

**A critical appraisal of “Prospective Randomized Trial of the  
Efficacy of Continuous Passive Motion Post Total Knee  
Arthroplasty: Experience of the Hospital for Special Surgery”**

**By**

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## **Abstract**

A clinical question about the effectiveness of continuous passive motion (CPM) compared to passive stretching for increasing knee range of motion (ROM) prompted a literature review and a subsequent critical appraisal of a 2015 article by Joshi et al. from The Journal of Arthroplasty. The article was selected based off its recency, strong experimental design, and its relevance to the clinical question. It addressed the ability of CPM to give better outcomes in ROM, clinical outcomes and complications, and discharge disposition for patients following total knee arthroplasty (TKA). This appraisal found that the introduction, methods, results, and discussion sections all had few errors and/or limitations. This prompted strong reasoning to support the results of the article. These results being that CPM therapy after TKA produced no significant differences in ROM gains or the other outcomes, and CPM should be removed from the standard of care to improve hospital costs. These results give an answer to the clinical question in that CPM is probably not any more effective than passive stretching in physical therapy.

## **Key words**

continuous passive motion, knee, total knee arthroplasty, range of motion, hospital

## **Introduction**

Continuous passive motion (CPM) is a therapy utilized by many people, mainly those with knee injuries, to recover range of motion (ROM) after surgeries. During CPM therapy, patients are strapped into a machine that automatically moves the knee back and forth through the ROM for several hours. To determine the efficacy of CPM therapy, this article was chosen for critical appraisal. Knowing whether CPM therapy is effective at recovering ROM is important because supplying and using these machines can be rather expensive compared to traditional stretching techniques. A comparison between CPM therapy and typical passive stretching done by a physical therapist was in order, so this question was formed. Is continuous passive motion therapy faster than passive stretching by the therapist during sessions for restoring knee range of motion?

## **Methods**

Before this appraisal was started, a literature review was needed to narrow down and eventually settle on one article to appraise. Two databases were used in this literature search: the U.S. National Library of Medicine (PubMed) and the Cumulative Index of Nursing and Allied Health Literature Complete (CINAHL). Within these databases, the following keywords were used to initiate the search: “continuous passive motion” and “knee”. Afterwards, several search limits were added including, articles published after 2001, full text results only, and controlled trials only. This way results were recent, fully available, and included setups that typically produce higher quality evidence. Articles that did not discuss the effect of CPM on ROM specifically as well as articles in which the experimental population did not have a current knee problem were excluded from this search. After choosing databases, keywords, limits, and exclusion criteria, about 50 results were available for further review.

The chosen article for this appraisal was published in The Journal of Arthroplasty in the year 2015. The clinicians and researchers that wrote this article did so to determine if policy changes were needed at their surgery hospital in New York City, New York. These authors were Rupali N. Joshi, PT, PhD, MEd, Peter B. White, BA, Mary Murray-Weir, PT, MBA, Michael M. Alexiades, MD, Thomas P. Sculco, MD, and Amar S. Ranawat, MD. This article was eventually chosen among others because after an initial evaluation of the intervention used, several criteria had been met to increase its validity. These criteria being that participants were randomly assigned to groups by an independent participant, the patients had similar demographic and clinical characteristics between groups, protocols were applied over a time frame adequate for outcomes to occur, and the researchers managed all groups in the same way except for the experimental intervention.

## **Results**

### Summary of the study

Past studies of CPM have produced mixed results regarding the ability of the therapy to increase ROM and decrease the time of acute care stays compared to traditional therapy. A randomized controlled trial was conducted on 109 patients after total knee arthroplasty (TKA) to determine if CPM produced significant differences in ROM improvement, hospital length of stay, and pain. The treatment group received CPM three times per day along with the standard physical therapy regimen, and the control group received only the standard regimen of two sessions per day with an additional ambulatory session. Outcome measures taken at six weeks and three months were unable to produce any clinically significant differences in favor of CPM regarding ROM, pain, and length of stay. These results conflicted with some studies that have

shown improvement and supported some studies that found no benefits from CPM. It was concluded that CPM should be removed from the standard of care to reduce hospital costs.

#### Appraisal of the study introduction

The strengths of the introduction section were as follows. It was mostly well written, explaining the importance of the study by explaining the importance of adequate knee ROM for activities of daily living and gait. It explained when CPM was introduced put into widespread use. It highlighted that much of the past research is conflicting on CPM efficacy, and it explained that despite the research, many hospitals still utilize CPM today. It used many up to date sources from credible journals as well. These sources were overwhelmingly primary research or meta-analyses. A proper conclusion was formed based off this background information, that CPM was likely unable to produce better outcomes for patients. A clear purpose and variables were outlined for this article. The purpose was to investigate the efficacy of CPM in their own institution to determine if it should be removed or maintained in the institution's standard of care. The independent variable was the use or nonuse of CPM during hospital stay. The dependent variables were active range of motion, length of stay, and complications and clinical outcomes (i.e. pain).

The weaknesses were very few and were as follows. There was not a definition of explanation of how CPM works, and there were a few articles referenced that may have been out of date. However, this may have been done to be comprehensive. Overall, the introduction was quite strong.

