THE EFFECTS OF CONTINUOUS PASSIVE MOTION FOLLOWING TOTAL KNEE ARTHROPLASTY

TUDOR SORIN POP[1], SÁNDOR ZUH[2], MARGIT HIDI[3], ATTILA VAS-TIFÁN[4], ISTVÁN GERGELY[5]

[1,2,5]University of Medicine and Pharmacy, Tîrgu-Mureş, [3,4]Mureş County Hospital

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Abstract: *With a sample of 80 subjects undergoing total knee arthroplasty with cemented total endoprosthesis, a prospective observational study was conducted on the influence of continuous passive mobilization on the development of joint mobility and on the quality of life. Patients in group I have performed daily active gym sessions, whereas the patients in group II received daily passive motion exercises. Comparing the average goniometric measurements between the two groups, the results revealed significantly differences from the second day to 6 weeks postoperatively: the joint mobility of patients in group II was significantly better than the mobility of patients in group I. At the 3 and 6 months postoperative evaluation, no significant differences were noted in the patients' mobility and quality of life. Skin complications were more common with patients in group II. Our findings show that continuous passive motion does not have clinically important effects on long term active knee flexion range of motion, function or quality of life.*

INTRODUCTION

Osteoarthritis of the knee is a condition in which the natural cushioning between joints (cartilage) wears away. Osteoarthritis of the knee is a degenerative joint disease characterized by loss of articular cartilage and adjacent bone remodeling associated inflammation. In advanced stages of the disease, total knee arthroplasty is the treatment of choice. The aim of surgery followed by postoperative recovery is correcting the affected limb alignment, relieving pain and restoring joint mobility and muscle strength.(1) The ultimate goal of the surgical treatment is the improvement of the patients' quality of life. Given that the number of days spent in hospital after surgery show declining trends, it is particularly important to identify the most effective methods of recovery. To restore joint mobility, in the first phase of recovery, many experts recommend the use of continuous passive motion devices. Continuous passive joint mobilization maintains the amplitude of motion range of the capsuloligamentous structures, increases the nutrition of articular structures, maintains or improves the neuro-muscular excitability, prevents the formation of adhesions, alleviates muscle contracture and/or restructure.(2) Yet, there are specialists who oppose the use of these devices, considering that it does not influence significantly the recovery process.

PURPOSE

The purpose of this paper is to assess the influence of continuous passive assets in the early phase of the recovery programme on the development of joint mobility and quality of life.

MATERIALS AND METHODS

Between September 2013 and June 2015, the Department of Clinical Orthopedics and Traumatology of Tîrgu-Mureş County Hospital conducted a prospective observational study on a sample of 80 study subjects undergoing total knee arthroplasty with cemented total endoprosthesis. The surgeries were performed according to the Clinic's protocol. Patients were excluded from the study if: age under 60 or over 80 years, contralateral symptomatic knee arthrosis (over 4 intensity on the visual analogue scale for pain), other orthopedic affections or the presence of neurological disorders that cause functional limitations, uncooperative or non-adherent patient for the proposed recovery programme.

We formed two groups of 40. The recovery programme recommended to patients in group I relied only on active gymnastics performed under the supervision of a physiotherapist. The time spent performing exercises was about 2 hours / day (4x30 min, with progressively increasing length and difficulty of the exercises). For the patients in group II, the daily active kinesiotherapy sessions were complemented with passive gym sessions. The time spent performing the recommended exercises was about 4 hours/day (2x1 h - mechanical passive mobilization during hospitalization, 4x30 minutes of active exercise with progressively increasing length and difficulty). During admission, all patients received daily sessions of gymnastics, initiated on the first postoperative day. In the first phase of recovery, the primary objective was to prevent the physical decline, improving joint mobility and muscle strength, resume walking with auxiliary support (a crutch) and making the patient independent (self-care). In the second phase of recovery, the objectives were to progressively increase the degree of flexion, improve muscle tone and strength of the operated limb and symmetric loading of the lower limb. The ultimate objective of the recovery was the complete stabilization of the articular amplitude and resume normal walking, possibly without auxiliary support.

