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SHORT TERM EFFECTS OF CONTINUOUS PASSIVE MOTION (CPM) TREATMENT ON PAIN AND ROM IN SUBJECTS AFTER TOTAL KNEE ARTHOPLASTY

Physiotherapy

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ABSTRACT

Background: Total knee arthroplasty (TKA) is an effective surgical intervention for end-stage knee osteoarthritis, aimed at alleviating pain and restoring joint function. Early postoperative rehabilitation plays a vital role in optimizing recovery outcomes. Continuous passive motion (CPM) is frequently used as an adjunct to physiotherapy: however, its short-term efficacy remains debated. **Objective:** To evaluate the short-term effects of continuous passive motion (CPM) on Postoperative pain and knee joint range of motion (ROM) among subjects following TKA. **Methodology:** A pre and post – experimental study was conducted on 30 participants (aged 50-75 Years) who underwent unilateral TKA due to degenerative changes. From the third postoperative day, subjects received CPM therapy for 45 minutes, followed by 15 minutes of knee exercises, three times per week for four weeks. Pain was assessed using the Visual Analogue Scale (VAS), and ROM was measured with a universal goniometer. Pre and post – intervention data were statistically analyzed using paired t-tests, with significance set at $p<0.05$. **Results:** Post-intervention analysis revealed a statistically significant reduction in pain scores (mean decrease on VAS) and improvement in knee flexion ROM Compared to baseline ($p<0.05$). These findings indicate that CPM facilitates early functional recovery and enhances patient comfort during the postoperative phase. **Conclusion:** Continuous passive motion (CPM) with conventional physiotherapy, significantly reduces postoperative pain and improves knee joint mobility in the short-term period following Total Knee Arthroplasty. Further randomized controlled trials with larger sample sizes are recommended to validate these findings and determine optimal treatment parameters.

KEYWORDS

Continuous Passive motion, Total Knee Arthroplasty, Osteoarthritis, Rehabilitation, Pain, Range of motion.

INTRODUCTION:

Osteoarthritis of the knee (OA) also known as degenerative joint disease, is one of the most common musculoskeletal disorders worldwide. It develops due to wear and tear, leading to progressive loss of articular cartilage. Knee OA is especially common in elderly individuals and occurs more frequently in women than in men.

A major global cause of pain, disability, and functional limitation, osteoarthritis primarily affects weight-bearing joints. It is classified as primary, with no identifiable cause, and secondary, resulting from trauma, deformity, or systemic disease. Synovial inflammation plays a key role in its symptoms and progression.[1,2]

Globally, the prevalence of knee osteoarthritis has been reported as 16% in individuals aged 15 years and older, and 22.9% (approximately 654.1 million people) in those aged 40 years and above. [4] In India, the prevalence among people over 50 years of age has been reported to range between 17% and 61%. [3,4]

The incidence of osteoarthritis (OA) rises with age, with women showing higher incidence than men, especially after 50 years. By around 80 years of age, the incidence generally plateaus or begins to decline across different joint sites. [5]

Knee osteoarthritis (KOA) develops through combined mechanical and inflammatory changes. Factors such as aging, obesity, injury, and genetic predisposition disturb cartilage balance, initiating inflammation and cartilage degeneration. Progressive bone remodeling, osteophyte formation, and joint capsule thickening lead to stiffness, pain, and restricted knee movement.[6,7,8,9]

Causes of osteoarthritis of the knee include age- related cartilage degeneration, hormonal and anatomical factors in women, obesity that increases joint stress, and previous knee injuries. Occupational activities like frequent squatting, heavy lifting, and abnormal knee alignment (varus or valgus) also contribute to cartilage damage and disease progression. [10,11]

The signs and symptoms of knee osteoarthritis include joint pain, stiffness, restricted range of motion, and muscle weakness. With progression, it may lead to decreased physical activity, reduced fitness, sleep disturbances, persistent fatigue, depression, and long-term disability. [12] Risk factors include genetics, female sex, past trauma, advancing age, and obesity. [13]

Management of knee osteoarthritis involves education, self-care, weight control, and lifestyle modification. Physiotherapy, walking aids, braces, and heat/cold therapy form the first line of treatment. If symptoms persist, medications such as NSAIDs, acetaminophen, or injections (steroids, hyaluronic acid, PRP) may be used. Exercise, nutrition, yoga, and proper footwear provide additional support, while surgical options like arthroscopy or knee replacement are considered when conservative methods fail.

Total knee replacement (TKR), also known as total knee arthroplasty, is performed to relieve pain and improve function in patients with advanced knee joint damage, most commonly due to osteoarthritis.

