Original Research Article

A comparative study between quadriceps combined with hip abductor strengthening versus quadriceps strengthening in treating osteoarthritis of knee: A short term pilot study

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Abstract

Background: Osteoarthritis is a chronic degenerative disease with predilection to elderly group. The efficacy of hip abductor strengthening is still controversial and hence not being routinely prescribed for treating patients with osteoarthritis knee. The current study aims at comparing quadriceps in combination with hip abductor strengthening can improve the function and reduce pain in KOA patients than quadriceps training alone.**Methods:**90 patients with symptomatic of osteoarthritis knee were randomly divided into two groups of 45 each. Cases in group 1 are managed with quadriceps strengthening exercises and group 2 with quadriceps combined with hip abductor strengthening exercises. Group 1 - straight leg raise and short arc quad (SAQ) exercises, group 2 in addition - lateral leg raise test and standing abduction test exercises were thought to the patient and were asked to continue for 6 weeks. Patients were evaluated at 6th, 8th, 10th week for VAS and WOMAC score.**Results:** There significant difference in mean VAS and WOMAC score between two groups from 6th week to 10th week. Mean VAS score was high in group 1, mean WOMAC score was high in group 2.**Conclusion:**Quadriceps combined with hip abductor strengthening is a simple exercise that aims in relieving pain and improving functional outcome of knee. Incorporation of this in treating knee osteoarthritis patient yields a good functional outcome and cost effective.

Keywords: Osteoarthritis knee, Quadriceps exercise, hip abductor exercises.

Introduction

Inflammation of a joint characterized by pain, deformity and limitation of range of movements is known as Arthritis.

Osteoarthritis is a chronic degenerative disease with predilection to elderly group and with advancing age its prevalence increases[1].It a progressive disease resulting in degeneration of the articular cartilage of the joint and most commonly affecting the knee joint[2].It is the fourth cause of disability in the world. It affects the day to day activities, often reducing the quality of life and impairment of the patients independence[3].Numerous treatment modalities are available for treating osteoarthritis knee which includes pharmaco-logical management such as non-steroidal anti-inflam-matory drugs,analgesics.Surgical management including proximal fibular osteotomy, total knee replacement surgery[4].Non pharmacological management including life style modification, physiotherapy, ultrasonotherapy aims at reducing the pain, increasing the range of movement of the joint, their by improving the quality of life [5]. Patient related factor such as age, attitude, comorbid conditions, economic status and compliance with treatment should be considered by a clinician while opting for a modality of treatment. Recent guidelines for osteoarthritis knee have paid attention to the non pharmacological management[6]. Altered biomechanics of the knee joint and excessive joint loading has been recognized as important contributing factors for the disease progression of knee osteoarthritis[7]. Recent articles concludes that patients suffering from knee osteoarthritis have altered hip biomechanics in the form of weak hip abductor strength. Hip abductor strengthening can alleviate the symptoms and improve the knee functions of the osteoarthritis knee patients[8,9].

Need for study

The efficacy of hip abductor strengthening is still controversial and hence not being routinely prescribed for treating patients with osteoarthritis knee. So the current study was done to compare which among two groups of patients i.e., quadriceps combined with hip abductor strengthening versus quadriceps strengthening alone can result in reduction of pain and improved function in patients with osteoarthritis knee.

Aims and Objective

To compare functional outcome and pain relief between patients receiving quadriceps and hip abductor strengthening with those undergoing quadriceps strengthening alone.

Material and methods

1. A comparative pilot study, since it is pilot study no sample size will be calculated using any formula. All participants fitting into inclusion and exclusion criteria in study period duration will be enrolled in the study.
2. Sample size and duration: 2 months (April – May 2020)
3.Mode of selection of subjects:This study will be conducted on patients attending the orthopedic outpatient section and inpatient of R.L. Jalappa hospital and research centre Tamaka, Kolar. It is a prospective and comparative study of 90 cases of osteoarthritis knee. All subjects meeting inclusion and exclusion criteria included in the

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study. Patients were divided into two groups each group included 45 cases. Cases in group 1 are managed with quadriceps strengthening exercises and group 2 with quadriceps combined with hip abductor strengthening exercises. All the patients underwent x-ray knee of affected limb and then classified according to Kellgren Lawrence grading for osteoarthritis knee. Functional outcome was evaluated using WOMAC scoreand pain score using visual analogue scale (VAS)[20,21]

4.**Inclusion criteria**

- ✓ Patients aged more than 45 years diagnosed with Kellgren-Lawrence grade (K-L grade) for osteoarthritis knee of grade II-IV.
- ✓ In case of bilateral OA knee the more severely affected side was considered.

