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Effectiveness of Hip Abductors Strengthening in Patients with Total Knee Arthroplasty: A Randomized Control Trial

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ABSTRACT

Introduction: Total Knee Arthroplasty (TKA) is a widely performed surgery for end-stage knee osteoarthritis, but many patients continue to experience pain and functional limitations postoperatively. While rehabilitation traditionally emphasizes quadriceps and hamstring strengthening, growing evidence highlights the critical role of hip abductors in enhancing lower limb function and stability. This study aims to compare the effectiveness of adding hip abductor strengthening to quadriceps/hamstrings exercises versus quadriceps/hamstrings exercises strengthening alone on pain, symptoms, QoL, ADLs and functional outcomes in TKA patients.

Material and Methods: The study was randomized controlled trial (RCT)in nature involved 20 subjects, aged between 50 and 70 years who had undergone unilateral Total Knee Arthroplasty (TKA) for primary osteoarthritis were included. The patients were randomly divided into two equal groups. Group A (n= 10) and Group B (n=10). Further the patients were assessed for Pain, symptoms, quality of life and activities of daily life by KOOS (Knee injury and Osteoarthritis Outcome Score) and lower extremity functions were assessed by LEFS (Lower Extremity Functional Scale). Group A (experimental group) received Hip abductors strengthening along with quadriceps/hamstrings strengthening and Group B (control group) received only quadriceps/hamstrings strengthening. The intervention consisted of 5 sessions per week for 12 weeks. Patients were assessed at 0^{th} week and reassessed at the end of 12^{th} week after completing the treatment.

Result: Statistical analysis revealed significant improvement within both groups. However, between-group comparison demonstrated that Group A exhibited statistically significant improvement ($p < 0.05$) than Group B across all outcome measures, including KOOS and LEFS.

Conclusion: The study concluded that adding hip abductor strengthening to quadriceps/hamstrings rehabilitation leads to greater improvements in pain, symptoms, quality of life, daily activities and lower limb function in patients who have undergone total knee Arthroplasty (TKA).

Keywords: Hip abductors strengthening, Quality of Life, Total knee Arthroplasty

INTRODUCTION

Total knee arthroplasty (TKA) is a widely performed procedure aimed at relieving pain and improving function in individuals with end-stage knee osteoarthritis. [1,2] With demographic shifts and rising rates of obesity and degenerative joint conditions, the demand for TKA has surged globally, exceeding 700,000 procedures annually in the United States alone1. While surgical techniques and prosthetic designs have advanced significantly, a notable proportion of patients continue to experience functional deficits well into the postoperative period3. Studies report that up to 37% of individuals demonstrate limitations such as reduced walking speed, impaired stair negotiation, and persistent lower limb dysfunction one year after surgery. [3]

Rehabilitation especially physiotherapy and exercise is strongly advocated following total knee replacement. [4] However, Conventional postoperative rehabilitation typically emphasizes strengthening the quadriceps and hamstrings, given their established role in knee stabilization and movement. However, despite structured rehabilitation, many patients struggle to regain full functional capacity [5]. This raises important questions about whether current protocols address the complete spectrum of muscular demands required for optimal recovery.

The mechanics of walking, stair climbing, and transitional movements are not governed solely by the sagittal plane musculature6. Instead, these tasks require integrated function across multiple planes, particularly in the frontal plane, where proximal hip musculature contributes to pelvic stability, postural control, and dynamic alignment of the lower extremity. [6,7] Among these, the hip abductors most notably the gluteus medius and minimus are biomechanically positioned to modulate pelvis-on-femur movement, counterbalance body weight during single-leg stance, and support trunk alignment during gait. [8,9]

Despite this, these muscles are frequently overlooked in standard TKA rehabilitation protocols, which often remain centered on knee-specific recovery strategies. [10,11] Moreover, preliminary studies in knee osteoarthritis populations and a limited number of trials in TKA cohorts suggest that alternative or adjunct strengthening strategies may hold promise, yet findings remain inconclusive due to heterogeneity in intervention design and outcome measures. [11,12,13,14]

As current evidence leaves critical questions unanswered regarding the role of proximal musculature in post-TKA function, it becomes imperative to explore whether a more holistic rehabilitation approach incorporating both distal (knee) and proximal (hip) muscle groups can enhance recovery outcomes. This study aims to address this gap by comparing the effects of combined hip abductor and quadriceps/hamstrings strengthening versus quadriceps/hamstrings strengthening alone on pain, symptoms, quality of life (QoL), activities of daily living (ADLs), and lower extremity function in patients undergoing TKA.

