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## Analysis of rehabilitation procedure following arthroplasty of the knee with the use of complete endoprosthesis

### Authors' Contribution:

- A** Study Design
- B** Data Collection
- C** Statistical Analysis
- D** Data Interpretation
- E** Manuscript Preparation
- F** Literature Search
- G** Funds Collection

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### Summary

#### Background:

The use of endoprosthesis in arthroplasty requires adaptation of rehabilitation procedures in order to reinstate the correct model of gait, which enables the patient to recover independence and full functionality in everyday life, which in turn results in an improvement in the quality of life.

#### Material/Methods:

We studied 33 patients following an initial total arthroplasty of the knee involving endoprosthesis. The patients were divided into two groups according to age. The range of movement within the knee joints was measured for all patients, along with muscle strength and the subjective sensation of pain on a VAS, and the time required to complete the 'up and go' test was measured. The gait model and movement ability were evaluated. The testing was conducted at baseline and after completion of the rehabilitation exercise cycle.

#### Results:

No significant differences were noted between the groups in the tests of the range of movement in the operated joint or muscle strength acting on the knee joint. Muscle strength was similar in both groups. In the "up and go" task the time needed to complete the test was 2.9 seconds shorter after rehabilitation in Group 1 (average age 60.4), and 4.5 seconds shorter in Group 2 (average age 73.1).

#### Conclusions:

The physiotherapy procedures we applied, following arthroplasty of the knee with cemented endoprosthesis, brought about good results in both research groups of older patients.

#### key words:

physiotherapy • kinesitherapy • arthroplasty of the knee

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## BACKGROUND

The first endoprosthesis of a knee joint was implanted in the 1950s, with work upon its construction being carried out by, among others Smith-Petersen, Waldius, Campbell. These prostheses had a hinge construction and as a result often became loose. In the 1960s and 1970s a new type of prosthesis became available. In 1971 the Canadian Frank H. Gunston in cooperating with Sir John Charnley on a new type of hip joint prosthesis, composed of a metal femoral part and a polyethylene acetabulum fastened by cement, developed a polycentric prosthesis of the knee joint [1]. From then onwards there has occurred constant improvement based on conducted research in enhancing prosthesis construction in order to allow for the best possible reflection of movement in a natural joint, as equally work into the materials used in its construction so that the best biocompatibility with human tissue can be obtained. Many prosthesis models have been built. At present two types are the most frequently used: unbound prosthesis, the so-called sledge prosthesis, and semi bound prosthesis, the so-called rear stabilised with a hinge fulfilling the function of the posterior cruciate ligament. One may list many types of prosthesis allowing at present individual application with regard to a given patient, including also, for example, unicompartmental prosthesis. Both types of prosthesis have their adherents. In the case of unbound prostheses the possibility of achieving a greater range of bending movement in the knee joint as well as the physiological model of gait is emphasised. In turn semi bound prostheses give greater possibilities for correcting deformation in the knee joint, however they are also the cause of an appearance of cutting forces can result in loosening. Yet, as is emphasised by the authors of publications the frequency of loosening in both types of prosthesis is comparable [2,3]. The progress and development of arthroplasty with the use of endoprosthesis resulted in the need to adapt the rehabilitation proceedings in order for it to be the most beneficial for the patient. There are many factors equally before, during and post operational which condition the final treatment effect obtained, while the main aim of the operation is a reduction in pain experienced and an increase in the scope of movement within the joint, which has been limited more often than not by pathological changes generally defined as degenerative [4,5]. Both of these factors are designed to return a correct model of gait as well as enable the patient to return to independence and activeness in everyday life which at the same time influences the patient's quality of life. Of importance therefore is the appropriate conducting of rehabilitation directed equally to individual patient possibilities as contemporary treatment norms. One may still find described in publications from the mid 1990s post-operational proceedings commenced on the 2–3 day through kinesitherapy (active-passive exercise, active) intensified through subsequent days. Only on the eighth day was it recommended to sit with suspended lower limbs while on the 10<sup>th</sup> day tilting to an erect position was commenced in order for the patient to be taught to walk from day 12–14 [6]. In the tests of Nolewajka et al (2008) into the factors of thrombosis risk for deep veins of the lower limbs in patients after complete arthroplasty, it was claimed that besides other factors such as, for example, age, obesity, and operation duration time equally the time spent erect had a significant effect in the prevention of thrombotic-embolic complications. At present,

