



Cochrane in CORR

Cochrane in CORR®: Continuous Passive Motion Following Total Knee Arthroplasty in People With Arthritis (Review)

Harman Chaudhry MD, Mohit Bhandari MD, PhD, FRCSC

Importance of the Topic

Total knee arthroplasty (TKA) effectively reduces pain and improves function in most

patients. It is also one of the most commonly performed orthopaedic procedures [7]; one projection suggests that in the United States alone, more than 1.3 million TKAs will be performed per year by

2020 [12]. However, knee stiffness complicates approximately 1.3% of TKAs, severely limiting patients' function [11], reducing quality of life, and resulting in early revision [13].

Continuous Passive Motion (CPM) refers to the use of a motorized device that is applied to a patient's lower extremity, and continuously moves the patient's knee through a predefined arc of motion [8]. This device is typically used during the immediate postoperative period, and it has been theorized that early passive range-of-motion (ROM) can prevent the formation of adhesions that cause joint stiffness [15]. However, the cost of CPM devices can be high, and the efficacy of CPM is uncertain. This Cochrane systematic review and meta-analysis evaluated the efficacy of CPM in patients undergoing primary TKA [8]. Based on evidence from 24 randomized trials (pooled n = 1445), the authors concluded that there is very little advantage of using CPM after TKA.

A Note from the Editor-In-Chief: We are pleased to publish the next installment of Cochrane in CORR®, our partnership between CORR®, The Cochrane Collaboration®, and McMaster University's Evidence-Based Orthopaedics Group. In it, researchers from McMaster University and other institutions will provide expert perspective on an abstract originally published in The Cochrane Library that we think is especially important.

(Harvey LA, Brosseau L, Herbert RD. Continuous passive motion following total knee arthroplasty in people with arthritis. *Cochrane Database of Systematic Reviews* 2014, Issue 2. Art. No.: CD004260. DOI:10.1002/14651858.CD004260.pub3). Copyright © 2014 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd. Reproduced with permission. The authors certify that they, or any members of their immediate families, have no funding or commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article. All ICMJE Conflict of Interest Forms for authors and *Clinical Orthopaedics and*

Related Research® editors and board members are on file with the publication and can be viewed on request.

The opinions expressed are those of the writers, and do not reflect the opinion or policy of CORR® or the Association of Bone and Joint Surgeons®.

Cochrane Reviews are regularly updated as new evidence emerges and in response to feedback, and The Cochrane Library (<http://www.thecochranelibrary.com>) should be consulted for the most recent version of the review.

This Cochrane in CORR® column refers to the abstract available at DOI:10.1002/14651858.CD004260.pub3.

H. Chaudhry MD, M. Bhandari MD, PhD, FRCSC
Division of Orthopaedics, Department of Surgery, McMaster University, Hamilton, ON, Canada

H. Chaudhry MD (✉)
Center for Evidence-Based Orthopaedics, 293 Wellington Street North, Suite 110, Hamilton, ON L8L 8E7, Canada
e-mail: chaudhh@mcmaster.ca; harman.chaudhry@medportal.ca

Upon Closer Inspection

This review used the Grading of Recommendations Assessment, Develop-

Cochrane in CORR

ment and Evaluation (GRADE) approach to rate confidence in the pooled outcomes. The highest rating given was “moderate” confidence for three outcomes: Active knee flexion at 6 weeks (10 studies); function at 6 months (six studies); and quality of life at 6 months (two studies). For each of these outcomes, no significant differences were detected between the CPM and control groups.

While CPM was shown to be advantageous in reducing the proportion of patients undergoing manipulation under anesthesia at 6 weeks followup (the only endpoint for which CPM was found to be effective), this finding received a GRADE confidence rating of “very low” due to imprecision of the pooled effect estimate, lack of blinding in trials reporting this outcome, and high level of heterogeneity among trials. Another possible explanation for this finding is changes in practice patterns over time. None of the trials published after the year 2000 favored CPM as an effective means to reduce the likelihood a patient will undergo manipulation

under anesthesia, so it is possible that newer rehabilitation protocols or changing surgeon preferences pertaining to manipulation under anesthesia could have nullified the effects demonstrated in earlier trials [6, 14].

Take-Home Messages

The conclusions of this Cochrane review are consistent with previous systematic reviews [4], as well as recent recommendations of the American Physical Therapy Association to avoid use of CPM following TKA [1]. Two recently published randomized trials [3, 9] that were not included in this review have corroborated these conclusions as well, demonstrating no benefit for CPM over conventional physiotherapy. However, a poll taken at the American Association of Hip and Knee Surgeons annual meeting in 2009 demonstrated that the majority of orthopaedic surgeons (58%) used CPM following TKA [2], and no official recommendations pertaining to CPM

have yet been made by any major American orthopaedic organization. Given its lack of efficacy as demonstrated in this Cochrane review, clinicians should consider discontinuing the routine use of CPM as an adjunct to standard physiotherapy following uncomplicated primary TKA and orthopaedic surgery clinical practice guidelines should consider incorporating this evidence into their recommendations.

