior anterior glide, caudal glide, posterior anterior glide with abduction, flexion and lateral rotation in 3 sets; 120 oscillations per minute). Grades were assigned from 1-4 depending on the tolerance level with duration of 30-second rest in between14 along with strengthening exercises of hip (hip abduction in side lying, hip extension in prone position, sideway walk, hip abduction in a stand up position and hip hitching with a frequency of 2-3 sets; 10-15 repetitions in each set) and evidence-based knee exercises (knee strengthening exercises, including knee extension static quads sets, terminal knee extension while standing, sitting leg press, step-ups; stretching exercises including calf, hamstring, and quadriceps stretch; ROM exercises, including flexing knee mid-range to full and flexing knee mid-range to full).[11] All exercises were performed in 10 repetitions, 3 sets with a rest of 5 seconds in between.

Group B received strengthening exercises of hip and evidence-based knee exercises, and group C received evidence-based knee exercises only.[11] Assessor physiatrist was blinded to group allocations. The Knee Injury and Osteoarthritis Outcome Score (KOOS) for physical functions, VAS for pain intensity, four-step square test (FSST) for dynamic balance were assessed and recorded at baseline and after the last session.[14-16]

The treatment schedule was concealed using sequentially numbered opaque, sealed envelopes. The envelopes were stored in a locker and opened in sequence within each stratum to reveal group allocation. The principal investigator performing the intervention received treatment assignment from the first researcher. Different time slot was allotted for each intervention used as a strategy to reduce the interaction between the participants. There were 18 treatment sessions with 5 sessions per week over a period of 3 weeks, and 3 sessions in week 4. Each session lasted 30-40 minutes. Attempts within ethical constraints were made to record outcomes. If symptoms precipitated, the participants were counselled to apply hot or cold pack and were prescribed analgesic medication to control discomfort and pain.

Data was analysed using SPSS 21. Data normality were checked through Shapiro-Wilk test. Mean and standard deviation (SD) were used for quantitative variables, while frequencies and percentages were used to express categorical variables. Repeated measure two-way analysis of variance (ANOVA) was applied for the comparison of mean differences between outcome variables within and among the groups. Pairwise comparison was done to see inter-group mean difference. $P<0.05$ was considered statistically significant.

Results

Of the 74 subjects assessed, 66(89.2%) were included (Figure). The sample had 19(28.8%) male subjects and 47(71.2%) female with an overall mean age of 54.73±4.22 years. Each group had 22(33.3%) patients and the mean age in groups A, B and C were 55.64±3.56 years, 53.64±4.65 years and 54.91±4.30 years, respectively. Demographic and

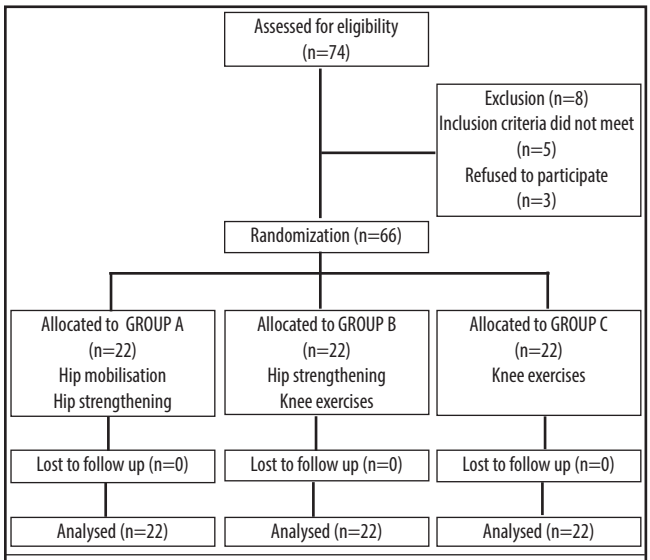

Figure: Consolidated Standards of Reporting Trials (CONSORT) flowchart.

Table-1: Baseline demographics of the 3 groups having 22 subjects each.

