Original Research Article

A Comparative Study To Evaluate The Effectiveness of Quadriceps Strengthening Exercises in Patients of Osteoarthritic Knee

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Abstract

Background: Osteoarthritis is a degenerative joint disease prevalence increases with age, woman being more symptomatic especially seen in post menopausal women. Quadriceps muscle weakness leads to functional dysfunction in knee osteoarthritis. Rehabilitation includes quadriceps exercises static as well as dynamic exercises for improving range of motion and strength. Biofeedback can be combined with isometric exercises to increase the awareness of the muscle work done by quadriceps. **Aim** To compare the Effectiveness of Quadriceps strengthening exercises in reducing extensor lag, VAS and improving functional activity in patients of osteoarthritic knee. **Method:** This experimental study was conducted on 60 Osteoarthritic knee patients and they were divided into 3 groups, 20 patients were included in each group. Patient aged 50-75 years were taken. Convenience sampling method was used for study. WOMAC scale, VAS and terminal extensor lag was assessed. **Results** P value: 0.036, 0.001 and less than 0.05 for extensor lag, VAS and WOMAC respectively as the mean difference value is more in group 3 therefore group 3 i.e. Modified Quadriceps sets with biofeedbackis clinically and statistically more effective than group 2 and 3. **Conclusion** All three groups were effective in reducing extensor lag, pain and improving functional activity in patients with knee osteoarthritis. It was also seen that in group 3 i.e. Modified Quadriceps sets with biofeedback clinically more improvement was seen as compared to the other groups.

Keywords: Osteoarthritis, Quadriceps Strengthening, Extensor lag.

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Introduction

Knee osteoarthritis (OA) is becoming a major public health problem. It is more prevalent in women over the age of 60yrs and increases in percentage of people older than 55 years in western countries[1]. Knee osteoarthritis is degenerative joint disease and most common form of disability affecting both women and men, woman being more symptomatic[2].Knee osteoarthritis is inflammatory joint disease that affects the cartilage between bones thereby restricting movements causing joint pain and leads to muscle weakness, periarticular muscle atrophy, tenderness, swelling. Majorly affects large weight bearing joints such as hips and knee[3]. Knee OA is classified as primary and secondary OA. Primary OA is result of age and secondary OA is result of complication of a disease or an injury leading to degeneration of joint[3].Quadriceps lag is a condition when patient cannot actively extend knee fully using muscle contraction, but can be passively extended by the therapist[2]. Knee pain is associated with weak quadriceps and thus it increases the loading at knee leading to joint degeneration. OA patient can easily perform isometric exercises as it produce low articular pressure and also improves muscle strength and static endurance thus preparing the joint for more dynamic movement[4].VMO originates from the medial intramuscular septum, adductor longus and majority of fibers arising from the tendon of the adductor magnus, based on this anatomical finding simultaneous activation of the knee extensors and the hip adductors might provide the VMO with more the quadriceps strength also the lowermost fibers of VMO attach to the anteromedial aspect of tibia through the medial extensor aponeurosis and may resist external rotation of tibia thus VMO can be recruited through active medial rotation of tibia[5].Exercise is important in osteoarthritis management. It seems that supervised exercises sessions are superior to home exercises for pain reduction1. Considering all these factors the aim of study is to compare the effectiveness of different quadriceps strengthening exercises in improvement of extensor lag, pain and functional activity in osteoarthritic knee.Therefore, the aim of this study was to compare the Effectiveness of Quadriceps strengthening exercises in reducing extensor lag, VAS and improving functional activity in patients of osteoarthritic knee.

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Material and Method

It prospective, unicentric, experimental study was conducted in the PMR OPD of Patna Medical College And Hospital, Patna. The study was approved by the institutional research and ethical committee.an informed and written consent was taken from all the participating subjects prior to the commencement of the study. The study was conducted over a period of 01 year from January 2020 to December 2020.The study sample consisted of randomly selected 60 osteoarthritic knee patients aged from 50-75 yrs, and they were divided into 3 subgroups and each group consisted 20 patients.