Importantly, trials within this review predominantly included cases of uncomplicated primary TKA. Thus, the results of this review do not necessarily apply to other procedures of the knee, including revision TKAs, or to cases with unique considerations where clinical judgment is still important. For instance, some surgeons believe CPM is important after manipulation under anesthesia given the high risk for recurrence of joint adhesions and stiffness [5, 10]. Further research is required to determine whether there are specific indications where CPM may be beneficial following TKA.

Cochrane in CORR

Appendix

Continuous passive motion following total knee arthroplasty in people with arthritis (Review)

Harvey LA, Brosseau L, Herbert RD



This is a reprint of a Cochrane review, prepared and maintained by The Cochrane Collaboration and published in *The Cochrane Library* 2014, Issue 2

<http://www.thecochranelibrary.com>

WILEY

Continuous passive motion following total knee arthroplasty in people with arthritis (Review)
Copyright © 2014 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

[Intervention Review]

Continuous passive motion following total knee arthroplasty in people with arthritis

Lisa A Harvey¹, Lucie Brosseau², Robert D Herbert³

¹Rehabilitation Studies Unit, Sydney Medical School/Northern, The University of Sydney, Ryde, Australia. ²School of Rehabilitation Sciences, Faculty of Health Sciences, University of Ottawa, Ottawa, Canada. ³Neuroscience Research Australia, Sydney, Australia

Contact address: Lisa A Harvey, Rehabilitation Studies Unit, Sydney Medical School/Northern, The University of Sydney, PO Box 6, Ryde, NSW, 1680, Australia. l.harvey@usyd.edu.au.

Editorial group: Cochrane Musculoskeletal Group.

Publication status and date: Edited (no change to conclusions), published in Issue 3, 2014.

Review content assessed as up-to-date: 24 January 2013.

Citation: Harvey LA, Brosseau L, Herbert RD. Continuous passive motion following total knee arthroplasty in people with arthritis. *Cochrane Database of Systematic Reviews* 2014, Issue 2. Art. No.: CD004260. DOI: 10.1002/14651858.CD004260.pub3.

Copyright © 2014 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

ABSTRACT

Background

Arthritis of the knee is a common problem causing pain and disability. If severe, knee arthritis can be surgically managed with a total knee arthroplasty. Rehabilitation following knee arthroplasty often includes continuous passive motion (CPM). CPM is applied by a machine that passively and repeatedly moves the knee through a specified range of motion (ROM). It is believed that CPM increases recovery of knee ROM and has other therapeutic benefits. However, it is not clear whether CPM is effective.

Objectives

To assess the benefits and harms of CPM and standard postoperative care versus similar postoperative care, with or without additional knee exercises, in people with knee arthroplasty. This review is an update of a 2003 and 2010 version of the same review.

Search methods

We searched the following databases: the Cochrane Central Register of Controlled Trials (CENTRAL) (*The Cochrane Library* 2012, Issue 12), MEDLINE (January 1966 to 24 January 2013), EMBASE (January 1980 to 24 January 2013), CINAHL (January 1982 to 24 January 2013), AMED (January 1985 to 24 January 2013) and PEDro (to 24 January 2013).

Selection criteria

Randomised controlled trials in which the experimental group received CPM, and both the experimental and control groups received similar postoperative care and therapy following total knee arthroplasty in people with arthritis.

Data collection and analysis

Two review authors independently selected trials for inclusion, extracted data and assessed risk of bias. The primary outcomes of interest were active knee flexion ROM, pain, quality of life, function, participants' global assessment of treatment effectiveness, incidence of manipulation under anaesthesia and adverse events. The secondary outcomes were passive knee flexion ROM, active knee extension ROM, passive knee extension ROM, length of hospital stay, swelling and quadriceps strength. We estimated effects for continuous data as mean differences or standardised mean differences (SMD), and effects for dichotomous data as risk ratios; all with 95% confidence intervals (CI). If appropriate, we performed meta-analyses using random-effects models.

Continuous passive motion following total knee arthroplasty in people with arthritis (Review)
Copyright © 2014 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Cochrane in CORR

Main results

We identified 684 papers from the electronic searches after removal of duplicates and retrieved the full reports of 62 potentially eligible trials. Twenty-four randomised controlled trials of 1445 participants met the inclusion criteria; four of these trials were new to this update.

