ORIGINAL ARTICLE

IJPHY

Is Continuous Passive Motion Therapy Useful in Improving the Health-Related Quality of Life Among Long-Term Immobilized Patients Following Trauma or Surgery?

[*1]Arvind Kumar
[2]Vivek Gupta
[3]Anil K Gupta
[4]Dileep Kumar
[5]Ganesh Yadav

ABSTRACT

Background: A continuous passive motion (CPM) device moves the joints passively when they are delicate to move by muscular forces due to pain and/or weakness. CPM is often applied in musculoskeletal issues to counter restriction of joint range of motion (ROM) and to prevent the development of hematomas and edema. CPM effectively reduces joint hemarthrosis and periarticular edema while enhancing hemarthrosis clearance. CPM effectively reduces joint hemarthrosis and periarticular edema while enhancing hemarthrosis clearance. CPM after knee arthroplasty accelerates motion recovery and protects against DVT and vascular issues.

Methods: Based on the inclusion criteria, 48 subjects were selected for the study and allocated equally into two groups. Group A participants had undergone CPM therapy in addition to strengthening exercises of the lower limb, whereas Group B participants had continued conventional physiotherapy, i.e., knee mobilization and strengthening exercises, alternate days up to 3 weeks in a month for 6 months.

Results: The average age of the individuals in groups A and B was 44.57±6.84 and 46.71±6.68 years, respectively. The mean change in VAS scores from baseline to the final assessment was also significantly more significant in group A [-2.68±0.73], [p=0.0.4661] compared to group B [-1.85±0.83], [p<0.0001]. The test group A showed more significant improvement (p<0.01) in the HRQOL score compared to group B.

Conclusion: CPM is advantageous in alleviating pain and enhancing health-related quality of life, as the functional status, mental health, and satisfaction with treatment of patients who received CPM have indicated improved outcomes.

Keywords: Continuous Passive motion, Knee stiffness, range of motion of the Knee, Quality of life, Immobilization.

Received 11th December 2024, accepted 26th February 2025, published 09th March 2025

www.ijphy.com

10.15621/ijphy/2025/v12i1/1684

[2]Senior Teacher-Physiotherapy, Faculty of Paramedical Sciences, King George's Medical University, Lucknow, Uttar Pradesh.
[3]Professor & Head, Department of Physical Medicine & Rehabilitation, King George's Medical University, Lucknow, Uttar Pradesh.
[4]Professor, Department of Physical Medicine & Rehabilitation, King George's Medical University, Lucknow, Uttar Pradesh.
[5]Additional Professor, Department of Physical Medicine & Rehabilitation, King George's Medical University, Lucknow, Uttar Pradesh.

CORRESPONDING AUTHOR

[*1]Arvind Kumar

Associate Professor, Department of Physical Medicine & Rehabilitation, King George's Medical University, Lucknow, Uttar Pradesh.
Email: arvindmspt@yahoo.in

INTRODUCTION

A continuous passive motion (CPM) device moves the joints passively when they are delicate to move by muscular forces due to pain and/or weakness. The device is motorized, allowing repeated movements of the joints to a pre-set degree of movement and up to the extent of the number of movements. CPM is generally used for the knee, ankle, and elbow joints. [1,3,21]

CPM is frequently utilized in musculoskeletal problems to combat the limitation of joint range of motion (ROM) and to prevent the development of haematomas and edema, which could lead to fibrosis [2].

It is confirmed that immobilization led harmful impacts on the articular cartilage of rabbit knee joints due to degeneration of articular cartilage [3]. It is thought that "The relative place of rest and motion is considerably less controversial based on experimental investigation than based on clinical empiricism." This is due to the fact that immobility damages joints. Perhaps continuous movement would be even more useful for both healthy and injured joints if intermittent movement is more beneficial [4].