Inclusion Criteria

1. Male/female patients between the age group of 50-75yrs
2. Confirmatory x-rays showing osteophytes, joint space narrowing (grade II,III).

3. Patient having Extensor lag.
4. Patients with complain of unilateral knee pain, stiffness, difficulty climbing stairs, in walking and sitting crossed leg
5. Occupation- sedentary job, housewife, sitting job

Exclusion Criteria

1. Patients with knee OA surgery, recent knee injury.
2. Patients having psychological, neurological, cardiac, vascular and sensory problems

Procedure: 60 patients suffering from unilateral OA meeting inclusion criteria were included in the group and were randomly divided into 3 different groups:

Group 1 (Quadriceps sets),

Group 2 (Quadriceps sets with biofeedback)

Group 3 (Modified Quadriceps sets with biofeedback).

Demographic data of the patient, degrees of extensor lag with the help of goniometer , VAS and functional activity by WOMAC SCALE was obtained and informed consent form was duly filled by the patients[6].Protocol was followed for 2weeks after first 3 days one day rest was given to avoid exertion and treatment was followed for 2weeks.pulsed ultrasound was given to patient with a frequency of 1MHz, power-2W/cm^2 with a pulsed mode duty cycle-1:4

Measurement of Extensor Lag

Patient position high sitting leaning 45 degrees backwards to minimize any resistance from hamstring during procedure. Patient is then asked to extend knee actively and extensor lag is measured with goniometer[7]

Group 1-Ask the patient to sit on plinth with knee flexed to 60-85° and then hold an isometric contraction of quadriceps

Group2-Ask the patient to sit on plinth place inflated sphygmomanometer cuff below the distal end of femur then patient is asked to maintain mercury level by holding an isometric contraction of quadriceps.

Group C-Ask the patient to sit on plinth with knee flexed to 60-85° place inflated cuff between thigh and press on the cuff from thigh and asked to perform isometric contraction of quadriceps.

Stastistical analysis:

The data was tabulated and was subjected to statistical analysis using SPSS software, Version 11.0.

Result

The mean Pre treatment value of Extensor Lag was 0.40, 1.15 and 0.95 for group 1, 2, and 3. The mean Pre treatment value of VAS was 6.30, 6.75 and 7.05 for group 1, 2, and 3. The mean Post treatment value of Extensor Lag was 5.35, 5.60 and 4.85 for group 1, 2, and 3. The mean Pre treatment value of VAS was 4.20, 3.80 and 2.55 for group 1, 2, and 3. This difference was highly statistically significant. (Table-1)

Table 1: Comparison of Pre and Post treatment value of Extensor Lag and VAS in Group 1, 2 and 3

		EXTENSOR LAG			VAS		
		Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Pre Treatment	Mean	0.40	1.15	0.95	6.30	6.75	7.05
	SD	.82	.63	2.1	.30	.29	.18
Post Treatment	Mean	5.35	5.60	4.85	4.20	3.80	2.55
	SD	0.14	0.76	0.9	0.32	0.95	0.65
	t value	8.96	21.65	23.4	4.65	2.56	6.18
	P value	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000

The comparison of mean Pre treatment and mean Post treatment WOMAC SCORE in the three groups showed a highly statistically significant difference for the pre and post treatment values. (Table-2)

Table 2: Comparison of Pre and Post treatment for WOMAC Score in Group 1, 2 and 3

		Group 1	Group 2	Group 3
Pre Treatment	Mean	54.75	51.10	48.75
	SD	8.60	4.53	7.83
Post Treatment	Mean	29.35	23.10	7.4
	SD	7.94	4.79	5.29
	t value	4.39	30.5	26.0
	P value	<0.000	<0.000	<0.000

Table 3: Anova for: Extensor LAG and VAS Comparison between group 1, 2 and 3

	Extensor LAG			VAS		
	Group 1	Group 2	Group 3	Group 1	Group 2	Group 3
Mean	5.05	5.55	6.05	2.	2.9	4.4
SD	.19	.14	.23	0.64	.05	.4
F value	3.5250			24.26		
P value	0.036			<0.000		

A comparison between group 1, 2 and 3 for EXTENSOR LAG and VAS is shown in table-3.