Demographics	Group 1	Group 2	Group 3	Total
Mean Age (year)[a]	55.64±3.56	53.64±4.65	54.91±4.30	54.74 ±4.24
Height of participant (metres)[a]	1.60±0.07	1.60±0.06	1.60±0.08	1.60±0.0
Weight of participant (kg)	71.62±11.60	74.52±16.91	71.81±12.41	72.61±13.71
Duration of morning stiffness (sec)[a]	14.71±6.52	14.73±6.03	15.42±5.83	14.92±6.14
Involvement site*				
Unilateral	16(72.70)	13(59.10)	12(54.50)	41(620)
Bilateral	6(27.30)	9(40.90)	10(45.50)	25(37.90)
BMI category				
18.5-24.9 (Normal)*	9(40.97)	7(31.83)	11(50.0%)	27(40.96)
25-29.9 (Overweight)*	6(27.36)	9(40)	7(31.82)	22(33.35)
>30 (Obese)*	7(31.81)	6(27.32)	4(18.22)	17(25.82)
Kellgren and Lawrence Scale Criteria*				
Grade 1	8(36.42)	9(40.90)	7(31.80)	24(36.42)
Grade 2	13(59.10)	10(45.52)	13(59.12)	36(54.52)
Grade 3	1(4.50)	3(13.62)	2(9.12)	6(9.10)
Gender*				
Male	9(40.92)	5(22.73)	5(22.72)	19(28.82)
Female	13(59.11)	17(77.31)	17(77.34)	47(71.23)

[a]= mean ± standard deviation;*= n(%); BMI: Body mass index.

anthropometric data was collected in detail from each subject (Table 1).

There was significant intra-group difference post-treatment (p<0.001), but group A group showed significant inter-group difference (p<0.001) in terms of KOOS domains of pain symptom, ADLs, sports and quality of life (Table 2). Also, group A was significantly different with respect to VAS and FSST outcomes (Table 3).

Discussion

The current study assessed the effect of hip mobilisations and hip strength training in KOA patients using KOOS, VAS and FSST tools. Findings showed superiority of adding hip mobilisations over the other two groups in which only strength training and conventional exercises were given.

The study found KOA to be more prevalent in females, which is in line with literature.[1] Symptomatic OA occurs in 13% of elderly women and in 10% of older men.[17] Among the many risk factors that play an important role, obesity is a major one.[18] The current findings were in contrast regarding the relation of KOA severity and BMI, as patients with increased BMI also showed the same effect as the patients with normal BMI.[19,20] Khan B et al. also associated prolonged standing as a risk factor for KOA, which further confirms the role of altered biomechanics.[18] Yamada et al. reported that hip adductor muscles showed stronger activity with increasing KOA severity, dissipating medial force on the tibiofemoral compartment, increasing varus alignment, letting the patients adopt a compensatory gait, and increasing the risk of fall because of patients' inability to maintain a level pelvis.[19,20] The current three-arm parallel RCT showed significant improvement in the hip mobilization group. This may be because of improvement in the extensibility of the tightened restricted tissues, thus not only taking off the load but also improving extensibility of the capsuloligamentous structures of the joint.[21]

Fatimah I et al. reported that joint mobilisations played a significant role in the reduction of pain in KOA patients which supports the hypothesis of the current study.[22]

Earlier studies using VAS as the outcome measure also reported significantly improved results related to hip mobilisation.[11,23] The VAS scores in the current study were in line with such studies.

Yuenyongviwat et al. conducted an RCT on patients with KOA, and reported improvement in both groups, but no significant difference on the final assessment on outcome measures even though the abductor strengthening group showed earlier improvement.[9] The current study showed significant difference in all the three groups. This could be due to the fact that the current study had more than one setting.

Tanvi A et al. conducted a single-centre study, while the current data was collected from four different tertiary care hospitals.[11]

The current study showed that pain and physical functions

Table-2: Intra- and inter-group analysis of KOOS domains.

