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Comparing the Efficacy of Enhanced Recovery Programs versus Progressive Resistive Exercise in Pre- and Post-Operative Total Knee Replacement Rehabilitation

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Abstract

Introduction: In today's sedentary lifestyle, both at work and home, people often prefer to rest rather than stay active. This inactivity can contribute to increased joint pain, particularly in the knees, which are crucial for supporting body weight and enabling movement. According to a 2017 report by the Indian Society of Hip and Knee Surgeons (ISHKS), osteoarthritis is the primary indication for total knee arthroplasty (**TKA**) in 97% of cases, with the majority of patients being women and the average age of surgery being 67 for men and 63 for women.

Aim & Objectives: To compare the efficacy of the Enhanced Recovery Program versus Progressive Resistive Exercise in pre- and post-operative total knee replacement rehabilitation.

Material and Methodology: After screening, 55 patients were initially enrolled; 5 dropped out pre-operatively. Pre-operative exercises were taught, and assessments were conducted using the Numeric Pain Rating Scale and Canadian Occupation Performance Measure. Participants were randomly assigned to Group A (ERP) or Group B (PRE). Post-operative assessments were conducted at 4 and 8 weeks. Five patients withdrew post-operatively. Data were collected and analyzed.

Result: The study included 50 patients aged 45-70 years who met the inclusion criteria and were followed for 8 weeks. Conducted in the Occupational Therapy department of a tertiary care hospital, the outcome measures were: Numeric Pain Rating Scale (NPRS), Canadian Occupational Performance Measure (COPM). Evaluations were performed one week pre-operatively, and at 4 and 8 weeks post-operatively.

Conclusion: Both the Enhanced Recovery Program and Progressive Resistive Exercise protocols are beneficial for reducing pain and improving performance and satisfaction in patients undergoing total knee replacement.

Keywords: COPM, ERP, ISHKS, NPRS, PRE, TKA

Introduction:

In today's sedentary lifestyle, both at work and home, people often prefer to rest rather than stay active. This inactivity can contribute to increased joint pain, particularly in the knees, which are crucial for supporting body weight and enabling movement.[1] Strong and healthy knees are essential for maintaining

an active lifestyle. However, conditions such as arthritis, osteoarthritis, injuries, and worn-out cartilage can cause knee inflammation, pain, and restricted flexibility, often leading to the need for knee arthroplasty.[2] Knee replacement surgery, where the knee joint is replaced with artificial materials, is the most recommended treatment for relieving knee pain and restoring function. According to a 2017 report by the Indian Society of Hip and Knee Surgeons (ISHKS), osteoarthritis is the primary indication for total knee arthroplasty (TKA) in 97% of cases, with the majority of patients being women and the average age of surgery being 67 for men and 63 for women.[3]

The International Classification of Functioning, Disability and Health (ICF) provide a framework for describing the functioning and disability related to health conditions. It emphasizes the positive abilities of individuals rather than focusing solely on disabilities. This framework helps in understanding the spectrum of problems faced by patients with osteoarthritis.[4,5] There are two main types of knee replacement surgeries: Total Knee Replacement and Partial Knee Replacement. TKA is suggested for patients experiencing severe pain, chronic inflammation, or significant knee deformities, while Partial Knee Replacement is recommended for those with arthritis confined to a specific area of the knee.

Enhanced Recovery Programs (ERP) represent a structured approach to patient care post-surgery, aiming to improve recovery times and reduce complications. Research suggests that early mobilization and resumption of normal activities post-surgery can significantly enhance recovery outcomes.[7]

Despite extensive research on both Enhanced Recovery Programs and Progressive Resistive Exercises, there is a lack of comparative studies between these two approaches in the context of TKA. This study aims to fill that gap, providing valuable insights into the efficacy of these rehabilitation programs. Various therapeutic approaches for total knee replacement rehabilitation include manual therapy, electrical modalities, active exercises, and advanced joint mobilization techniques.[9,10] This study specifically aims to determine the functional outcomes achieved after TKA in patients treated with either an Enhanced Recovery Program or Progressive Resistive Exercises.