Preoperative evaluation of patients was performed daily during hospitalization, the average hospitalization duration being 10 days, 6 weeks, 3 months and 6 months postoperatively.

[3]Corresponding author: Margit Hidi, Str. Mihai Viteazu, Nr. 31, 540080, Tîrgu-Mureş, România, E-mail: hidi_margit@yahoo.com, Phone: +40741 366147

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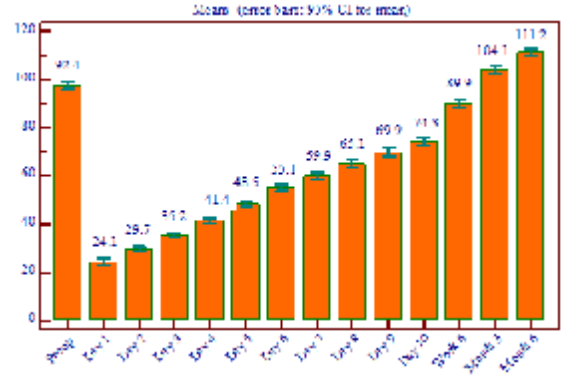
To accurately measure the joint mobility/range of motion, the knee was examined in the supine position. To test muscular endurance, the "six minute walk" test was applied. The evaluators measured the distance covered by the patient in six minutes on a flat surface. The patient was allowed to slow down, take breaks or rest, even to stop and resume the walk. Applying the Knee Society Score (KSS), the difficulty of performing every day activities was assessed.

All statistical calculations were performed using spreadsheets of the MedCalc software. The data thus obtained were considered both as nominal and quantitative variables. Nominal variables were characterized using frequencies. Quantitative variables were tested for normal distribution using the Kolmogorov-Smirnov test, and were characterized by the average percentage (25-75%), or, where appropriate, by the standard deviation. Quantitative variables were compared using a T-test and ANOVA test. To register multiple comparisons, the Bonferroni correction method was used. Statistical significance was set at $p < 0.05$.

RESULTS

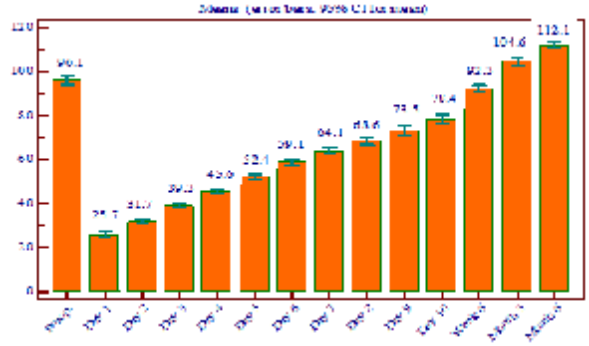
Repartition by age and gender of subjects included in the study was balanced. The evolution of the average values of active mobility is shown in figures no. 1, 2.

Figure no. 1. Evolution of the average values of active mobility – patients in group I



After statistically processing of the average post-operator goniometric measurements, in both groups, statistically significant differences were found (p-0.0001) between the medians of 13 developments.

Figure no. 2. Evolution of the average values of active mobility – patients in group II



For the comparison between the active range of motion values obtained preoperatively and at 6 months postoperatively with the contralateral knee range of motion, considered healthy, a student test was performed. There were significant differences between contralateral knee mobility and average values obtained preoperatively and between the values obtained preoperatively and 6 months postoperatively (p-0.0001). Between the average values obtained at the 6 month postoperative assessment and contralateral knee mobility, statistically significant values were not registered (p-0.4 in group I, group II p-0.3)

Comparing the average goniometric measurements between the two groups, statistically significant differences were registered from the second day to 6 weeks postoperatively, joint mobility of patients in group II was significantly better than that of patients in group I. There were no statistically significant differences found between average pre- and postoperative "6 minutes walk" test. The same applies also to KSS score at 3 and 6 months - no statistically significant differences found.