A comparison between group 1, 2 and 3 for WOMAC SCORE is shown in table-4.

Table 4: Anova for: Womac Score comparison between group 1, 2 and 3

	Group 1	Group 2	Group 3
Mean	25.4	28	31.8
SD	7.89	4.10	4.43
F Value	6.39		
P Value	0.003		

Group 1, 2 and 3 all the three groups are statistically significant. Group 3 i.e. Modified Quadriceps sets with biofeedback is clinically more effective compared to the other two groups.

Discussion

In the present study, mean value of extensor lag in group 3 ie modified quadriceps sets with biofeedback was effective clinically in reducing extensor lag compared to other two groups. Brownstein et al, 1985 suggested that simultaneous activation of knee extensors and hip adductors might provide the VMO with more force of Quadriceps,VMO muscle originates in part from fascia overlying adductor magnus muscle. Exercising larger muscle first may generate tension within it and thereby VMO muscle has mechanical advantage

in reducing lateral shearing .Relative activity of VMO and VL during knee extension has been conducted by Hanten,1990 reported proportionally greater VMO activity during maximal hip adduction with knee extension exercises in both weight bearing and non weight bearing condition[9].Bose et al,1980 suggested that VMO oblique portion of vastusmedialis muscle function primarily as an active medial stabilizer of the patella and primarily function in final 20 degree of extension training this muscle teaches the patient to contract vastusmedialis muscle isometrically and isotonically thus increases strength in VMO and increases support and stabilization of patella.Group B and C ie Quadriceps isometrics and Quadriceps isometrics with biofeedback also showed decrease in percentage of extensor lag[10-14].Study conducted by et al, 2003 concluded that isometric quadriceps exercises brought significant gain in strength of the quadriceps muscle after 5 week training sessions and therefore increasing stability of knee joint. 0 Shahnawak Anwer, et al, 2003 reported that subjects having stronger Quadriceps strength showed a reduction in knee pain and better functional activity as compared with those with least strength. Another study reported that subjects having stronger quadriceps strength has less knee pain because Strong muscle stabilize the joint in proper alignment, attenuate shocks that are transmitted to the joint and decrease effect of impact by spreading the forces over greater area . So it may be concluded that improvement in quadriceps strength improves extensor lag, reduces pain and disability and increases stability. Van barr, Dekker et al, 2001 concluded that isometric contractions can improve muscle strength and static endurance and prepare the joints for more dynamic movement[2].In the present study biofeedback showed positive results in reducing extensor lag, pain and improvement in WOMAC SCORE seen in group B and C. Mortatini and deveris et al, 2000 describe neural factors as a facilitation occuring as a result of neurological reorganization and it increases the number of motor units with help of biofeedback and thus increases motor unit recruitment and muscle strength.Work of basmajian 1999 suggest that amount of muscle tension produced during training sessions increases because of more fibers fires at faster rate[3,4].In the present study group 3 was more effective clinically in reducing pain and improving functional activity of the patients.study suggested that VMO exercises reported a modest 8-10% improvement in pain and functioning scores among their sample of knee OA patients[5].In the present study pulsed ultrasound with intensity of $2w/cm^2$ with duty cycle 1:4 was applied to the patient and showed reduction in VAS. Falconer et al, 2008 indicates that therapeutic US reduces pain in knee OA i.e. when applied over tender point around the knee joint prior to exercise decreases soft tissue pain as US increases blood flow to the muscle in spasm and causes muscle relaxation[17].Centin et al 2008 concluded that exercises and physical agents can reduce pain and improve function in patients with knee OA[15-18].

Conclusion

All three groups were effective in reducing extensor lag, pain and improving functional activity in patients with knee osteoarthritis. It was also seen that in group 3 i.e. Modified Quadriceps sets with biofeedback clinically more improvement as compared to the other groups.

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