Aim & Objectives:

To compare the efficacy of the Enhanced Recovery Program versus Progressive Resistive Exercise in pre- and post-operative total knee replacement rehabilitation.

Material and Methodology

Study Design: This experimental, interventional, comparative study utilized Block Randomization with Simple Random Sampling. The study protocol, informed consent documents, and case record form were reviewed and approved by the Institutional Ethics Committee of tertiary medical college and hospital.

Sample Size: A minimum sample size of 25 per group was determined using a 90% power and 5% α-error. A total of 50 subjects participated, with 25 in Group A (Enhanced Recovery Program) and 25 in Group B (Progressive Resistive Exercise).

Inclusion Criteria:

1. Individuals undergoing Total Knee Replacement.
2. Both male and female subjects aged 45-70 years.
3. Revision surgery for knee replacement.

Exclusion Criteria:

1. History of hip, knee, or ankle fractures.
2. Recent knee injuries.
3. Cognitive impairment.

Study Procedure: Subjects planned for total knee replacement were selected based on inclusion criteria. Informed consent was obtained after explaining the study's purpose, procedure, risks, benefits, and confidentiality assurance. After screening, 55 patients were initially enrolled; 5 dropped out pre-operatively. Pre-operative exercises were taught, and assessments were conducted using the Numeric Pain Rating Scale and Canadian Occupation Performance Measure. Participants were randomly assigned to Group A (ERP) or Group B (PRE). Post-operative assessments were conducted at 4 and 8 weeks. Five patients withdrew post-operatively. Data were collected and analyzed.

Treatment:

Pre-operative Phase: Patients were instructed to perform the following exercises 10 times, 3-5 times per day:

1. Ankle Pumps
2. Heel Slides
3. Quad Set with Towel
4. Short Arc Quad
5. Thigh Squeezes
6. Side-lying Straight Leg Raise
7. Straight Leg Raise
8. Clam Shells
9. Hamstring Curls

Post operative protocol

Enhanced recovery program:

1. Knee flexion
2. Ankle pumps
3. Inner range quads
4. Active knee extension
5. Walking with walkers
6. Stairs technique
7. Knee flexion in standing
8. Calf raises
9. hip abduction
10. Mini squads
11. Steps up for strengthening

Progressive resistive exercise:

1. SLR with resistance
2. Side lying slr with resistance
3. Pelvic bridging
4. Pelvic bridging with hip abduction with light resistance
5. Pelvic bridging with hip abduction with moderate resistance
6. Knee extension with light resistance
7. Hip abduction with light resistance
8. Hip abduction with moderate resistance
9. Knee flexion with light resistance
10. Knee flexion with moderate resistance
11. Knee flexion with maximum resistance
12. Hip flexion with maximum resistance
13. Hip flexion with light resistance
14. Hip flexion with moderate resistance

Results:

The study included 50 patients aged 45-70 years who met the inclusion criteria and were followed for 8 weeks. Conducted in the Occupational Therapy department of a tertiary care hospital, the outcome measures were:

Numeric Pain Rating Scale (NPRS)

Canadian Occupational Performance Measure (COPM)

Evaluations were performed one week pre-operatively, and at 4 and 8 weeks post-operatively. Data were entered into Microsoft Excel and analyzed using GraphPad Prism. Continuous variables were presented as mean ± SD, and categorical variables as frequency and percentages.

NPRS and COPM scores (performance and satisfaction) were compared at different follow-up periods within each group using one-way repeated measures ANOVA, with post hoc comparisons by Bonferroni t-test. Changes from baseline at 4 and 8 weeks post-op between the two groups were compared using independent t-tests for normalized data and Mann-Whitney tests for non-normalized data. A p-value <0.05 was considered statistically significant.

