Continuous passive motion compared to active physical therapy after knee arthroplasty

Similar hospitalization times in a randomized study of 68 patients

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68 consecutive patients who had primary knee arthroplasties because of arthrosis were randomized to postoperative continuous passive motion (CPM) or active physical therapy (APT). Rehabilitation in both groups was initiated on the first postoperative day. The CPM group sustained less postoperative knee swelling with more rapid initial improvement in knee flexion than did the APT group, but there were no differences between the groups in knee flexion at discharge. Postoperative pain rating and hospitalization times were similar in the two groups.

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Several retrospective studies (Davis 1984, Fisher et al. 1985, Goletz and Henry 1986, Gose 1987, Romness and Rand 1988) on knee arthroplasty have reported a favorable effect of CPM in reducing the hospitalization time and in facilitating early return of range of motion (ROM). These benefits were also noted by Coutts et al. (1984) in a prospective study of 82 patients. One randomized study (Colwell and Morris 1992) reported a decreased length of hospital stay while others could not reproduce the favorable influence of CPM (Lynch et al. 1988, Nielsen et al. 1988), although an initial improvement in ROM during the early postoperative period was demonstrated (Vince et al. 1987).

The duration of hospitalization, postoperative pain and knee swelling are related to knee motion. Therefore, early knee motion might have a positive impact on these factors. In this prospective randomized study, we assessed the effect of CPM on various factors related to knee motion.

Patients and methods

68 patients operated on consecutively because of gonarthosis were postoperatively randomized into a CPM group (continuous passive motion) or APT group (active physical therapy) and followed prospectively. All patients had an uncemented PCA (porous-coated anatomic) prosthesis: 25 tricompartmental and 43 unicompartmental (Table 1).

In the CPM group, continuous passive motion was applied for 3 hours 3 times daily, 7 days a week, using a Kinetec® machine. The range of motion was adjustable and it was increased until the patient experienced pain. The speed varied between 2 and 6 minutes per cycle and it was also adjusted up to the levels of pain. The patients were instructed to self-train actively when the knee was out of the machine. Instruction in proper walking technique was also given.

In the APT group, active physical therapy implied active and passive motion exercises of the knee, assisted by a physiotherapist 30 minutes twice daily, 5 days a week. Self-training was encouraged and instructions in proper walking technique were given.

In both groups, the therapy was initiated on the first postoperative day and continued until discharge. The criteria for discharge were active knee flexion of at

Table 1. Distribution of sex and surgical procedure

	CPM	APT
Number of patients	34	34
Excluded	6	2
Women / Men	24 / 4	24 / 8
Age	74 *5*	76 *6*
Knee flexion preop (°) [a]	112 *18*	114 *18*
Prosthesis		
unicompartmental	18	21
tricompartmental	10	11

CPM continuous passive motion.
APT active physical therapy.
[a] Mean *SD*

least 70°, no wound problems, ability to walk and to engage in daily life activity, including stair-climbing.

Pain at rest was estimated using a visual analog scale (VAS) on the 1st, 3rd and 5th postoperative days. Knee swelling preoperatively and at discharge were recorded. The mid-patellar circumference was determined using a measuring-tape. The intraobserver measurement error was ± 0.5 cm. Moreover, the number of days required to attain 70° knee flexion postoperatively as well as knee flexion at discharge were recorded. The ROM was determined with a goniometer. The intraobserver measurement error was ± 2°.

8 patients were excluded from the study, 6 patients assigned to the CPM group—inadequate CPM program (3), immobilization because of a superficial wound complication (2) and deep-vein thrombosis (1)—and 2 patients assigned to the APT group—superficial wound complication (1) and myocardial infarct (1).

The Mann-Whitney test was used for analysis of data from the ordinal, visual analog scale. The Student t-test was used to analyze all other data.

Results

There was no difference between the two groups with regard to the duration of hospitalization or postoperative pain. Postoperative knee flexion of 70° was attained earlier in the CPM group, but there was no difference between the groups in knee flexion at discharge. Knee swelling, measured as the difference in mid-patellar circumference pre/postoperatively for each patient, was less in the CPM group than in the APT group (Table 2).

Table 2. Distribution of postoperative hospitalization, postoperative pain, knee flexion and knee effusion. Mean *SD* or (range)

	CPM	APT	P-value
Hospitalization (days)	9 *3*	10 *4*	
Postoperative pain (VAS)			
day 1	7 (1–10)	8 (1–10)	
day 3	4 (1–8)	5 (1–10)	
day 5	5 (1–10)	5 (2–8)	
Mid-patellar effusion (cm)			
preoperative	43 *5*	41 *3*	
at discharge	44 *4*	44 *3*	
individual diff pre/post	1.3 *2*	4.6 *8*	< 0.05
Knee flexion at discharge (°)	77 *8*	76 *6*	
ROM 70° (days)	5 *2*	7 *3*	≤ 0.01

Discussion

Continuous passive motion is usually prescribed for 20 hours a day, but treatments as short as 3 × 1 hour daily have been studied (Gose 1987). Basso and Knapp (1987) found no improvement in knee motion in patients receiving CPM 20 hours daily compared with 5 hours. When CPM was prescribed for as long as the patient could tolerate, the average time was 10 hours daily from the third postoperative day (Lynch et al. 1988).

For practical reasons—e.g., patients leaving the ward for radiographic examinations—we found strict continuous treatment difficult to perform. Therefore, we used intermittent continuous passive motion for 3 hours 3 times daily.

In retrospective studies (Davis 1984, Fisher et al. 1985, Goletz and Henry 1986, Gose 1987, Romness and Rand 1988) showing improvement in knee motion using CPM, the selection criteria may be a confounding factor. In several prospective studies (Coutts et al. 1984, Ritter et al. 1989, Johnson 1990, Maloney et al. 1990, Colwell and Morris 1992), the CPM was started on the first postoperative day, whereas the APT was delayed for at least 3 days—meanwhile, the knee was immobilized. In fact, the comparison was between early knee motion, not specifically CPM, and postoperative immobilization.

In two prospective randomized studies (Vince et al. 1987, Lynch et al. 1988), CPM was prescribed for at least 10 hours daily and APT began in the control group on postoperative days 2–3. No effect of CPM on the duration of hospitalization or knee motion at discharge was found, in accordance with our results (Vince et al. 1987, Lynch et al. 1988). Criteria for discharge included factors such as ability to perform daily life activity and walk with canes. These factors are not strictly related to improved knee motion.

The difference in knee swelling pre/postoperatively was less using CPM. The long-time pumping effect (O'Driscoll et al. 1983) may be an explanation.

In conclusion, CPM provided an improvement in early knee motion. However, this did not affect hospitalization or postoperative pain.

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