Continuous passive motion following primary total knee arthroplasty: short- and long-term effects on range of motion
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CRD summary
This review set out to evaluate continuous passive motion after total knee arthroplasty for range of motion. The authors concluded that there was moderate, conflicting evidence of a positive, short-term effect of adding continuous passive motion to standardised physiotherapy, but no long-term effects. The conclusion appears appropriate, but potential selection bias and the omission of data may weaken this conclusion.

Authors' objectives
To investigate the efficacy of continuous passive motion after total knee arthroplasty for range of motion in the knee.

Searching
MEDLINE (1966 to July 2002), EMBASE (1988 to July 2002), CINAHL (1988 to July 2002) and the Cochrane Controlled Trials Register were searched; the search terms were reported. The reference lists of identified studies were screened. Studies published in English, Dutch and German were eligible for inclusion.

Study selection
Study designs of evaluations included in the review
Randomised controlled trials (RCTs) were eligible for inclusion.

Specific interventions included in the review
Studies evaluating post-operative continuous passive motion compared with no treatment or physiotherapy alone were eligible for inclusion. The included studies evaluated continuous passive motion either alone or in conjunction with physiotherapy, compared with physiotherapy, passive knee flexion, immobilisation and slider board, or compared different continuous passive motion regimes.

Participants included in the review
Studies of patients who had undergone a total knee arthroplasty were eligible for inclusion. No details of the participants in the included studies were provided.

Outcomes assessed in the review
Studies reporting on range of motion were eligible for inclusion. The primary outcome was flexion range of motion. The outcomes were classified as short term (5 to 14 days post-surgery) or long term (3 to 5 months post-surgery). Three studies assessed active range of motion, three assessed passive range of motion, one assessed both active and passive range of motion, and it was unclear which type of outcome assessment was carried out in eight. Where reported, the studies assessed outcomes between 5 days and 12 months post-operatively.

How were decisions on the relevance of primary studies made?
One author selected studies for the review.

Assessment of study quality
Study quality was assessed using the Maastricht Amsterdam Consensus List criteria, which assess the method of randomisation, similarity of the baseline characteristics and cointerventions, blinding of the carers, patients and assessors, compliance, drop-out rate, length of follow-up, and the use of an intention-to-treat analysis. Each criterion was classed as positive, negative, or unclear, and the total score (out of 10) for each study was the sum of the positive responses. Two reviewers independently assessed study quality. Any disagreements were resolved by consensus or consultation with a third reviewer.

Data extraction
Two reviewers independently extracted the data. The weighted mean differences and 95% confidence intervals were calculated for each study. Where the standard deviation was not reported, this was estimated either from the pooled standard deviation (using means, sample sizes and the P-values) or from graphs.

**Methods of synthesis**

How were the studies combined?
A pooled weighted mean difference and 95% confidence intervals were calculated for studies comparing continuous passive motion plus physiotherapy with physiotherapy alone, using a random-effects meta-analysis. Where less than 3 studies were available for a combination of the intervention, comparator and timing of outcome assessment, the results were combined in a narrative.

How were differences between studies investigated?
Heterogeneity between the pooled studies was assessed using the X^2 statistic. Some study details and results were tabulated. Differences between the studies were discussed in the text.

**Results of the review**

Fifteen RCTs (n=990) were included in the review.

For quality, one RCT scored 8 out of a possible 10, three scored 6, three scored 5, five scored 4, two scored 3 and one scored 2. All studies were scored positive for the method of randomisation, twelve for similarity at baseline, seven for blinding of the assessors, fourteen for length of follow-up, ten for drop-out rate, and three for the use of an intention-to-treat analysis. Blinding of the patients and carers was not applicable because of the intervention being evaluated.

Continuous passive motion plus physiotherapy versus physiotherapy: there was no statistically significant difference in short-term effects on flexion range of motion between continuous passive motion plus physiotherapy versus physiotherapy alone (WMD 8.27, 95% CI -1.60 to 18.15; five studies). There was highly statistically significant heterogeneity between these studies (p<0.0001). Four studies reported no statistically significant difference in long-term effects on flexion range of motion.

Continuous passive motion versus physiotherapy (two studies): one study reported better short-term effects of continuous passive motion in comparison with physiotherapy, while the other reported no difference between continuous passive motion and physiotherapy in either short- or long-term effects.

Continuous passive motion versus immobilisation (one study): both short- and long-term results favoured continuous passive motion over seven days of cast immobilisation.

Continuous passive motion versus slider board (two studies): there were no differences in short- or long-term effects between these treatments.

Continuous passive motion plus physiotherapy versus physiotherapy plus 'drop and dangle' (one study): there were no differences in flexion range of motion after 5 days, but slightly better range of motion with continuous passive motion plus physiotherapy after six months.

**Authors' conclusions**
The authors concluded that there was moderate yet conflicting evidence of a positive, short-term effect of adding continuous passive motion to standardised physiotherapy after total knee arthroplasty, but no long-term effects.

**CRD commentary**
The inclusion criteria were clear regarding the participants, interventions, outcomes and study design, and were relevant to the evaluation undertaken. Several relevant databases were searched. The review was restricted to published articles in three languages, which might have resulted in publication or language bias. A single author selected studies, therefore error and bias might have been introduced. The data extraction and quality assessment were conducted in duplicate, with study quality being assessed using suitable criteria.

Adequate study details were reported. The pooling of clinically and statistically heterogeneous data might not have been
appropriate. There was an inconsistency between the text and forest plot, as only four of the 5 studies stated in the text as being included in the meta-analysis were represented on the forest plot, with the fifth being a different study. Also, 2 studies omitted from the meta-analysis were also omitted from the narrative synthesis, therefore their results were not considered in the review. The conclusion appears appropriate based on the evidence presented, although the potential for selection bias and the omission of some data may weaken this conclusion.

**Implications of the review for practice and research**

**Practice**: The authors suggested incorporating continuous passive motion in inactive patients and in patients where rapid range of motion gain is of great importance.

**Research**: The authors suggested that future research should identify relevant subgroups and assess whether continuous passive motion is more effective in patients that are unable to undergo intensive physiotherapy, or where physiotherapy is unavailable. They also suggested investigating whether longer term use of continuous passive motion after surgery would be beneficial, and what the effect of continuous passive motion is on other outcome measures.

**Bibliographic details**


**PubMedID**

19881322

**DOI**

10.3944/AOTT.2009.412

**Original Paper URL**


**Other publications of related interest**


**Indexing Status**

Subject indexing assigned by NLM

**MeSH**

Arthroplasty, Replacement, Knee /rehabilitation; Humans; Knee Joint /surgery; Length of Stay; Motion Therapy, Continuous Passive; Motor Activity; Osteoarthritis /surgery /therapy; Prospective Studies; Range of Motion, Articular

**AccessionNumber**

12004008316

**Date bibliographic record published**

30/06/2006

**Date abstract record published**

30/06/2006

**Record Status**

This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.