bearing in mind the need for the individual application of the rehabilitation programme for each patient, rehabilitation proceedings are commenced on the 1–2 day starting with breathing, isometric, active-passive and active exercises. On the 2–3 day making the patient erect is conducted in the initial period with the help of a tall Zimmer frame and subsequently the learning to walk with elbow crutches. Around day 7–9 learning to walk up stairs is introduced and depending on the patient's fitness, walking with just one elbow crutch [2,7,8].

## MATERIAL AND METHODS

The research was conducted in 2008 at the Cracow Rehabilitation Centre. 33 patients were qualified for the tests after having undergone total arthroplasty of the knee with the use of complete cemented endoprosthesis. The patients were divided into two groups according to age. In Group 1 were 15 patients aged up to 65, while Group 2 was composed of 18 individuals aged over 65. All the patients were rehabilitated according to the same programme which had been used in the Cracow Rehabilitation Centre since 2005. Before the operation the patient is taught to walk on elbow crutches with a gradual burdening of the lower limb in which the replaced knee joint is to be, as well as undergoing instruction as to the course of the post-operation rehabilitation programme. On the 1–2 day after the operation kinesitherapy is begun (breathing exercises, isometric exercises, constant passive movement, active movements of the ankle joint of the operated on limb as well as active movements of the other lower limb and of the upper limbs). On day 2–3 active exercises on the operated on limb are introduced with subsequent transversal straightening through sitting with suspended lower limbs as well as learning to walk, initially with the aid of a high Zimmer frame. On subsequent days the kinesitherapy is intensified in the form of time, the number of repetitions and the type of exercises. Also in teaching the patient to walk the patient undergoes by turns its subsequent stages: walking on elbow crutches, walking up stairs (around day 7–9), walking on one elbow crutch. Between day 10 and 14 after the operation the patient is discharged from the Department of Surgery, Orthopaedics and Rehabilitation and instructed on the course of further rehabilitation. In certain cases the patient continues rehabilitation at home according to the instructions given, and sometimes in the form of hospitalisation at a rehabilitation department. The rehabilitation programme in department conditions involves constant passive movement, isometric movements (chiefly of the quadriceps thigh muscle) active free and active with resistance, exercises on ladders and on a rotor as well as the PNF method and gait re-education. Within the physiotherapy, one individually geared for each patient, cryotherapy, magnetic fields and laser therapy are employed.

For all of the patients qualified for the tests a measurement of the scope of movements in knee joints was conducted using a hand goniometer, the strength of the muscle acting on the knee joint according to the Lovett test, subjective pain complaints according to the VAS scale as well as the noting of the time taken to complete the 'up and go' test. There was also analysed the means of translocating and an evaluation of fitness in a test devised on a scale of 0 to 6 points, where 0 points represented an inability to move position

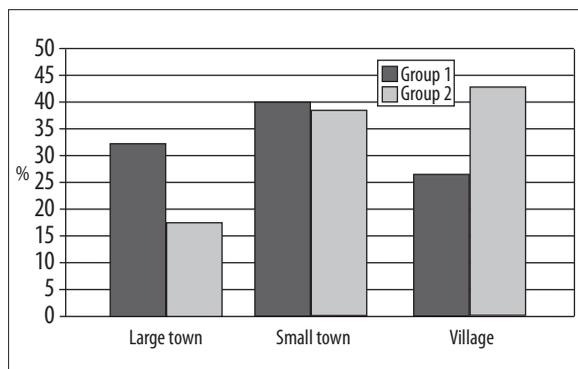


Figure 1. Patient place of abode.