There is a significant possibility of venous thromboembolism when individuals are immobilized after experiencing injury or trauma. Orthopedic surgeons commonly use the pairing of low-molecular-weight heparin with graduated compression stockings to help avert such episodes, yet a considerably high occurrence of thromboembolic episodes persists. Mechanical instruments that provide continuous passive motion simulate muscle work and enhance the volume and speed of venous circulation. Venous stasis caused by the lack of muscle contraction in immobilized patients is a critical contributing factor [5].

Some theories suggest joint movement promotes 'healing and recovery of articular cartilage' [6, 7]. CPM is valuable in playing down the joint hemarthrosis and periarticular edema, and CPM has been observed to enhance the clearance of hemarthrosis [8]. Vasileiadis et al. (2021) affirmed the part of CPM within the development of heterotopic ossification by performing CPM restoration in a 46-year-old male with right deviation. Ceasing the movement and maintenance of heterotopic ossification significantly enhanced joint flexibility [9].

Following knee joint arthroplasty, CPM allows subjects to regain range of motion rapidly and protects against vascular complications like DVT (Deep vein thrombosis) [10].

A study conducted by John DP (1990) aimed to assess the result of continuous passive motion on wound healing, the health of its edges, and the knee's range of motion following arthroplasty. Furthermore, skin viability was evaluated objectively to identify which postoperative regimen reduced the adverse impacts of continuous passive motion on wound healing, revealing that continuous passive motion notably enhanced initial and terminal knee flexion, shortened hospital stays, and didn't raise the rates of exterior surface infections or issues with wound recovery. Knee flexion exceeding 40 degrees progressively reduced the viability of the lesion edges, especially the sides. Based on the given findings, a protocol for continuous passive motion was formulated to mitigate the adverse effects on wound viability [11].

Numerous studies have shown unfavorable outcomes of CPM, thus causing disputes on its effectiveness [12-14]. However, in contrast, many studies have indicated positive effects of CPM on the enhancement of ROM [15-17] and refinement in flexion or AROM during the duration of inpatient care that was 7 days or more [15-17].

The aim of the present study is to find out the effectiveness of CPM in improving the quality of life of long-term immobilized patients and, therefore, to conclude the positive effects of CPM therapy for the betterment of patients.

METHOD AND MATERIALS

A total of 48 subjects (25 male and 23 female) were selected (as per sample size calculation) to take part in the study based on the inclusion criteria, and they were allocated equally in two groups (Group A & B) using a lottery system of Microsoft Excel software. The study design was two group experimental pre-test post-test type. All the participants were under treatment in the Department of Physical Medicine and Rehabilitation and the Department of Orthopedic Surgery, King George's Medical University, Lucknow, Uttar Pradesh, India.

Inclusion criteria for the study were post-operative, post-injury knee stiffness and osteoarthritis of the knee. Exclusion criteria were the chronic stiffness of knee such as long term knee pain and restriction of movement following trauma, arthritis or surgery which cannot be managed conservatively and the cases of knee stiffness continuing other therapies or treatment such as mobilization and manual therapy treatment, Knee Active exercises protocol, Heat therapy and Electrical current application. The study spanned one year from the time subjects were recruited. Participants in the study were between the ages of 20 and 65. They were also required to give consent for active participation. Baseline data of all the participants were collected by a blinded observer following assessment for:

1. Health-related QOL using short form-36 [18]
2. Visual analogue scale (VAS) [19]

Intervention

Group A participants had undergone CPM application for 15 minutes once a day and thereafter knee mobilization and strengthening exercises (knee pendular exercises, active knee flexion and extension exercises), straight leg raise, and active ankle and foot exercises were practiced for 30 minutes twice daily with 20 repetitions of each up to six months. In contrast, Group B had continued conventional physiotherapy, i.e., knee mobilization and strengthening exercises (Knee Pendular exercises, active knee flexion extension exercises), Straight leg raises, and active ankle foot exercises, for 6 months. After six months, participants of both groups were under follow-up treatment. All the participants were reassessed after one year for the same outcome measures.