Surgical treatment, particularly Total Knee Replacement (TKR), is widely recognized as the most effective intervention for relieving pain and improving functional status in patients with symptomatic, end-stage knee osteoarthritis. Surgical management is considered the treatment option for individuals whose symptoms persist despite all forms of conservative management. TKR provides significant symptomatic improvement in more than 85% of cases, with reported long-term failure rates of less than 1% per year, making it a highly reliable and durable option for advanced disease management. [14,15,16]

Clinically, two intervention strategies are commonly utilized to guide patients during postoperative rehabilitation — Continuous Passive Motion (CPM) and traditional physical therapy.

CPM, introduced in the 1970s, involves the use of a mechanical device that continuously moves the affected joint through a controlled range of motion. This method aims to enhance joint mobility and facilitate

functional improvement. Moreover, CPM has demonstrated positive biological effects on tissue healing, as well as in the reduction of edema and hematoma formation, thereby supporting faster and more effective postoperative recovery.[17,18,19,20,21,22]

CPM refers to a rehabilitation device/method that moves the knee joint passively through flexion and extension, usually immediately post-surgery, with the goal of improving range of motion (ROM), reducing stiffness, improving circulation, reducing pain etc.,

Short-term typically denotes the early recovery phase following TKA, ranging from the immediate postoperative period up to about 2-6 weeks. Most studies assess short-term outcomes at hospital discharge, within 1-3 weeks, or up to 4-6 weeks after surgery.

Aim:
The aim of the study is to evaluate the early effect of CPM in the subjects after total knee arthroplasty.

Objectives:
- To find out the effect of CPM on post operative pain in TKA subjects using VAS scale.
- To evaluate the effect of CPM on knee joint range of motion (ROM) using universal goniometer.

Materials And Methodology:
Materials Used For My Study Are:
- CPM machine
- Foam pads or cushions
- Adjustable straps
- Couch
- Visual analog scale questionnaire
- Universal goniometer

Methodology:
1. **Study Design:** Pre and post – experimental study design
2. **Study Setting:** BIRRD AND SVIMS
3. **Sample Size:** 30 participants
4. **Study Period:** 3 months
5. **Treatment Duration:** 1 session per day (60 minutes), 3 session per week for 4 weeks.

Inclusion Criteria:
- Patients underwent to undergo unilateral TKA due to degenerative changes
- Individuals aged 50 yrs to 75 yrs
- Body mass index <35kg/m^2
- Both males and females

Exclusion Criteria:
- Rheumatoid arthritis
- Post Osteotomy in lower limbs
- Secondary Osteoarthritis
- Subjects aged more than 75 years
- Surgery owing to cause other than degenerative changes
- Osteoporosis
- Cardiovascular disease
- Severe obesity (body mass index <35kg/m^2)
- Past history of surgical in lower limbs

Outcome Measures:
1. **Pain Intensity –** measured using the visual analog scale (VAS) questionnaire.
2. **Knee Range Of Motion (ROM) –** Measured using universal goniometer.

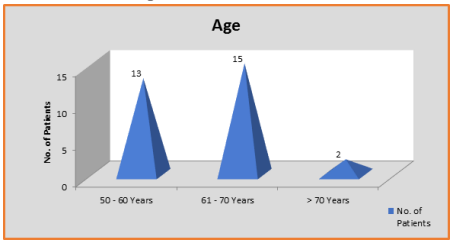
Procedure:
Subjects who fulfilled the inclusion and exclusion criteria and expressed willingness to participate were recruited to the study. Informed consent was obtained from all participants after providing a detailed explanation of the treatment procedure.

Starting from the third postoperative day, Subjects were given CPM therapy sessions under the supervision of a physiotherapist. The subjects are positioned in supine lying position, and CPM machine was placed under the lower limb with the flexion and extension range set according to the subject's pain tolerance. Knee range of motion (ROM) for both knee flexion and extension was recorded before and after each treatment, and any contraindications were noted. Each session lasted 45 minutes, after which 15 minutes of knee exercises were performed. This combined intervention was provided three times per week on alternative days and continued regularly for four weeks.

Results:
Age:
Table No.1

Age Group Yrs	Total	
	No. of Patients	%
50 - 60 Years	13	43.3
61 - 70 Years	15	50.0
71-75 Years	2	6.7
Total	30	100.0
Mean Age	61.60 ± 5.83	

Interpretation:
Categorization of subjects according to age includes 30 patients with an average age of 61.60 years, and a standard deviation of ± 5.83 years, indicating a moderately narrow spread around the mean.
- The majority of patients (93.3%) fall within the age range of 50 to 70 years.
- 50.0% of the patients are aged 61–70 years, making this the most represented age group.
- 43.3% are aged 50–60 years, also forming a significant portion of the population.
- Only 6.7% of patients are above 70 years, indicating fewer older individuals in the sample.

