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Effect of continuous passive motion on knee flexion range of motion after total knee arthroplasty

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ORIGINAL ARTICLE

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Abstract

Objective: To compare mean knee flexion in patients on continuous passive motion and those without it after total knee arthroplasty.

Methods: The randomised controlled study was conducted at Aga Khan University Hospital, from July 2013 to June 2014, and comprised patients who underwent total knee arthroplasty. Patients were randomly assigned to either group, with Group A receiving standardised physiotherapy from 1st postoperative day, and Group B receiving physiotherapy and one hour of continuous passive motion twice a day from 1st postoperative day until discharge. Outcome assessment was done on the day of discharge.

Results: Of the 76 patients, there were 38(50%) in each group. There were 61(80%) women and 15(20%) men, with a mean age of 65.5±7.9 years in Group A and 61.6±9.1 years in Group B. The mean preoperative knee flexion in Group A was 90.3±13.2° and in Group B it was 96.9±11.5°. Mean maximum flexion at the time of discharge was 96.3±5.7° in Group A and 94.3±8.4° in Group B (p=0.22). The mean length of stay in Group A was 6.1±1.4 days and in Group B it was 8.6±2.4 days (p=0.01).

Conclusion: Continuous passive motion had no influence on knee range of motion after total knee arthroplasty at the time of discharge.

Keywords: Knee arthroplasty, Osteoarthritis, Physical therapy modalities, Range of motion, Continuous passive motion. (JPMA 65: S-32 (Suppl. 3); 2015)

Introduction

Adequate and intensive rehabilitation is an important requirement for successful total knee arthroplasty (TKA) with the ultimate goal being pain-free function of the joint and improvement of the patient's quality of life. As functional activities are influenced by knee range of motion (ROM), it is considered one of the primary indicators of a successful TKA.[1]

Since long continuous passive motion (CPM) machines are frequently used as an adjunct to physiotherapy to promote a rapid postoperative recovery. Many studies have tried different CPM protocols and have revealed conflicting results regarding its effect on knee ROM. Some have shown that early postoperative knee ROM is improved with the addition of CPM,[2-4] whereas other studies have demonstrated no difference.[5-7] This difference may be attributed to variation in CPM protocols, sample sizes and differences of study design. However, it is clear that use of CPM does not affect the knee ROM in the long term.[8]

In our resource-constrained country, where patients finance their own healthcare expenditure, undergoing TKA involves substantial cost. The use of CPM postoperatively adds to this cost and the benefit achieved is controversial, putting its use in question.

The current study was planned to assess the effect of CPM on knee flexion ROM using the protocol prevalent at our institution.

Materials and Methods

The randomised controlled study was conducted at Aga Khan University Hospital (AKUH), from July 2013 to June 2014, and comprised patients who underwent TKA. The sample size was calculated with a study power of 90% and significance level of 5%.

All patients with osteoarthritis admitted for unilateral TKA were included. Those with primary diagnosis other than osteoarthritis, or undergoing revision TKA, or needing concurrent intervention during surgery that would influence the outcome (e.g. collateral ligament repair), or developing any major health complication during hospital stay (e.g. pulmonary embolism, myocardial infarction etc) were excluded.

After obtaining written informed consent, the patients were randomly assigned to two groups; Group A receiving standardised physiotherapy from 1st postoperative day, and Group B receiving physiotherapy and one hour of

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CPM twice a day from 1st postoperative day until discharge. Randomization was done using lottery method by a person not related to the study.

After collection of demographic data knee ROM was assessed preoperatively by a Tesident blinded to the randomisation, using a goniometer.

Surgery was performed by one of four admitting consultants respectively, each having greater than 5 years' experience in performing knee arthroplasty.

Standardised physiotherapy comprised bed-to-chair mobilisation, ambulation with walker and isometric and isotonic quadriceps strengthening exercises by a physiotherapist twice a day from 1st postoperative day. CPM started from 0°-30° with 10° daily increment until discharge. Outcome assessment was done on the day of discharge, usually 7th to 10th day of admission, by a Resident blinded to the intervention.