Statistical analysis

Statistical analysis was conducted by a statistician unaware of the treatment methods implemented in both groups. Continuous data is represented as mean ± SD, whereas dichotomous data is shown as percentages. The unpaired t-test was utilized to differentiate continuous variables between the groups pre- and post-intervention. The paired t-test was applied to examine the changes in continuous variables from pre- to post-intervention within each group. A p-value of ≤ 0.05 was considered to be statistically significant. Frequency tables were used to summarize the measurements from the groups. In addition, the Wilcoxon rank sum test was applied to assess the changes between the two groups over the two visits. Furthermore, the Mann-Whitney U test and Friedman ANOVA were used to illustrate the differences in pain scores between and within the groups. The data was analyzed using version 20 of the SPSS for Windows software.

RESULTS

The average age of the individuals in groups A and B was 44.57±6.84 and 46.71±6.68 years, respectively. There was no preponderance of any gender in both groups. The anthropometric data showed comparable height, weight, and BMI. No substantial difference was recorded in the demographics. [Table-1] At baseline, group A had a mean VAS score [6.17±1.71], while group B had a mean score [6.31±1.73], [p= 0. 0.4661] However, at the final assessment, group A had a significantly [p<0.0001*] lower mean VAS score [2.85±0.41] compared to group B with a mean score [4.76±1.98]. The mean difference in VAS scores from baseline to the final assessment was also significantly more significant in group A [-2.68±0.73] compared to group B [-1.85±0.83]. [Table 2] These data represent that group A experienced a more significant reduction in VAS scores and symptom improvement than group B, which only practiced routine physical therapy exercises.

Table 1: Demographic parameters of enrolled patients among groups.

Demographic parameterS	Group A [n=24]		Group B[n=24]		p-Value
	N/Mean	%/SD	N/Mean	%/SD	
AGE	44.57	6.84	46.71	6.88	t=0.753 p=0.4512
Gender					
Male	13	53.75%	12	50.63%	X=0.181 P=0.6727
Female	11	46.25%	12	51.38%	
Anthropometry					
Height	1.82	0.32	1.85	0.36	t=0.411 p=0.6634
Weight	66.10	10.65	64.96	9.80	t=0.246 p=0.8037
BMI	26.48	2.76	25.73	2.90	t=0.438 p=0.6381

Table 2: Comparison of the initial and final values for VAS of the participants enrolled in the groups.

VAS	Group A [n=24]		Group B [n=24]		p-Value
	Mean	SD	Mean	SD	
Baseline	6.17	1.91	6.31	1.73	t=0.715 p=0.4661
Post treatment	2.85	0.41	4.76	1.98	t=8.746 **p<0.0001***
Mean change [Final - Baseline]	-2.68	0.73	-1.85	0.83	t=14.860 **p<0.0001***

A significant finding of this study is that parameters associated with the quality of life markedly improved in groups (p<0.01), with the test group A showing greater improvement than group B. The parameters evaluated were the function, discomfort, self-perceived image, mental wellbeing, and management satisfaction, as shown in Table 3.