Table no. 1. The average values of evaluations

	Group I Mean (SD)	Group II Mean (SD)	$p^{\#\#}$ value
Goniometry (°)	**$p^{\#}$-0.0001**	**$p^{\#}$-0.0001**	
Preop.	97.48 (4.432)	96.1 (4.434)	**0.22**
Day 1	24.08 (4.548)	25.78 (4.627)	**0.10**
Day 2	29.70 (3.560)	31.75 (3.152)	**0.0008***
Day 3	35.25 (3.152)	39.33 (3.222)	**0.001***
Day 4	41.45 (3.328)	45.68 (3.339)	**0.001***
Day 5	48.55 (3.602)	52.43 (3.537)	**0.001***
Day 6	55.18 (4.302)	59.13 (3.743)	**0.001***
Day 7	59.95 (4.546)	64.13 (4.916)	**0.001***
Day 8	65.38 (4.932)	68.63 (5.271)	**0.003***
Day 9	69.93 (5.408)	73.50 (6.118)	**0.007***
Day 10	74.35 (5.646)	78.40 (6.503)	**0.004***
Week 6	89.95 (5.007)	92.35 (5.021)	**0.03***
3 Months	104.00 (5.079)	104.65 (4.572)	**0.54**
6 Months	111.23 (4.104)	112.08 (4.451)	**0.37**
6 minute walk test	**$p^{\#}$-0.0001**	**$p^{\#}$-0.0001**	
Preop.	280.13 (40.173)	284.48 (39.401)	**0.63**
3 Months	459.28 (60.484)	461.28 (60.19)	**0.88**
6 Months	457.08 (57.685)	476.30 (57.676)	**0.92**
KSS	**$p^{\#}$-0.0001**	**$p^{\#}$-0.0001**	
Preop.	33.13 (3.988)	32.82 (3.312)	**0.70**
3 Months	78.95 (2.970)	79.35 (2.842)	**0.54**
6 Months	91.00 (1.908)	91.95 (1.648)	**0.63**

*The level of statistical significance was set at $p<0.05$. $p^{\#}$- obtained by comparing vertical data; $p^{\#\#}$- obtained by comparing horizontal

Skin complications were more common in patients in group II. In 3 patients, the emergence of a defect of skin necrosis with small wound on the distal was noted, yet, in group I, just one patient showed similar symptoms.

DISCUSSIONS

In the present study, we evaluated the influence of continuous passive mobilization at the beginning of the recovery programme on the development of joint mobility and quality of life. The importance of continuous passive motion in the knee arthroplasty recovery is a subject much discussed and debated by specialists worldwide, but nevertheless there is still no universally accepted view about the importance of using this type of exercise in recovering knee prosthesis. Numerous studies (3,4,5) demonstrated that at 6 months postoperatively, there are no significant differences between patients who received only active gymnastics and patients whose rehabilitation programme was completed with daily sessions of passive motion. Some authors recognize the benefits of using passive motion devices, but they did not recommend its prolonged use as an adjunct to physiotherapy, as these did not offer any significant benefit concerning the range of knee motion and knee function.(6,7,8) Miniar et al. (9) even discouraged the use of continuous passive

motion after knee arthroplasty, supporting that it not only did not significantly improve immediate functional recovery, but also had a negative impact on postoperative swelling. Pope et al. (10) found that those patients who had CPM had a significant increase in analgesic requirement.

Complications resulting from the application of CPM can occur. Among the literature on wound complications following knee replacement we found many studies that did not find an increase in wound healing complications with CPM use (11,12), but Maloney (13) et al. did found. According to the results of the present study we concluded that skin complications are more common in patients receiving passive mobilization.

Currently, there is very little information that allows clinicians to select the optimum parameters for the use of passive motion devices, such as boot time exercises, the optimal number of daily degrees of advancement during exercises or the duration of the performed passive exercises.(14,15) The subject of a future study could be optimizing initialization time of passive motion, the daily degrees of progress and the time required to obtain beneficial effects.

CONCLUSIONS

Our findings show that continuous passive motion does not have clinically important effects on long term active knee flexion range of motion, function or quality of life to justify its routine use. There were some differences at 6 weeks after operation, but after 6 months, all the patients had achieved ranges of movement comparable with their contralateral knee. The frequency of skin complications was increased in patients who have received passive mobilization exercises.

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