There was moderate-quality evidence to indicate that CPM does not have clinically important short-term effects on active knee flexion ROM: mean knee flexion was 78 degrees in the control group, CPM increased active knee flexion ROM by 2 degrees (95% CI 0 to 5) or absolute improvement of 2% (95% CI 0% to 4%). The medium- and long-term effects are similar although the quality of evidence is lower.

There was low-quality evidence to indicate that CPM does not have clinically important short-term effects on pain: mean pain was 3 points in the control group, CPM reduced pain by 0.4 points on a 10-point scale (95% CI -0.8 to 0.1) or absolute reduction of -4% (95% CI -8% to 1%).

There was moderate-quality evidence to indicate that CPM does not have clinically important medium-term effects on function: mean function in the control group was 56 points, CPM decreased function by 1.6 points (95% CI -6.1 to 2.0) on a 100-point scale or absolute reduction of -2% (95% CI -5% to 2%). The SMD was -0.1 standard deviations (SD) (95% CI -0.3 to 0.1).

There was moderate-quality evidence to indicate that CPM does not have clinically important medium-term effects on quality of life: mean quality of life was 40 points in the control group, CPM improved quality of life by 1 point on a 100-point scale (95% CI -3 to 4) or absolute improvement of 1% (95% CI -3% to 4%).

There was very low-quality evidence to indicate that CPM reduces the risk of manipulation under anaesthesia; risk of manipulation in the control group was 7.2%, risk of manipulation in the experimental group was 1.6%, CPM decreased the risk of manipulation by 25 fewer manipulations per 1000 (95% CI 9 to 64) or absolute risk reduction of -4% (95% CI -8% to 0%). The risk ratio was 0.3 (95% CI 0.1 to 0.9).

There was low-quality evidence to indicate that CPM reduces the risk of adverse events; risk of adverse events in the control group was 16.3%, risk of adverse events in the experimental group was 15%, CPM decreased the risk of adverse event by 13 fewer adverse events per 1000 or absolute risk reduction of -1% (95% CI -5% to 3%). The risk ratio was 0.9 (95% CI 0.6 to 1.3). The estimates for risk of manipulation and adverse events are very imprecise and the estimate for the risk of adverse events does not distinguish between a clinically important increase and decrease in risk.

There was insufficient evidence to determine the effect of CPM on participants' global assessment of treatment effectiveness.

Authors' conclusions

CPM does not have clinically important effects on active knee flexion ROM, pain, function or quality of life to justify its routine use. It may reduce the risk of manipulation under anaesthesia and risk of developing adverse events although the quality of evidence supporting these findings are very low and low, respectively. The effects of CPM on other outcomes are unclear.

PLAIN LANGUAGE SUMMARY

Continuous passive motion after knee replacement surgery

Background

Knee replacement surgery is common for the management of arthritis but can cause knee stiffness. Knee stiffness can make it difficult to perform certain activities including standing up from a seated position. Continuous passive motion (CPM) is a way of providing regular movement to the knee using a machine. This Cochrane review presents what we know about the effects of CPM following knee surgery. After searching for all relevant studies in January 2013, we found 24 studies with 1445 participants who had knee replacement surgery primarily for knee arthritis. CPM was started from the first to the fourth day post surgery and applied for 1.5 to 24 hours a day, over 1 to 17 days. The review showed that CPM following knee replacement surgery probably improves the ability to bend the knee slightly and the person's quality of life but may not improve pain or function. We are uncertain about the effects of CPM on need for manipulation under anaesthesia, participants' perceptions of treatment effectiveness or risk of complications.

Best estimates of what happens to people who have CPM after knee replacement surgery are:

Continuous passive motion following total knee arthroplasty in people with arthritis (Review)
Copyright © 2014 The Cochrane Collaboration. Published by John Wiley & Sons, Ltd.

Cochrane in CORR

Range of motion - active knee flexion (i.e. ability to bend the knee)

People who had CPM were able to bend their knees an average of 2 degrees more (0 to 5 degrees more) than those who did not have CPM at six weeks (2% absolute improvement, 0 to 4% absolute improvement)

- People who had CPM were able to bend their knees an average of 80 degrees.
- People who did not have CPM were able to bend their knees an average of 78 degrees.

Pain (higher scores means worse or more severe pain)

People who had CPM rated their pain an average of 0.4 points lower (0.8 points lower to 0.1 points higher) on a 0 to 10 point scale at six weeks (4% absolute reduction, 8% reduction to 1% increase)

- People who had CPM rated their pain an average of 2.6 points on a 0 to 10 scale.
- People who did not have CPM rated their pain an average of 3 points on a 0 to 10 scale.