Table 3: Health-related quality of life evaluation

Variables	Group A (n=24)		Group B (n=24)		p-value
Function	**Mean**	±SD	**Mean**	±SD	
Pre-Intervention	2.15	0.44	2.46	0.61	0.24
Post- Interven-tion	4.19	0.02	3.86	0.55	p=0.001*
Mean difference	1.39	0.46	0.59	0.48	
p-value[2]	p=0.001*		p=0.002*		
Pain					
Pre-Intervention	2.47	0.16	2.19	0.38	0.42
Post-Intervention	1.74	0.81	2.73	0.35	p=0.0001*
Mean difference	1.43	0.43	0.69	0.38	
p-value[2]	p=0.001*		p=0.003*		
Mental health					
Pre-Intervention	3.91	0.48	3.41	0.45	0.17
Post-Intervention	2.89	0.47	3.12	0.40	p=0.02*
Mean difference	0.84	0.38	0.89	0.41	
p-value[2]	p=0.001*		p=0.002*		
Self-perceived image					
Pre-Intervention	2.52	0.28	2.65	0.08	0.12
Post-Intervention	3.51	0.31	3.41	0.14	p=0.001*
Mean difference	0.93	0.31	0.41	0.15	
p-value[2]	p=0.001*		p=0.002*		
Satisfaction with Management					
Pre-Intervention	2.72	0.16	2.98	0.01	NA
Post-Intervention	3.93	0.50	3.18	0.82	p=0.001*
Mean difference	1.98	0.51	0.69	0.75	
p-value[2]	p=0.001*		p=0.003*		

[1]Mann Whitney U test, [2]Wilcoxon rank-sum test, *Significant

DISCUSSION

The present study showed that CPM therapy and exercises are statistically effective following post-immobilization knee stiffness. However, from a clinical standpoint, the group A cases who had received CPM application experienced a greater reduction in pain and better scores on health-related quality of life than the group B cases who were practicing routine physical therapy exercises only.

In their research, Magdalena Richter et al. (2021) determined that CPM had significant positive outcomes on the personal evaluation of pain intensity, joint rigidity, and functional capability [20].

Johnson DP et al. (1992) in a study on the effects of CPM found that patients who underwent the CPM regimen post-surgery regained functional knee flexion more swiftly than those who were immobilized. This advantage did not compromise wound healing issues and therefore led to an earlier discharge from the hospital for both rheumatoid and osteoarthritic patients within this group. A cautious CPM regimen can thus be suggested as a safe and effective method for achieving quicker and more successful postoperative rehabilitation following knee arthroplasty in both rheumatoid and osteoarthritic individuals [15]. Continuous passive motion successfully improves short-term flexion and decreases the need for knee manipulation without increasing expenses. [16]

Harvey LA et al. (2014) in the Cochrane Database of Systematic Review of Continuous passive motion after total knee arthroplasty in individuals with arthritis established that Individuals who underwent CPM experienced an enhancement in quality of life equal to an average of 1 point on a 0- to 100-point scale at six months (1% absolute improvement, with reductions of 3% to increases of 4%) [21].

CPM has shown great results in this study in enhancing the quality of life among the cases. The results indicated a significant enhancement in the quality of life for patients receiving therapy by CPM. It was noted that there was a considerable improvement in HRQL parameters within the community of Group A. When the sample from group A was evaluated using the Short Form 36 (SF-26), all parameters, such as social functioning, emotional well-being, and physical well-being, showed significant improvement. Furthermore, there was a notable change in this group's level of discomfort compared to the other group.

CONCLUSION

Based on the findings of the current study, it is clear that CPM is advantageous in alleviating pain and enhancing health-related quality of life, as the functional status, mental health, and satisfaction with treatment of patients who received CPM have indicated improved outcomes. Consequently, the implementation of CPM is advised for patients following immobilization to alleviate pain and enhance quality of life. Nevertheless, further research is necessary to confirm the positive effects of CPM, as there are compelling arguments concerning the efficacy of this device.

Conflict of interest- No conflicts of interest were declared by the authors.

Source of funding- None

Consent- As per international or university standards, the authors have collected and preserved written participant consent.

Ethical approval- In accordance with international or university standards, the author(s) has obtained and maintained written ethical consent.

REFERENCES

[1] Salter RB, Hamilton HW, Wedge JH, Tile M, Torode IP, O'Driscoll SW, Murnaghan JJ, Saringer JH: Clinical application of basic research on continuous passive motion for disorders and injuries of synovial joints: a preliminary report of a feasibility study. J Orthop Res 1984, 1(3):325-342.