Table 1: Demographic characteristics of subjects

Sr.No.	Baseline Characteristics	Group A,(ERP)	Group B (PRE)
1	No. of subjects	25	25
2	Age range (years)	45-70	45-70
3	Mean age	60.56	60.72
4	Gender M/F	8/17	7/18

Graph 1- Gender distribution of study population

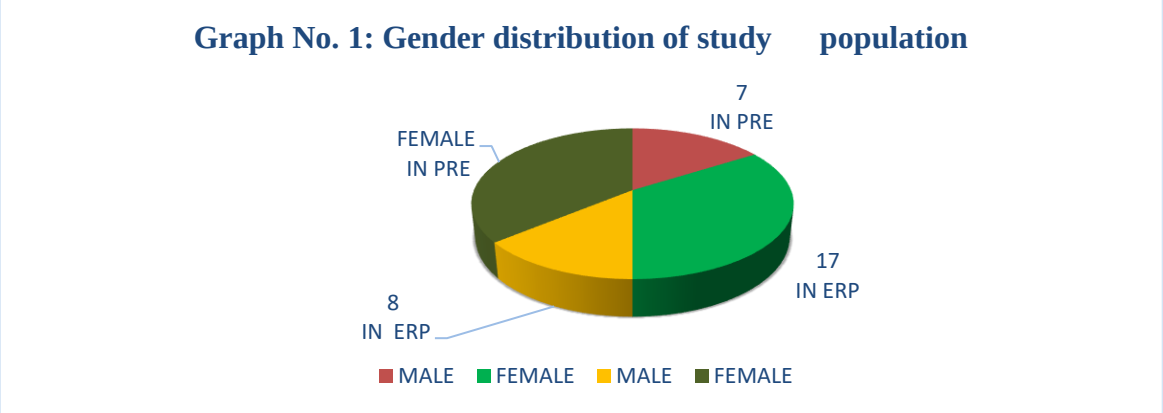


Table 2: Comparison of Numeric Pain Rating Scale (NPRS) in Group A and Group B.

Groups	ERP	PRE	P-value
	Mean ± Std. Dev.		
PRE-OP	4.52 ± 0.16	4.36 ± 0.81	>0.05
4th Week	8.16 ± 0.68	8.24 ± 0.77	>0.05
8th Week	3.16 ± 0.99	3.88 ± 1.2	>0.05

Graph 2: Comparison of Numeric Pain Rating Scale (NPRS) in Group A and Group B.

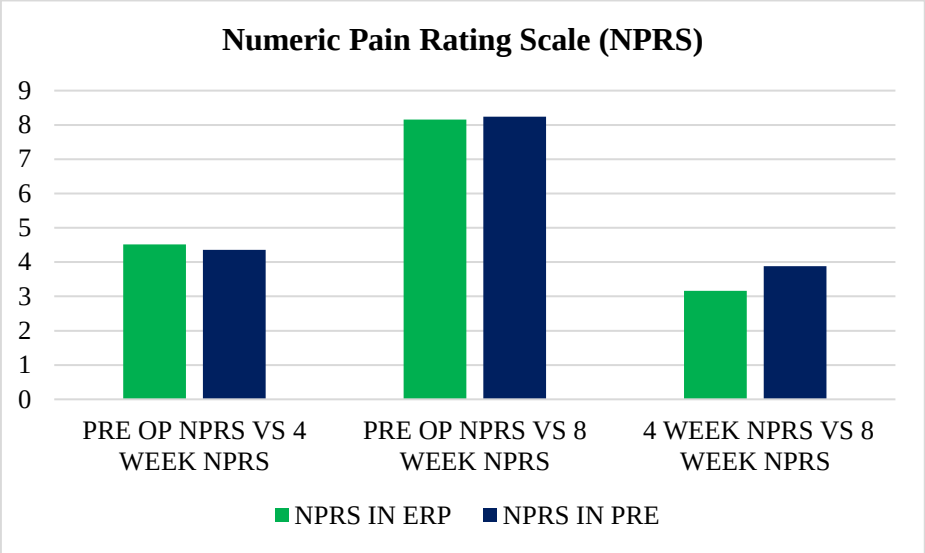


Table 3: Comparison of performance in Canadian Occupation Performance Measure (COPM) in Group A and Group B.