Function (higher scores means better function)

People who had CPM had a loss in function equivalent to an average of 1.6 points on a 0- to 100-point scale at six months (2% absolute reduction, 5% reduction to 2% increase).

- People who had CPM had function equivalent to an average of 56 points on a 0- to 100-point scale.
- People who did not have CPM had function equivalent to an average of 57.6 points on a 0- to 100-points scale.

Quality of life (higher scores means better quality of life)

People who had CPM had an increase in quality of life equivalent to an average of 1 point on a 0- to 100-point scale at six months (1% absolute improvement, 3% reduction to 4% increase).

- People who had CPM had a quality of life equivalent to an average of 41 points on a 0- to 100-point scale.
- People who did not have CPM had function equivalent to an average of 40 points on a 0- to 100-points scale.

Manipulation under anaesthesia

People who had CPM had a decrease in the risk of requiring manipulation under anaesthesia equivalent to an average of 25 fewer manipulations per 1000 patients (4% absolute risk reduction, 8% risk reduction to 0% risk reduction).

- People who had CPM had on average a 1.6% risk of requiring manipulation under anaesthesia.
- People who did not have CPM had on average a 7.2% risk of requiring manipulation under anaesthesia.

Adverse events

People who had CPM had a decrease in the risk of developing adverse events equivalent to an average of 13 fewer adverse events per 1000 patients (1% absolute risk reduction, 5% risk reduction to 3% risk increase).

- People who had CPM had on average a 15% risk of developing adverse events.
- People who did not have CPM had on average a 16.3% risk of developing adverse events.

Cochrane in CORR

References

- American Physical Therapy Association. Five things physical therapists and patients should question. Available at: <http://www.apta.org/ChoosingWisely/5Things/>. Accessed July 23, 2015.
- Berry DJ, Bozic KJ. Current practice patterns in primary hip and knee arthroplasty among members of the American Association of Hip and Knee Surgeons. *J Arthroplasty*. 2010;25:2–4.
- Boese CK, Weis M, Phillips T, Lawton-Peters S, Gallo T, Centeno L. The efficacy of continuous passive motion after total knee arthroplasty: A comparison of three protocols. *J Arthroplasty*. 2014;29:1158–1162.
- Brosseau L, Milne S, Wells G, Tugwell P, Robinson V, Casimiro L, Pelland L, Noel MJ, Davis J, Drouin H. Efficacy of continuous passive motion following total knee arthroplasty: A metaanalysis. *J Rheumatol*. 2004;31:2251–2264.
- Esler CNA, Lock K, Harper WM, Gregg PJ. Manipulation of total knee replacements: Is the flexion gained retained? *J Bone Joint Surg Br*. 1999; 81-B:27–29.
- Fitzsimmons SE, Vazquez EA, Bronson MJ. How to treat the stiff total knee arthroplasty? A systematic review. *Clin Orthop Relat Res*. 2010;468:1096–1106.
- Garrett WE, Swiontkowski MF, Weinstein JN, Callaghan J, Rosier RN, Berry DJ, Harrast J, Derosa GP. American Board of Orthopaedic Surgery practice of the orthopaedic surgeon: Part-II, certification examination case mix. *J Bone Joint Surg Am*. 2006;88:660–667.
- 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.
- Herbold JA, Bonistall K, Blackburn M, Agolli J, Gaston S, Gross C, Kuta A, Babyar S. Randomized controlled trial of the effectiveness of continuous passive motion after total knee replacement. *Arch Phys Med Rehabil*. 2014;95:1240–1245.
- Ingmar I, Mittag F, Lahrman J, Kunze B, Kluba T. Arthrofibrosis after TKA – influence factors on the absolute flexion and gain in flexion after manipulation under anaesthesia. *BMC Musculoskelet Disord*. 2011;12:184.
- Kim J, Nelson CL, Lotke PA. Stiffness after total knee arthroplasty. Prevalence of the complication and outcomes of revision. *J Bone Joint Surg Am*. 2004;86-A:1479–1484.
- Kurtz SM, Ong KL, Lau E, Bozic KJ. Impact of the economic downturn on total joint replacement demands in the United States: Updated projections to 2021. *J Bone Joint Surg Am*. 2014;96: 624–630.
- Le DH, Goodman SB, Maloney WJ, Huddleston JI. Current modes of failure in TKA: Infection, instability, and stiffness predominate. *Clin Orthop Relat Res*. 2014;472:2197–2200.
- Ranawat AS, Ranawat CS. Pain management and accelerated rehabilitation for total hip and knee arthroplasty. *J Arthroplasty*. 2007;22:12–15.
- Salter RB. The biologic concept of continuous passive motion of synovial joints. The first 18 years of basic research and its clinical application. *Clin Orthop Relat Res*. 1989;242:12–25.