[2] O'Driscoll SW, Giori NJ. Continuous passive motion (CPM): theory and principles of clinical application. J Rehabil Res Dev 2000;(37):179-88

[3] Salter RB, Simmonds DF, Malcolm BW, Rumble EJ, MacMichael D, Clements ND. The biological effect of continuous passive motion on the healing of full-thickness defects in articular cartilage. An experimental investigation in the rabbit. J Bone Joint Surg Am. 1980 Dec; 62(8):1232-51.

[4] Salter RB. Motion vs. rest. Why immobilize joints? J Bone Joint Surg 1982;(64-B):251-4.

[5] Brotman DJ, Deitcher SR, Lip GY, Matzdorff AC. Virchow's trial revisited. South Med J 2004; (97):213-14.

[6] Salter RB. The physiologic basis of continuous passive motion for articular cartilage healing and regeneration. Hand Clin 1994;10(2):211-9.

[7] Salter RB. History of rest and motion and the scientific basis for early continuous passive motion. Hand Clin 1996;12(1):1-ll.

[8] O'Driscoll SW, Kumar A, Salter RB. The effect of continuous passive motion on the clearance of a hemarthrosis from a synovial joint. An experimental investigation in the rabbit. Clin Ortho1983; (176):305–11.

[9] Vasileiadis GI, Varvarousis DN, Manolis I, Ploumis A. The impact of continuous passive motion on heterotopic ossification maturation. Am J Phys Med Rehabil. 2021;100(12): 194–7.

[10] Vince KG, Kelly MA, Beck J, et al. Continuous passive motion after total knee arthroplasty. J Arthroplasty 1987;2(4):281.

[11] Johnson DP. The effect of continuous passive motion on wound-healing and joint mobility after knee arthroplasty. JBJS. 1990;72(3):421-6.

[12] Alkire MR, Swank ML. Use of inpatient continuous passive motion versus no CPM in computer-assisted total knee arthroplasty. Orthop Nurs 2010;29(1):36-

40.
[13] Beaupre LA, Davies DM, Jones CA, et al. Exercise combined with continuous passive motion or slider board therapy compared with exercise only: A randomized controlled trial of patients following total knee arthroplasty. Phys Ther 2001;81(4):1029-37.
[14] Chen LH, Chen CH, Lin SY, et al. Aggressive continuous passive motion exercise does not improve knee range of motion after total knee arthroplasty. J Clin Nurs 2013; 22(3–4):389-94.
[15] Johnson DP, Eastwood DB. Beneficial effects of continuous passive motion after total condylar knee arthroplasty. Ann R Coll Surg Engl 1992;74(6):412-16.
[16] Romness DW, Rand JA. The role of continuous passive motion following total knee arthroplasty. Clin Orthop Relat Res 1988;226:34-7.
[17] Ververeli PA, Sutton DC, Hearn SL, et al. Continuous passive motion after total knee arthroplasty: analysis of cost and benefits. Clin Orthop Relat Res 1995;(321):208-15.
[18] Ware JE Jr, Sherbourne CD. The MOS 36-item short-form health survey (SF-36). I. Conceptual framework and item selection. Med Care. 1992;30(6):473–83.
[19] Tashjian RZ, Deloach J, Porucznik CA, Powell AP. Minimal clinically important differences (MCID) and patient acceptable symptomatic state (PASS) for visual analog scales (VAS) measuring pain in patients treated for rotator cuff disease. J Shoulder Elb Surg. 2009;18(6):927–932.
[20] Magdalena Richter, Tomasz Trzeciak, Małgorzata Kaczmarek. Effect of continuous passive motion on the early recovery outcomes after total knee arthroplasty. International Orthopaedics 2021: 46(2):1-5.
[21] Harvey LA, Brosseau L, Herbert RD. Continuous passive motion following total knee arthroplasty in people with arthritis. Cochrane Database of Systematic Reviews 2014;2: CD004260.