#### Appraisal of the study methods

The strengths of the methods section were as follows. The design of the protocol was experimental, prospective, and longitudinal, which allows for new data to be analyzed, the same

groups to be evaluated for outcomes, and more valid levels of evidence. The group assignment for each subject was concealed from the participant that enrolled people into each group, allowing for less bias in the placement process. The patients had similar demographic and clinical characteristics between groups at the start of the study. All patients were managed in the exact same manner with the only exception being the addition of CPM as an independent variable, allowing for a more controlled environment and setup. The instruments and outcome measures were described well, these being goniometry, length of stay, number of physical therapy visits, discharge location, the Western and McMaster Universities Osteoarthritis Index (WOMAC), and the Patient Administered Questionnaire (PAQ) for pain and psychological symptoms. The data collection procedure was described in clear detail so that replication would be easy to accomplish. Finally, the statistical tests were used in the correct context. The Mann-Whitney U tests were used for continuous variables, and the chi-squared and Fisher's exact tests were used for categorical variables.

The weaknesses were as follows. Neither the patients nor the clinicians were blinded to group assignments. However, this would be difficult to do with CPM machines. There was attrition from four subjects as well, caused by complications after surgery. This could have very slightly skewed the results. Parts of the intervention were not well described, with the control group only described as receiving a "uniform physical therapy regimen". This would make replication harder to accomplish. Finally, the reliability and/or validity of outcome measures were not noted, requiring additional reading to have this information. Overall, the methods had a couple of issues but were rather strong.

### Appraisal of the study results

The strengths of the results section were as follows. Each result was presented in the same order that the purposes were stated in the introduction and the procedures were presented in the methods. This made the results flow well. All research questions (ROM, complications and clinical outcomes, discharge disposition, and cost analysis) and outcome measures (goniometry, WOMAC scores, PAQ scores, length of stay, discharge location, number of visits, and cost analysis) were addressed as well, making for a complete results section. All tables and figures were presented clearly, with relevant data (e.g. *p* values) being easy to spot. Finally, confidence intervals and *p* values were set at 95% and 0.05, respectively. This was an appropriate alpha level for such an experiment.

The weaknesses were as follows. There was one discrepancy of a reported outcome measure. One of the tables indicated that preoperative to three-month improvement in PAQ scores was significantly better for the “no CPM” group, while the corresponding paragraph indicated that the score was significantly better for the “CPM” group. Otherwise, all other significant differences were correctly reported in favor of the “no CPM” group. Additionally, there was no mention of minimal clinically important difference (MCID) or number needed to treat (NNT) for any of the outcomes. Despite a few issues, the results section is still strong.

#### Appraisal of the study discussion

The strengths of the discussion section were as follows. It was reflective of the results section, addressing all aspects of the results and further indicating them instead of just repeating them. The results were put into context and not over concluded in that all statistically significant differences were found to not be clinically significant (this also effectively erased the discrepancy in the results section). The findings were compared to many up-to-date sources from controlled trials and meta-analyses, concluding that the results agree and disagree with several

sources. The limitations of the study were acknowledged as well, those being that there was no blinding of subjects or clinicians and that some patients received additional anesthesia or implants to meet their needs while in the hospital. Finally, it was reasonably concluded that CPM is neither hurtful or helpful, suggesting that it be removed from the standard of care.

The weaknesses were very few and as follows. The results were compared to some older sources, but this was probably to be comprehensive. Also, the authors did not suggest any future studies to further address this question. Overall, the discussion section was very strong.

## **Discussion**

This study was very relevant to the current practice of physical therapy because it makes an argument against continuing to use a costly machine for TKA rehabilitation. If CPM proves to incur no additional benefits (or negative benefits) there is no use in continuing to use it. However, if there are actual benefits from this therapy, its continued use may be crucial to shortening rehabilitation time for these patients. This study was relevant to the clinical question that launched this appraisal as well, as it compared CPM usage to traditional uniform therapy sessions. This clinical question addressed passive stretching specifically, but it is probable that the therapy sessions incurred by the control group involved passive stretching (as well as other techniques) to address ROM issues.

After a full appraisal of this article, one should argue against the continued use of CPM interventions. The results of previous studies were mixed at best, and the results of this strong article indicated that using CPM resulted in the same outcomes as not using CPM. It is possible that a select few may benefit more from this intervention, but most will likely have no real improvements if sound therapy is performed. Combine this with the added cost of CPM



machines, and the disadvantages clearly outweigh the advantages. If one could find a way to mitigate these extra costs, the argument in favor of CPM might be improved.

Based off the results of this study and others, I would be comfortable giving my future patients rehabilitation without CPM intervention. The results of this seemingly valid study and the overarching trend of research seem to suggest that CPM usage is negligible. Given my current knowledge, I feel I would be able to safely implement CPM into my practice, but I would not do so. I do not want to give my patients the additional cost burden.

In conclusion, this study presents with few errors and understandable limitations, and it makes a strong case against the continued use of CPM for TKA patients. It meets many criteria and misses very few that would increase its validity. Based off this appraisal, one should agree with the conclusions of this study. Additional funds should not be directed toward negligible practices, and it is likely that the time of CPM usage should be left behind.