Groups	ERP	PRE	P-value
	Mean ± Std. Dev.		
PRE-OP	1.85±0.65	2.51±0.92	>0.05
POST OP 4th Week	5.24±0.93	5.59±1.35	>0.05
POST OP 8th Week	8.1±1.06	8.19±1.25	>0.05

Graph 3: Comparison of performance in Canadian Occupation Performance Measure (COPM) in Group A and Group B.

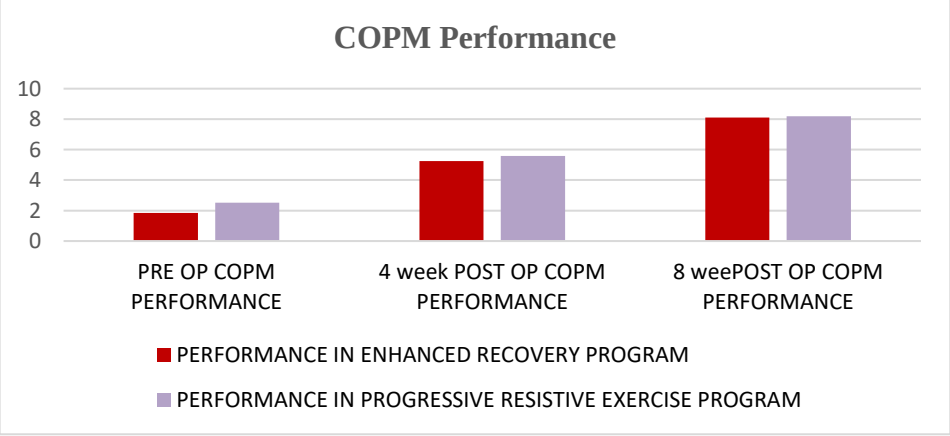
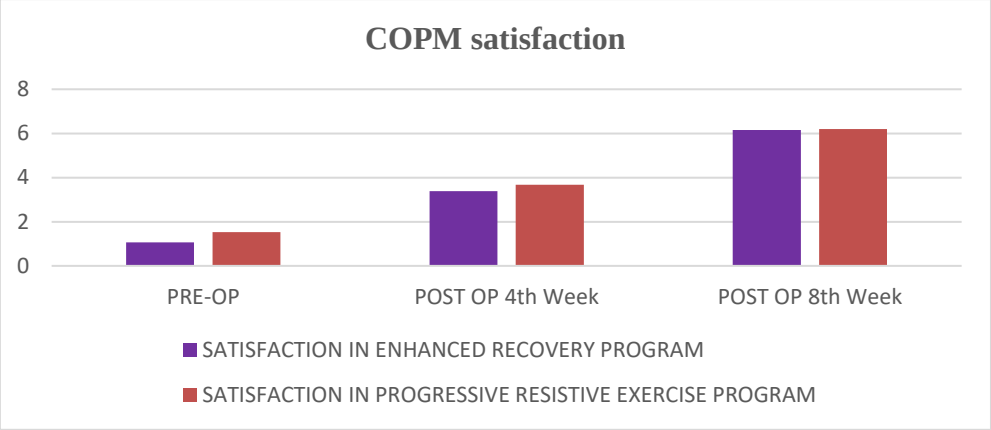


Table 4: Comparison of Canadian Occupation Performance Measure (COPM), for SATISFACTION in Group A and Group B.

Groups	ERP	PRE	P-value
	Mean ± Std. Dev.		

PRE-OP	1.07±0.30	1.53±0.65	>0.05
POST OP 4th Week	3.39±0.92	3.68±1.43	>0.05
POST OP 8th Week	6.16±1.18	6.20±1.51	>0.05

Table 4: Comparison of Canadian Occupation Performance Measure (COPM), for SATISFACTION in Group A and Group B.