Data was entered and analysed using SPSS 19. Continuous variables like age, body mass index (BMI), knee flexion and length of stay were expressed as mean ± standard deviation, and categorical variables like gender as frequency/percentage. Student's t-test was used to compare the mean flexions between the groups with $p<0.05$ being considered significant. Effect of gender, BMI and preoperative knee flexion on the knee flexion at discharge was determined by analysis of co-variance.

Results

Of the 76 patients, there were 38(50%) in each group. There were 61(80%) women and 15(20%) men, with a mean age of 65.5±7.9 years in Group A and 61.6±9.1 years in Group B. Overall, 37(48.6%) patients were operated on their right knee, and 39(51.3%) on their left knee (Table-1). The mean preoperative knee flexion in Group A was 90.3±13.2° and in Group B it was 96.9±11.5°. Mean maximum flexion at the time of discharge was 96.3±5.7° in Group A and 94.3±8.4° in Group B (p=0.22) (Table-2).

Table-1: Demographics.

Group	A (No CPM)	B (CPM)
Number of Patients	38	38
Age (Mean with SD)	65.5 (7.9)	61.6 (9.1)
Sex		
Males	9	6
Females	29	32
Side		
Right	22	15
Left	16	23
BMI (Mean with SD)	33.6 (5.7)	31.9 (4.3)

CPM: Continuous passive motion
BMI: Body mass index
SD: Standard deviation.

Table-2: Mean pre-operation flexion and maximum flexion at discharge.

Group	A (No CPM)	B (CPM)	P-value
Pre-op Flexion (Mean with SD)	90.3 (13.2)	96.9 (11.5)	0.67
Flexion at Discharge (Mean with SD)	96.3 (5.7)	94.3 (8.4)	0.22

CPM: Continuous passive motion
SD: Standard deviation.

Table-3: Mean length of stay with standard deviation in both groups.

Group	A (No CPM)	B (CPM)	P value
Length of stay in days (mean with SD)	6.18 (1.4)	8.65 (2.4)	0.001

CPM: Continuous passive motion
SD: Standard deviation.

The mean length of stay in Group A was 6.1±1.4 days and in Group B it was 8.6±2.4 days (p=0.01) (Table-3).

The effect of gender, BMI, and pre-operative flexion on post-operative knee flexion at discharge was not significant (p>0.05 each).

Discussion

CPM originally was introduced to promote articular cartilage healing after trauma, but was applied to arthroplasty patients also with proposed advantages of increased ROM, diminished stiffness, reduced pain and decreased incidence of deep vein thrombosis (DVT).[9] Literature has failed to provide conclusive evidence favouring CPM with regards to any of these proposed benefits.[8]

With regards to early ROM, the evidence has remained controversial. Several studies have shown positive results in terms of ROM achieved in the first week after surgery.[2-4]

Early studies[10] found that the patients given CPM gained 90° flexion sooner than controls and still had better knee flexion two weeks post-operatively. Woods et al.[11] found that ROM at discharge was significantly greater in the CPM group and that this group also achieved independent straight-leg raising sooner than the control group.

Harms and Engstrom[12] noted that apart from increased flexion in the CPM group, patients with good pre-operative flexion did better post-operatively than those with poorer pre-operative ROM irrespective of which group they were in; a finding which our study failed to demonstrate.

Many researchers have found no statistically significant difference in ROM between the two groups in the early stages of recovery.[5-7] Vince et al.[13] reported that although the patients given CPM reached 90° sooner than the control group, by the date of discharge mean flexion in both groups was almost identical. Our study has also confirmed this by not showing any statistically significant difference in ROM at the time of discharge. Brosseau et al.,[14] concluded that CPM resulted in an additional four degrees of active knee flexion in the short term, but questioned the clinical significance of this small difference.

Our study also revealed a significantly increased length of stay in the CPM group which may be attributed to our CPM protocol with which it takes a week to gain a flexion of 90º.

Conclusion

There was no significant short-term difference in ROM with the addition of CPM in the rehabilitation of patients after TKA. Though a few studies have demonstrated short-term advantages of CPM, these effects on ROM are too small and clinically insignificant to justify its routine use which needs to be carefully weighed against its inconvenience and expense, especially in a resource-constrained environment.

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