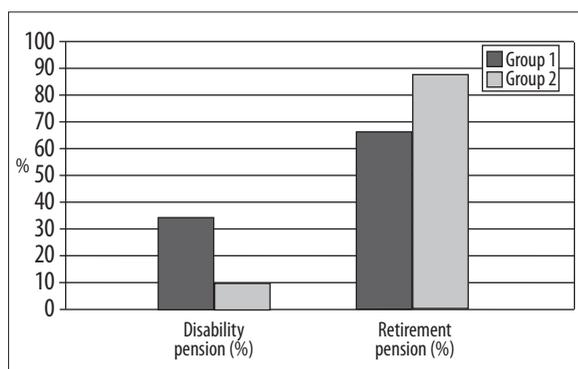


Figure 2. Patient occupational status.

and extremely intensive constant complaints of pain, noticeable movement limitation in the operated on joint; 1 point – walking on crutches, pain while at rest and in movement, limitation to movement in the operated on joint; 2 points – walking on crutches for short distances, pain experienced only during movement, bending of the knee to 40°; 3 points – capable of walking on crutches, pain during movement, bending in the knee 40–60°; 4 points – able to walk competently on one crutch, minimal pain experienced that recedes with rest, bending between 60° and 80°; 5 points – walking without crutches with breaks, intermittent not too intensive pain, bending to 90°; 6 points – normal walking without pain, bending in the joint above 90°. The tests were conducted twice, before the cycle of rehabilitation exercises (Test 1) and after their completion (Test 2). All the results obtained were entered into the research questionnaire. There was also noted information in relation to a visual and manual evaluation of the fibre from the area around the operated knee joint. The results were subjected to statistical analysis in Microsoft Excel.

**RESULTS**

The research encompassed 33 patients, who were divided according to age, the borderline being established as 65, into two groups. Group 1 comprised 15 individuals (average age 60.4 years; min=52; max=65). 18 people were qualified into Group 2 (average age x=73.1 years; min=69; max=78 years). On the basis of the data on body mass and height the BMI was calculated, the average value of which was for the particular groups: Group 1 x=29.02 (min=22.2; max=39.5); Group 2 x=28.89 (min=21.9; max=35.7). The

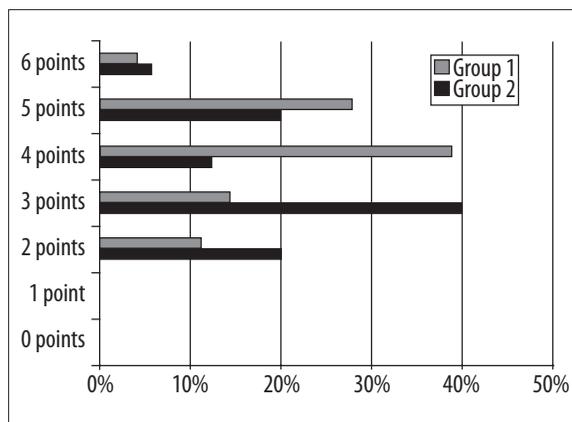


Figure 3. Results of fitness evaluation conducted in test 1.

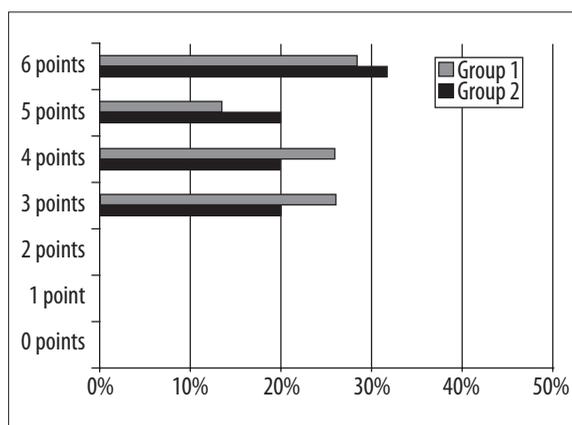
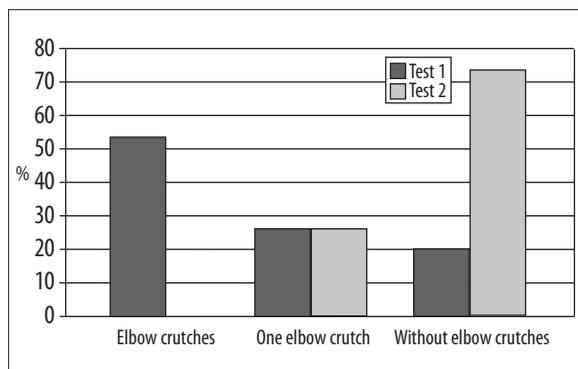