MATERIAL AND METHODS

Research Design and Setting:

The study was a randomized controlled trial (RCT) conducted at Guru Gobind Singh Medical College and Hospital, Faridkot and University College of Physiotherapy, Faridkot, from February 2024 to April 2025.

Patients:

A total of 20 patients aged between 50 and 70 years who had undergone unilateral Total Knee Arthroplasty (TKA) for primary osteoarthritis were included. These patients experienced pain during functional activities such as ascending or descending stairs, prolonged sitting, or walking. Patients were excluded if they had mechanical issues evident on radiographic examination; a history of cardiac, pulmonary, or neurological disorders; previous orthopaedic surgery involving the lower limbs.

Procedure:

The patients were randomly divided into two equal groups. Group A (n= 10) and group B (n=10). Further the patients were assessed for Pain, symptoms, quality of life and activities of daily life by KOOS (Knee injury and Osteoarthritis Outcome Score) [15] and lower extremity functions were assessed by LEFS (Lower Extremity Functional Scale) [16]. Group A (experimental group) received Hip abductors strengthening along with quadriceps/hamstrings strengthening and Group B (control group) received only quadriceps/hamstrings strengthening. The intervention consisted of 5 sessions per week for 12 weeks. Patients were assessed at 0^{th} day and reassessed at the end of 12^{th} week after completing the treatment. (Fig. 1)

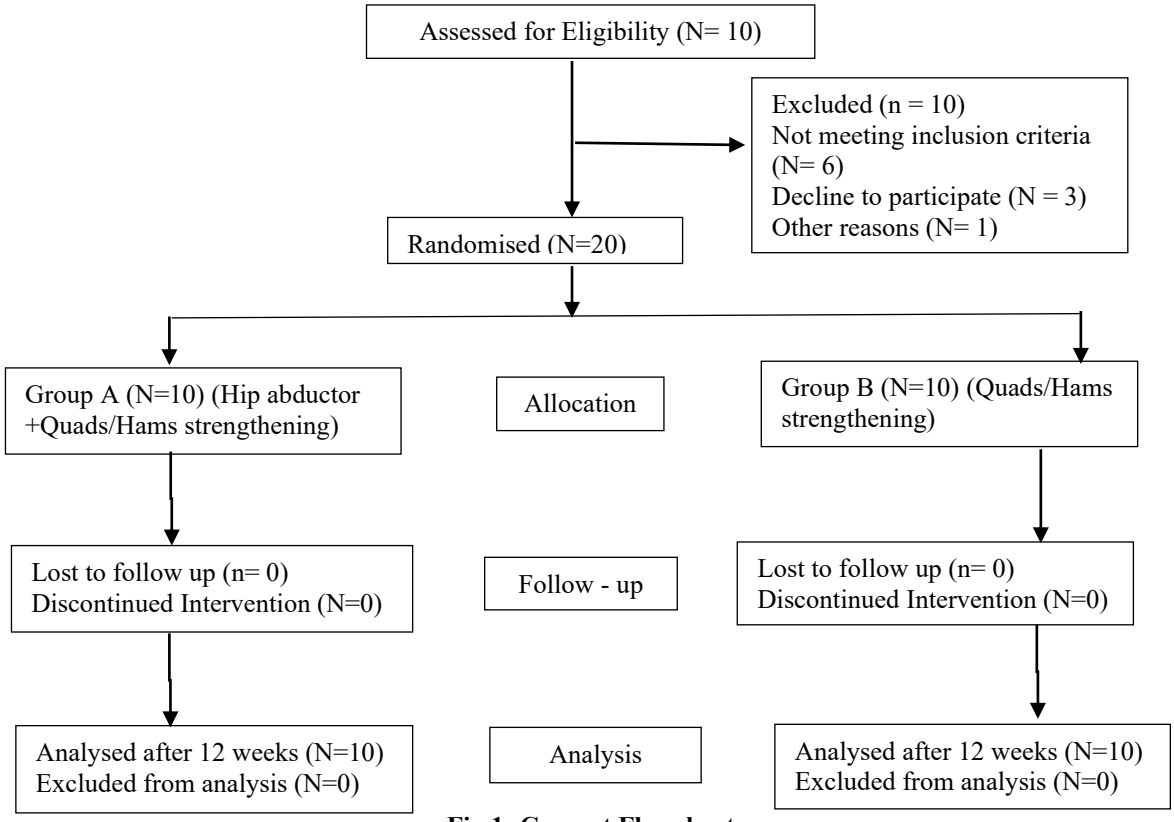

Fig 1: Consort Flowchart

Intervention:

Table 1: Hip abductors strengthening Protocol [13]

Phase	Days/Weeks	Exercise	Details
Phase I: Inpatient Rehab	Post operative day 1-2	Supine Hip Abduction	1–3 sets of 10 reps with 10 sec hold
	Post operative day 3-7	Supine & Standing Hip Abduction (Progressed)	1–3 sets of 10 reps with 10 sec hold
Phase II: Outpatient Physical Therapy	Day 8 – Week 4	Side-Lying Hip Abduction	Bodyweight initially
		Standing Unilateral Hip Abduction	Performed with support, bodyweight
		Isometric Hip Abduction	Against wall or resistance, static hold
		Clamshell Exercises	Basic (no resistance)
Phase III: Advanced Outpatient Physical Therapy	Week 5 – Week 12	Side-Lying Hip Abduction with Weights	1–2 kg weights, 3 sets of 10 reps @ 10RM
		Standing Hip Abduction	1–2 kg ankle weights, 3

		with Weights	sets of 10 reps
		Isometric Abduction Against Wall	Standing, static hold
		TheraBand Clamshells	3 sets of 10 reps, 5-sec hold
		Lateral Band Walks	Controlled movement with resistance band
Maintenance Phase	Post-12 Weeks	All Above (as tolerated)	1–2x/week, 1–3 sets of 10–20 reps

Table 2: Quads/Hams strengthening Protocol [13]

Phase	**Days/Weeks**	**Exercise Type**	**Details**
Phase I: Inpatient Rehabilitation	Post operative day 1	Bedside Exercises: Ankle Pumps, Quad Sets, Gluteal Sets, Short Arc Quads, SLR (with brace)	1–3 sets of 10 reps with 10 sec hold
		Mobility & Transfers	Sit-to-stand, bed mobility
	Post operative day 2	ROM Exercises: AROM, AAROM, Heel Slides	1–3 sets of 10 reps, twice daily
		Strength: Quad/Glute Sets, Heel Slides, SLR	1–3 sets of 10 reps with 10 sec hold
	Post operative day 3-7	Strength: Progress as tolerated (Ankle pumps, SLR, Heel Slides)	1–3 sets of 10 reps with 10 sec hold, 2x daily
		Gait Training	Progress ambulation, assistive device
Phase II: Outpatient Physical Therapy	Day 8 – Week 4	ROM & Activation: Knee AROM, Seated Knee Extension, Dorsiflexion/Plantarflexion	Basic mobility training
		Strengthening: Quad Sets, SLR, Hamstring Sets	Bodyweight/isometric
		Functional: Sit-to-stand, Single-leg standing	Supported balance work
Phase III: Advanced Outpatient Physical Therapy	Week 5 – Week 12	Weighted Strengthening: Quad Sets, SLR, Standing Leg Curls, Seated Knee Extensions	1–2 kg weight, 3 sets of 10 reps
		Terminal Knee Extension	Focus on final 15–20° of extension
		Maximal Isometric Contractions	At multiple knee angles (30°, 45°, 60°, 90°), hold 5–10 seconds
		Functional Exercises: Step-Ups, Sit-to-Stand	Forward/lateral step-ups, stairs
		Ambulation + Stair Training	Gait cycle focus (heel strike, push-off)
Maintenance Phase	Post-12 Weeks	All Above (as tolerated)	1–2x/week, 1–3 sets of 10–20 reps

RESULT

The Statistical Analysis was done using SPSS (version 18) and Microsoft Excel 2010. The dependent variables were expressed by arithmetic means and standard deviation and tested using paired t-test within the group and unpaired t-test between the groups. The p-value of less than 0.05 was considered as significant.

Table 2: Demographic Profile of patients of both groups.

Demographic characteristics	Group A (N=10)	Group B (N=10)
Age (in years) (Mean ± SD)	62.80 ± 6.373	62.90 ± 5.801
Male (N), %	3 (30%)	2 (20%)
Female (N), %	7 (70%)	8 (80%)

The demographic distribution of patients in both groups was comparable. The mean age of patients in Group A was 62.80 ± 6.373 years, while in Group B it was 62.90 ± 5.801 years, indicating no significant age difference between the groups. In terms of gender, Group A consisted of 3 males (30%) and 7 females (70%), whereas Group B had 2 males (20%) and 8 females (80%). The demographic details of the study population are summarized in Table 2.