Exclusion criteria

- ✓ Patient aged > 80years
- ✓ Patients who underwent physiotherapy of hip and knee for past one month
- ✓ Patients with systemicarthritic conditions
- ✓ Patients who took systemic steroids within the last 1 month or intra-articular corticosteroid injection within the last 3 months
- ✓ Patients who had underwent hip or knee joint surgeries in the past
- ✓ Patient with lower limb neurological or muscular diseases

Methodology

Statistical analysis: Data was entered into Microsoft excel data sheet and was analyzed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. **Chi-square test** was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. **Independent t test or Mann Whitney U test** was used as test of significance to identify the mean difference between two quantitative variables and qualitative variables respectively[10,11]

Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram.

p value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests[12,13].

Statistical software: MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

Procedure: All subjects included in the study received routine care management for osteoarthritis knee, including health education and pharmacological agent therapy (Tablet Paracetamol 650mg oral SOS) when necessary.

Group 1: Quadriceps strengthening exercises

Quadriceps- strengthening training was composed of two exercises designed to strengthen the quadriceps

1.Straight Leg Raise – patient made to lie on their back with the leg to be exercised in straight position. The other knee should be bent to support the lower back. Patient was asked to lift the diseased leg to the heel 25-30 cm away from the bed. It was held in that position for 5–10 seconds and then slowly laid down.

Fig 1: Straight leg raise exercise

2.The short arc quad (SAQ) exercise -patient made to lie on their back and use a small paper towel roll to prop your knee up. Patient was asked to slowly straighten the bent knee until it is all the way straight. Tighten the quadriceps muscle and hold it tight for five seconds. Slowly lower leg down.

Fig 2: The short arc quad (SAQ) exercise

Group 2: Quadriceps combined with hip abductor strengthening

It consists of group one exercises and two more hip abductor strengthening exercises which includes

1.Lateral leg raise test- Lying on the sound side bend the hip and knee to keep from rolling over. Raise the top leg towards the sky. Hold for 5 seconds, repeat in 3 sets of ten. The leg can be moved backwards as well to make the exercise harder.

Fig 3: Lateral leg raise exercise

2.Standing abduction test- Stand on the best leg. Turn the painful leg inward pointing across the body. Keeping the leg straight lift it out to the side and hold for 5 seconds. The pelvis should be kept level. A hand rail or table was be used for balance if needed.

Fig 4: Standing abduction exercise

All patients was asked to perform each exercise for 10 times as a set, for 3 sets each time and twice a day for 6 weeks altogether.

Results and observations

In this series of 90 patients, 45 were included in group 1 and 45 were included in group 2.

Table 1: Age and Sex distribution comparison between two groups

		Group				P value
		Quadriceps Exercise (n =45)		Hip Abduction + Quadriceps exercise (n =45)		
		Count	%	Count	%	
Age	<50 years	27	60.0%	32	71.1%	0.206
	51 to 60 years	14	31.1%	7	15.6%	
	>60 years	4	8.9%	6	13.3%	
Sex	Female	27	60.0%	21	46.7%	0.205
	Male	18	40.0%	24	53.3%	

In group 1, mean age was 51.53 ± 6.15 years and in group 2, mean age was 51.36 ± 6.85 years. There was no statistical significance in age distribution between two groups. In group 1, 60% were females and 40% were males. In group 2, 46.7% were females and 53.3% were males. There was nostatistical significance in sex distribution between two groups.

Table 2: Side distribution comparison between two groups

		Group			
		Quadriceps Exercise		Hip Abduction + Quadriceps exercise	
		Count	%	Count	%
Side	Left	23	51.1%	25	55.6%
	Right	22	48.9%	20	44.4%
	Total	45	100.0%	45	100.0%

$\chi 2 = 0.179$, df =1, p =0.673

In Quadriceps exercise group, 51.1% were on left side and 48.9% were on right side and in Hip Abduction + Quadriceps exercise group, 55.6% were on left side and 44.4% were in right side. There was no significant difference in side distribution between two groups.

