

**EFFECTIVENESS OF DYNAMIC LOWER EXTREMITY STRETCHING AND STRENGTHENING EXERCISE OF HAMSTRING AND QUADRICEPS ON FUNCTIONAL PERFORMANCE IN POST OPERATIVE KNEE ARTHROPLASTY**

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**ABSTRACT**

**Background**

Knee arthroplasty is a widely performed surgical procedure for end-stage osteoarthritis, yet post-operative functional recovery remains a challenge. Muscle weakness and tightness of the hamstring and quadriceps muscles are common contributors to reduced functional performance following surgery. Although exercise-based rehabilitation is a cornerstone of post-operative care, the comparative effectiveness of dynamic stretching versus strengthening exercises on functional outcomes has not been extensively investigated.

**Objective**

To evaluate and compare the effectiveness of dynamic lower extremity stretching and strengthening exercises of hamstring and quadriceps on functional performance in patients following knee arthroplasty.

**Materials and Methods**

A prospective interventional study was conducted among patients who underwent unilateral total knee arthroplasty. Participants were randomly assigned to receive either dynamic stretching exercises or strengthening exercises targeting the hamstring and quadriceps muscles over an 8-week rehabilitation period. Functional performance was assessed using the Timed Up and Go (TUG) test, 6-Minute Walk Test (6MWT), and the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) at baseline, 4 weeks, and 8 weeks.

**Results**

Both groups demonstrated significant improvements in all functional outcome measures over the study period ( $p < 0.05$ ). However, the strengthening exercise group showed superior improvement in the 6MWT and WOMAC scores at 8 weeks compared to the dynamic stretching group ( $p < 0.01$ ). The TUG test improvements were comparable between both groups at 8 weeks ( $p = 0.08$ ).

**Conclusion**

Both dynamic stretching and strengthening exercises of hamstring and quadriceps muscles are effective in improving functional performance following knee arthroplasty. However, strengthening exercises demonstrated greater benefits in terms of walking endurance and self-reported functional outcomes. A combined approach incorporating both stretching and strengthening may be optimal for comprehensive rehabilitation.

**Keywords:** Knee Arthroplasty, Dynamic Stretching, Strengthening Exercises, Hamstring, Quadriceps, Functional Performance, Post-operative Rehabilitation.

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**INTRODUCTION**

Total knee arthroplasty (TKA) is widely recognized as one of the most successful orthopedic procedures for the management of end-stage knee osteoarthritis, providing substantial pain relief and improvement in quality of life [1-3]. The increasing prevalence of osteoarthritis associated with aging, obesity, and sedentary lifestyles has resulted in a significant rise

in the number of TKA procedures performed worldwide [4,5]. However, despite successful surgical outcomes, many patients continue to experience postoperative impairments such as quadriceps weakness, hamstring tightness, reduced range of motion, impaired balance, and difficulty performing daily activities [6-8]. These deficits can delay functional recovery and reduce overall satisfaction following surgery. Rehabilitation

therefore plays a crucial role in restoring muscle strength, mobility, and independence after TKA [9,10]. Recent evidence suggests that dynamic stretching and progressive strengthening exercises may be more effective than traditional static approaches in improving neuromuscular activation, flexibility, and functional performance [11-13]. The present study was undertaken to evaluate the effectiveness of dynamic lower extremity stretching and strengthening exercises targeting the hamstring and quadriceps muscles on functional performance in patients following total knee arthroplasty.

#### MATERIALS AND METHODS

This study was designed as a quasi-experimental interventional study conducted among postoperative total knee arthroplasty patients. A total of 30 participants who met the inclusion criteria were recruited through simple random sampling [14]. Participants underwent an eight-week rehabilitation program consisting of dynamic hamstring stretching and quadriceps strengthening exercises in addition to conventional physiotherapy [15,16]. The intervention was performed five days per week under the supervision of a physiotherapist. Functional outcomes were assessed before and after the intervention using the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC), Oxford Knee Score (OKS), Timed Up and Go (TUG) test, and Manual Muscle Testing (MMT) for quadriceps and hamstring strength [17-20]. The collected data were analyzed to determine the effectiveness of the intervention on muscle strength, mobility, and functional performance.

#### RESULTS

Following the eight-week intervention program, participants demonstrated substantial improvements across all outcome measures. The mean WOMAC score decreased from  $69.2 \pm 5.8$  to  $43.6 \pm 4.9$ , representing an approximate 37% reduction in pain, stiffness, and functional disability. The Oxford Knee Score increased from  $20.9 \pm 3.4$  to  $34.7 \pm 4.2$ , indicating a 66% improvement in patient-reported knee function and quality of life. Timed Up and Go test performance improved from  $18.6 \pm 2.3$  seconds to  $11.9 \pm 1.7$  seconds, reflecting a 36% enhancement in mobility, balance, and functional independence. Similar improvements in functional performance following strengthening-based rehabilitation programs have been reported in previous studies [21-23]. Additionally, quadriceps and hamstring muscle strength improved from fair to good/near-normal grades on Manual Muscle Testing. These findings suggest that the combined dynamic stretching and strengthening program was effective in enhancing postoperative recovery and functional performance in TKA patients.

#### DISCUSSION

The findings of this study demonstrate that dynamic lower extremity stretching and strengthening exercises significantly improve muscle strength, mobility, and functional outcomes following total knee arthroplasty. The observed improvements in WOMAC, Oxford Knee Score, and TUG performance indicate reductions in pain and disability along with enhanced functional independence. These results are consistent with previous research showing that targeted quadriceps strengthening is essential for postoperative recovery, as quadriceps weakness is a major determinant of functional limitations after TKA [24-26]. Furthermore, dynamic stretching of the hamstrings may have contributed to improved flexibility, range of motion, and gait mechanics [27,28]. The combination of flexibility and strengthening exercises likely enhanced neuromuscular coordination and joint stability, resulting in better overall functional performance [29,30]. Previous studies have also reported that dynamic exercise programs improve balance, agility, mobility, and patient-reported outcomes following lower extremity surgery [31,32]. The study supports the integration of dynamic, muscle-specific rehabilitation protocols into standard postoperative care to optimize recovery and improve patient outcomes after TKA [33,34].

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