There were significant differences in the Knee Injury and Osteoarthritis Outcome Score (KOOS) in both Group A (14.659 ± 1.011 to 67.955 ± 2.506) and Group B (14.268 ± 1.371 to 59.5 ± 2.047). However, on comparing both the groups, Group A showed a significantly greater improvement in KOOS scores than Group B ($p<0.05$).

Both the groups also showed statistically significant improvements in Lower Extremity Functional Scale (LEFS) scores i.e., Group A (15.25 ± 2.108 to 76.25 ± 5.833) and Group B (14.275 ± 1.492 to 56.55 ± 6.285). However, on comparison, Group A showed significantly better functional improvement compared to Group B ($p<0.05$). (Table No. 3)

Table 3: Comparison of scores of KOOS and LEFS between two groups at 0th day and after 12th week.

Parameters	Group A			Group B			Between group	
	Pre-test	Post-test	Within Group P value	Pre-test	Post-test	Within Group P value	Pre-test P value	Post-test P value
KOOS (Mean ± SD)	14.659 ±1.011	67.955 ±2.506	<0.05	14.268 ±1.371	59.5± 2.047	<0.05	0.477	<0.05
LEFS (Mean ± SD)	15.25± 2.108	76.25± 5.833	<0.05	14.275 ±1.492	56.55 ±6.285	<0.05	0.248	<0.05

***KOOS- Knee Injury and Osteoarthritis Outcome Score, LEFS- Lower Extremity Functional Scale**

DISCUSSION

The current study aimed to compare the effect of adding hip abductor strengthening to a quadriceps-hamstrings strengthening regimen versus quadriceps-hamstrings strengthening alone on pain, quality of life (QoL), and activities of daily living (ADL).

The findings of this study revealed that patients who underwent hip abductor strengthening in addition to quadriceps-hamstring exercises showed statistically significant improvements in KOOS and LEFS scores, with a p-value < 0.001, indicating greater reductions in pain and disability and enhanced functional performance.

These findings are in line with those reported by Karvannan Hari Kesavan et al. (2017), who demonstrated that incorporating hip abductor strengthening significantly improved QoL and ADL. This is due to the hip abductors' critical role in stabilizing the pelvis during gait, maintaining femoropelvic alignment, and efficiently transmitting force between the lower limbs and the trunk. [13]

Similarly, Varah Yuenyongviwat et al. (2020) found that supplementing standard quadriceps/hamstring strengthening with hip abductor exercises resulted in significant improvements. Their study highlighted the importance of strong hip abductors, such as the gluteus medius, in reducing the knee adduction moment (KAM) by up to 9%, thereby decreasing medial knee joint loading and pain. These biomechanical

benefits strongly align with the outcomes of the present study [17].

Further support comes from Thomas et al. (2022) whose research showed that hip abductor-focused rehabilitation resulted in meaningful pain reduction and QoL enhancement in patient's post-TKA. [18] Consistent with their results, the current study also observed improved ADL performance and reduced functional disability in the hip abductor intervention group.

The growing body of literature emphasizes the hip abductors' crucial role in TKA rehabilitation. Piva et al. (2011) reported that hip abductor strength had a stronger correlation with physical function than quadriceps strength, particularly in tasks such as stair negotiation. [19]

Karvannan et al. (2016) also found that adding hip abductor training led to superior results in functional mobility tests compared to conventional protocols. [20] Ammar Suhail et al. (2021) confirmed that combining hip strengthening with knee rehabilitation significantly reduced knee pain and improved health status, findings that resonate with those of the current study [21].

However, it is important to note contrasting evidence. A study by Margaret B. Schache et al. (2019) concluded that adding hip abductor strengthening to standard rehabilitation did not produce additional benefits in hip strength, KOOS, LEFS, or secondary outcomes at 6 or 26 weeks post-TKA [11].

CONCLUSION

The study concluded that incorporating hip abductor strengthening into a quadriceps and hamstrings strengthening program leads to greater improvements in pain, symptoms, quality of life, daily activities and lower limb function in patients who have undergone total knee arthroplasty (TKA).

Declaration by Authors

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