Table 3: Kellgren-Lawrence grade distribution comparison between two groups

		Group			
		Quadriceps Exercise		Hip Abduction + Quadriceps exercise	
		Count	%	Count	%
Kellgren-Lawrence grade	2	20	44.4%	21	46.7%
	3	18	40.0%	17	37.8%
	4	7	15.6%	7	15.6%
	Total	45	100.0%	45	100.0%

$\chi 2 = 0.053$, df =2, p =0.974

In Quadriceps exercise group, Kellgren-Lawrence grade was 2 in 44.4%, grade 3 in 40% and grade 4 in 15.6% and in Hip Abduction + Quadriceps exercise group, Kellgren-Lawrence grade was 2 in 46.7%, grade 3 in 37.8% and grade 4 in 15.6%. There was no significant difference in Kellgren-Lawrence grade between two groups.

Table 4: VAS Score distribution comparison between two groups

		Group				P value
		Quadriceps Exercise		Hip Abduction + Quadriceps exercise		
		Count	%	Count	%	
Day 1	6	20	44.4%	17	37.8%	0.535
	7	12	26.7%	18	40.0%	
	8	6	13.3%	7	15.6%	
	9	5	11.1%	2	4.4%	
	10	2	4.4%	1	2.2%	
	Mean ± SD	7.04	1.21	6.93	0.96	0.969
2nd Week	4	8	17.8%	16	35.6%	0.078

	5	12	26.7%	18	40.0%	
	6	16	35.6%	7	15.6%	
	7	5	11.1%	3	6.7%	
	8	3	6.7%	1	2.2%	
	9	1	2.2%	0	0.0%	
	Mean ± SD	5.69	1.22	5.00	1.00	0.004*
4th Week	3	0	0.0%	15	33.3%	<0.001*
	4	19	42.2%	21	46.7%	
	5	17	37.8%	7	15.6%	
	6	6	13.3%	2	4.4%	
	7	2	4.4%	0	0.0%	
	8	1	2.2%	0	0.0%	
	Mean ± SD	4.87	0.97	3.91	0.82	<0.001*
6th Week	2	4	8.9%	13	28.9%	0.004*
	3	15	33.3%	23	51.1%	
	4	17	37.8%	5	11.1%	
	5	8	17.8%	3	6.7%	
	6	1	2.2%	1	2.2%	
	Mean ± SD	3.71	0.94	3.02	0.94	<0.001*
8th Week	1	0	0.0%	2	4.4%	0.014*
	2	12	26.7%	26	57.8%	
	3	21	46.7%	11	24.4%	
	4	9	20.0%	5	11.1%	
	5	3	6.7%	1	2.2%	
	Mean ± SD	3.07	0.86	2.49	0.84	0.001*
10th Week	1	1	2.2%	5	11.1%	0.008*
	2	20	44.4%	32	71.1%	
	3	14	31.1%	4	8.9%	
	4	9	20.0%	4	8.9%	
	5	1	2.2%	0	0.0%	
	Mean ± SD	2.76	0.88	2.16	0.74	<0.001*

In this study there was significant difference in VAS Score between two groups at 4th week, 6th week, 8th week and 10th week.
VAS Score was high in Quadriceps exercise group compared to Hip Abduction + Quadriceps exercise group. There was no significant difference in VAS score between two groups on Day 1 and 2nd week. Hip Abduction + Quadriceps exercisegroup had between reductions in VAS score compared to Quadriceps exercise group. In this study there was significant difference in mean VAS Score between two groups from 2nd week to 10th week. Mean VAS score was high in Quadriceps exercise group compared to Hip Abduction + Quadriceps exercise group.