Measure / group	Pre[a]	Post[a]	Improvement (%)	Within Group Comparison[b]	B/w Group Comparison[b] A vs B	A vs C
KOOS pain						
A	32.86±12.19 (28.02 , 37.64)	53.59±11.3 (48. 04, 59.07)	63	20.72 (<0.001)	7.81(<0.001)	6.31 (<0.001)
B	35.13±12.04 (30.33 , 39.94)	45.77±15.04 (40.26 ,51.28)	30	10.63 (<0.001)		
C	38. 27±9.36 (33.46, 43.07)	47.27±12.08 (41.76 , 52.78)	23.5	9.00 (<0.001)		
KOOS Symptoms						
A	34.95±15.61 (28.6 , 41.2)	60.22±11.51 (54.2 , 66.2	72	25.27 (<0.001)	12.50 (<0.001)	10.00 (<0.001)
B	35.63±16.37 (29.2 , 41.9)	47.68±16.72 (41.6 , 53.6)	33	12.04 (<0.001)		
C	39.22±12.32 (32.8 , 45.5)	50.22±13.62 (44.2 , 56.2)	28	11.00 (<0.001)		
KOOS ADLs						
A	32.63±9.36 (28.57 , 36.69)	46.22±10.61 (41.31 , 51.14)	41	13.59 (<0.001)	7.12(<0.001)	3.86(<0.001)
B	34.68± 8.35 (30.62, 38.74)	39.04±11.01 (34. 13 , 43.96)	13	4.36 (<0.001)		
C	36.45±10.73 (32.39 , 40.51)	42.36±12.84 (37.44 , 47.27)	16	5.90 (<0.001)		
KOOS Sports						
A	13.86±9.62 (8.74 , 18.98)	31.9±13.50 (25.48 , 38.14)	31	17.95 (<0.001)	2.72(<0.001)	2.23 (<0.001)
B	16.81±14. 18 (22.76 ,35.42)	29.0±18.36 (11.69 , 21.94)	72	12.27 (<0.001)		
C	22.72± 11.82 (23.21 , 35.87)	29.5 ± 11.94 (17.60, 27.85)	30	6.81 (<0.001)		
KOOS Quality of Life						
A	23. 31±8.97 (18.92 , 27.34)	45.72±16.55 (39.98 , 51.46)	97%	22.59 (<0.001)	6.32(<0.001)	8.04 (<0.001
B	24.50±11.53 (20.29 , 28.70)	39.40±12.69 (28.70 , 45.15)	61	14.90 (<0.001)		
C	23.78 ± 8.88 (19.51 , 27.93)	37.68± 10.46 (31.92 , 43.42)	59%	13.95 (<0.001)		

[a]=mean±standard deviation (95% Confidence Interval); [b]= mean difference (*p*-value)

improved with the help of mobilisations and strengthening. These results are in line with earlier findings.[24,25]

In a study conducted on the effect of strength training, the participants did not show any improvement on the outcome measure of physical function. This could be due to the small number of subjects.[26] Thus, the findings were in contrast with those in the current study. In one study, it was observed that adding hip abductor and adductor strengthening led to noticeable decrement in pain, but no improvement in biomechanical load decrement.[23]

This could be due to the addition of adductor strengthening as well which was not required as the adductors are tightened in KOA patients. Another reason might be the assignment of conducting an unsupervised home-based treatment plan.[23]

The current results also showed improvement on FSST scale, decreasing the risk of fall of KOA patients. These results strongly correlate with a systemic review.[25]

Furthermore, hip mobilisations used by previous studies have either gone redundant or were conducted for a very short time.[17,21,24,26]

The current study has limitations, like the lack of long-term follow up and lower than the required sample size. Another limitation is the use of cold pack for patient satisfaction. However, no adverse event surfaced during the trial.

Table-3: Intra- and inter-group analysis of FSST and VAS.

Measure / group	Pre[a]	Post[a]	Improvement (%)	Within Group Comparison[b]	B/w Group Comparison[b] A vs B	A vs C
FSST						
A	19.12± 2.90 (17.94 , 20.33)	14.92± 1.55 (14.01 , 15.92)	22%	4.21(<0.001)	0.90(<0.001)	1. 11 (<0.001)
B	18.82± 1.81 (17.72 , 20.03)	15.84± 1.82 (14.91 , 16.82)	16%	3.00(<0.001)		
C	18.81 ± 0.61 (17.52 , 19.83)	16.01 ± 3.11 (15.11 , 17.12)	15%	2.80(<0.001)		
VAS						
A	6.64± 0.73 (6.22 , 7.05)	4.42± 1.08 (3.94 , 4.92)	37%	2.23(<0.001)	-1.33 (<0.001)	-0.80 (<0.001)
B	6.81+_1.09 (6.49 , 7.23)	5.77+_1.20 (5.24 , 6.21)	16%	1.10(<0.001)		
sC	6.45 ± 1.04 (6.00 , 6.88)	5.24 ± 1.09 (4.71 , 5.70)	19%	1.22(<0.001)		

[a]=mean±standard deviation (95% Confidence Interval); [b]=mean difference (p-value); A: Hip mobilization group; B: Hip strength training group; C: Knee exercises group; FSST: Four-step square test, VAS: Visual analogue scale.

Conclusion

Addition of hip mobilisations and hip strength training exercises was found to be far more effective in improving pain, increasing dynamic balance and improving physical function of the KOA patients compared to the conventional knee exercises alone.

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Conflict of Interest: None.

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