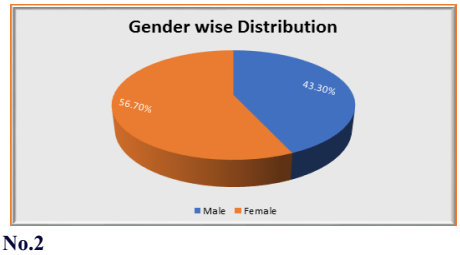


Graph No.1

Gender Wise Distribution
Table No.2

Gender		
	No. of Patients	%
Male	13	43.3
Female	17	56.7
Total	30	100.0

Interpretation:
Categorization of subjects according to gender includes a total of 30 patients, with the following gender breakdown:
- **Females:** 17 patients (56.7%)
- **Males:** 13 patients (43.3%)



Graph No.2
BMI (Body Mass Index)

Table No.3

Classification	BMI	
	No. of Patients	%
18.5-22	1	3.3
23-25	14	46.7
26-30	13	43.3
30-35	2	6.7
Total	30	100.0
Mean BMI	30.07 ± 3.005	

Interpretation:
Categorization of subjects according to BMI includes:

- The mean BMI of 30.07 places the average patient in the Obesity Class 1 category.
- The relatively low standard deviation (± 3.005) suggests that most patients have BMI values close to the mean, with limited variation.

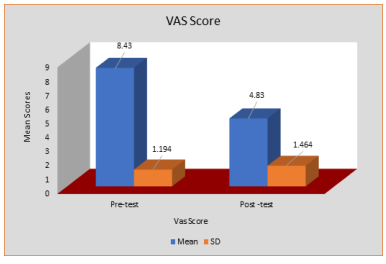
VAS Score
Table No.4

	N	Pre-Test Score Mean ± S. D	Post -Test Score Mean ± S. D	Mean Difference	t-value (p-value)	Sig. (2-tailed)
VAS Score	15	8.43 ± 1.194	4.83 ± 1.464	3.600	15.794**	0.000

**significant at 0.01 level; P < 0.01 (Highly Significant)

Interpretation:
Categorization of subjects according to VAS Score includes:

- The study measured VAS (Visual Analog Scale) scores before and after an intervention in 15 patients.
- The mean pre-test score was 8.43, indicating a high level of perceived pain or discomfort.
- After the intervention, the mean post-test score dropped to 4.83, showing a substantial improvement.
- The mean difference between the two scores was 3.600, suggesting a clinically meaningful reduction in symptoms.
- The t-value of 15.794 and a p-value of 0.000 indicate that this difference is highly statistically significant (p < 0.05).
- Therefore, the intervention had a statistically significant effect on reducing VAS scores.



Graph No.3

ROM - Table No.5

	N	Before Mean ± S. D	After Mean ± S. D	Mean Difference	t-value (p-value)	Sig. (2-tailed)
Knee Flexion	15	66.17 ± 6.209	92.97 ± 3.388	-26.800	22.755**	0.000
Knee extension	15	12.43± 1.695	10.53 ± 1.737	1.900	19.000**	0.000

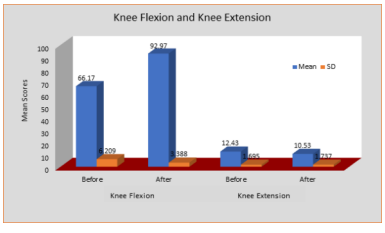
**significant at 0.01 level;

Interpretation:
Categorization Of Subjects According To ROM Includes:
Knee Flexion:

- Mean flexion improved from 66.17° to 92.97°, a mean increase of 26.8°.
- This large improvement is statistically significant (t = 22.755, p = 0.000).
- It indicates a marked enhancement in joint mobility or range of motion after the intervention.

Knee Extension:

- Mean extension improved (i.e., decreased) from 12.43° to 10.53°, a mean improvement of 1.9°.
- Though the change is smaller compared to flexion, it is still highly statistically significant (t = 19.000, p = 0.000).
- This suggests better joint straightening or reduced contracture post-intervention.



Graph No.4

DISCUSSION:

The present study evaluated the short-term effects of Continuous Passive Motion (CPM) therapy after Total Knee Arthroplasty (TKA), focusing on pain reduction and range of motion (ROM) improvement. Results showed a notable decrease in pain (VAS: 8.43 ± 1.19 to 4.83 ± 1.46) and significant gains in knee flexion and extension after four weeks of CPM. These findings suggest CPM effectively supports early postoperative recovery by enhancing joint mobility and reducing stiffness.

Most participants were aged 50–70 years and were overweight or obese, reflecting the common TKA population. Overall, the study confirms the short-term benefits and clinical relevance of CPM in postoperative TKA rehabilitation.

CONCLUSION:

Continuous Passive Motion (CPM) therapy, when combined with conventional physiotherapy, significantly reduces postoperative pain and enhances knee joint mobility during the early recovery phase following Total Knee Arthroplasty. The findings support the inclusion of CPM as an effective adjunct in the short-term rehabilitation protocol for TKA patients to facilitate faster functional recovery and improved comfort. Further large-scale studies are needed to explore its long-term benefits and to define standardized treatment parameters for clinical application.

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