Table 5: WOMAC Score distribution comparison between two groups

	Group						P value
	Quadriceps Exercise			Hip Abduction + Quadriceps exercise			
	Mean	SD	Median	Mean	SD	Median	
Day 1	63.96	10.13	64	63.29	7.09	62	0.958
6th Week	54.67	10.34	54	47.27	8.01	45	<0.001*
10th Week	43.22	10.41	38	37.33	8.14	36	0.001*

In the study there was no significant difference in WOMAC Score between two groups on Day 1. There was significant difference in WOMAC Score between two groups at 6th Week and 10th Week. Mean WOMAC Score was high in Quadriceps exercise group compared to Hip Abduction + Quadriceps exercise group.

Discussion

Few studies showed that there is quadriceps muscle weakness compared to normal contralateral knee by 20-40 % in patients with osteoarthritis knee[14].Hip musculature predominately hip abductor plays a role in stabilizing pelvis during a gait cycle. Weakness of hip abductors alter the biomechanics of the lower limb and increases the magnitude of knee adduction which a reason for osteoarthritis knee progression[15,16].Few articles has been published analyzing the strength of hip abductors in osteoarthritis knee. They have compared hip abductors strengthening versus quadriceps strengthening alone for treating osteoarthritis knee.The mean age in our study of quadriceps exercise group was 51.53± 6.15 years and mean age of hip abduction + quadriceps exercise group was 51.36 ± 6.85 years and there was no statistically significant difference in sex, side, Kellgren-Lawrence grade between two groups. Evaluation of VAS was done day 1 and every alternate week till 10th week. There was significant difference in VAS score between two groups from 4th week onwards till the final follow up. This implies that Hip Abduction + Quadriceps exercise group had better pain relief from osteoarthritis knee compared to Quadriceps exercise group. WOMAC score was evaluated on day 1, 6th and 10th week. Mean WOMAC score was high in Quadriceps exercise group compared to Hip Abduction + Quadriceps exercise group. Low score signifies that patients had improvement in the stiffness and functional outcome of the limb evaluated through set of 24 questionaire in WOMAC score.

Hinman et al conducted a study to assess hip muscle weakness in medial compartment osteoarthritis knee patient with asymptomatic population group. With a hand held dynamometer isometric strength of hip flexors, abductors and adductors were measured. For assessing the knee pain VAS score was used and it was 4 ±2 over a week and in control group it was o which had significant p value. There was no

significant difference in VAS score between two groups on Day 1 and by the end of 2nd week in our study. They had significant difference in p value because they compared with asymptomatic control group. Their study showed that there is hip musculature weakness present in osteoarthritis knee patient but was not proven whether it occurs as a consequence of the disease or it initiates the medial compartment osteoarthritis[17].A study conducted by Yujie et all showed that there was relief in pain and improvement in knee range of movement when hip abductor strengthening regimen was added for physical therapy in treating osteoarthritis knee[15].They evaluated the functional outcome using VAC, WOMAC and short form health survey (SF-6).Shreya et al in their study which included 4 parameters like 6 minute walk test, WOMAC score , hip strength and hip endurance for comparison between hip abductor strengthening versus quadriceps strengthening in patients with medial compartment osteoarthritis knee having a mean age of 55.10 years. They used modified sphygmomanometer to measure hip abductor strength. Mean WOMAC score in hip strengthening group was 59 and in quadriceps group was 82 at the end of 6 weeks intervention, where as in our study mean WOMAC score was 47.27 in hip strengthening group and 54.67 quadriceps group at the end of 6th week of intervention which showed significant improvement in the functional outcome when compared to day one as well as compared to quadriceps strengthening group. They concluded that weakness of hip abductor acts a contributing factor for disease progression in osteoarthritis knee patients[18].Costa and his colleagues conducted a study on assessment of isokinetic strength of hip muscles by comparing peak torque using isokinetic dynamometry in osteoarthritis knee patient and normal control group. Their study revealed there is significant lower peak torque in both ipsilateral and contralateral hip of osteoarthritis knee patient when compared to control group. They concluded that osteoarthritis knee patient exhibits lower isokinetic strength of hip muscles and reduced range of movement of knee when compared to control group who were free from symptoms[19]

Conclusion

A clinician has to consider the patients age, sex, family support, economic status while opting for the management for osteoarthritis. Adding Hip abductor exercise regimen along with quadriceps exercise helps in both, pain relief and improvement in functional outcome of the knee. There by it is a cost effective and simpler palliative treatment for prevention of disease progression in osteoarthritis knee patients.

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