Discussion

This study aimed to compare the efficacy of the Enhanced Recovery Program (ERP) versus Progressive Resistive Exercise (PRE) in pre- and post-operative rehabilitation for total knee replacement (TKR) patients. Fifty patients undergoing TKR were randomly divided into two groups: 25 patients in Group A (ERP) and 25 in Group B (PRE). Both groups received pre-operative exercises for a week and were evaluated using the Numeric Pain Rating Scale (NPRS) and Canadian Occupational Performance Measure (COPM) at one-week pre-operative, 4 weeks post-operative, and 8 weeks post-operative intervals.[12]

The mean age of participants in Group A was 60.56 years, and in Group B, it was 60.72 years. The gender distribution showed a higher prevalence in females, with 8 males and 17 females in Group A, and 7 males and 18 females in Group B. This aligns with previous research indicating that women are more prone to osteoarthritis due to hormonal changes, musculoskeletal differences, and biomechanical factors.[2,13,]

Regular exercise is known to alleviate pain by improving range of motion, muscle tone, strength, and flexibility, and by promoting the release of endorphins. Both groups began range of motion (ROM) exercises on the first post-operative day to prevent adhesions and improve recovery. Post-operative adhesions usually form within the first week after surgery, and early ROM exercises help mitigate this by promoting blood flow and reducing muscle tightness.[14]

Group A (Enhanced Recovery Program)

In Group A, significant improvements in pain scores were observed from pre-operative to 4 weeks post-operative and from 4 to 8 weeks post-operative. The ERP included exercises that increased blood flow and muscle relaxation, enhancing range of movement and reducing pain.[15] This is consistent with studies showing that preoperative hypoalgesia and aerobic exercise are associated with pain relief post-TKR. ERP also improved joint function and reduced complications, as noted in studies by Vaegter and

Handberg, and Jiang et al., who found that ERP effectively reduces postoperative pain and enhances joint function in elderly TKA patients.[16]

Group B (Progressive Resistive Exercise)

Group B also showed significant pain reduction from pre-operative to 4 and 8 weeks post-operative. The PRE program, which focuses on controlled and gradual muscle strengthening, demonstrated efficacy in decreasing pain and improving physical function. This aligns with findings by Vincent and Vincent, who highlighted that resistance exercise, is beneficial for reducing joint pain and improving muscle strength and joint mechanics, which are crucial for patients with knee osteoarthritis.[5,17,24]

Inter-group Comparison

There were no significant differences in pain reduction between the two groups, indicating that both ERP and PRE are effective in managing post-operative pain. Both groups also showed significant improvements in performance and satisfaction scores on the COPM from pre-operative to 8 weeks post-operative.[18,22] The ERP group benefited from reduced muscle wasting and improved mobility due to early mobilization, while the PRE group experienced gradual muscle strengthening, leading to enhanced physical function and self-efficacy.[19,25]

Performance and Satisfaction

The COPM performance scores showed significant improvement in both groups, with Group A showing slightly better performance at 8 weeks post-operative. This improvement is attributed to the structured nature of ERP, which reduces hospital stay and accelerates recovery.[20,21] Group B's progressive exercises led to steady improvements in muscle power and joint stability.

Satisfaction scores also improved significantly in both groups, with no major differences between them. Both protocols effectively enhanced patients' quality of life by reducing pain and improving functional abilities and satisfaction.[22,23]

Conclusion

Both the Enhanced Recovery Program and Progressive Resistive Exercise protocols are beneficial for reducing pain and improving performance and satisfaction in patients undergoing total knee replacement. The results indicate that both approaches can be effectively integrated into rehabilitation programs to achieve optimal outcomes for TKR patients.

Limitations:

1. The study's limited duration prevented the assessment of long-term effects.
2. The small sample size may limit conclusions on the dose-effect relationship of exercise, making generalization difficult.

Future Recommendations:

1. Incorporate electrical modalities with the Enhanced Recovery and Progressive Resistive Exercise programs.
2. Test the long-term effectiveness of Progressive Resistive Exercise.

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