Figure 4. Results of fitness evaluation conducted in test 2.

number of days from the moment of operation to the first test was for Group 1 49 days, and in Group 2–58 days. In the test questionnaire was recorded information on the place of abode and the professional situation of the patients under examination. This data is presented in Figures 1 and 2. In Group 1 there were noticeably more people living in large towns and who were on disability benefit, something that is understandable given their age. In Group 2 were more people who lived in the countryside and who were retired.

Within the research into the scope for movements in the operated on joint and the muscle strength acting on the knee joint there was not noted in Test 1 any significant differences between the groups. The range for bending displayed was on average for Group 1 x=63.27°, for Group 2 x=65.72°. In the measurements of extension there was noted a deficiency in this movement in both groups tested – in Group 1 (in 10 patients) on average x=-6.33°; in Group 2 (in 11 patients) on average x=-8.89°. The muscle strength was similar in both groups and thus in the operated on limb was respectively 3.1 and 3.2, in the non-operated on limb 4.6 and 4.8 according to the Lovett scale. In test 2 there was observed an increase in the range of bending and a reduction in the extension deficit, as well as an increase in muscle strength. In Group 1 the scope of bending increased on average by 25.3°, while the deficit of extension reduced on average by 3.47°. In Group 2 the scope of bending increased on average by 23.9°, while the deficit in extension



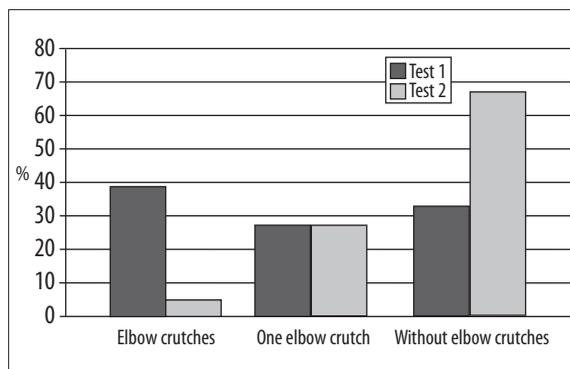
**Figure 5.** Movement of patients from group 1 in particular tests.

reduced by 5.89°. The muscle strength measured according to the Lovett scale underwent an increase in both tested group to the amount of 1 degree. In Group 1 for Test 1 there was noted a warming up of the area around the knee joint in 73% of patients. In Group 2 a warming up of the area around the operated on knee joint and ballottement of the kneecap was noted in 20%, while in Group 2 this was the case in 22% of those tested. In the 'up and go' test there was noted a shortening in the time for test completion in both groups examined (in Group 1 by 2.9 seconds, while in Group 2 by 4.5). The results illustrating fitness are presented in Figure 3 (the data from Test 1) and Figure 4 (the data from test 2), while in Figures 5 and 6 there is presented the means of patient movement within the particular tests and groups. In both groups the patients confirmed a diminished intensification of pain symptoms within a subjective evaluation.

## RESULTS

An improvement in the measured parameters within both groups was obtained in the tests conducted, with the better results being obtained in the group with younger patients. The time that had elapsed from the operation to the beginning of rehabilitation could have also had an effect on the result, something that is also confirmed in the tests conducted by Błaszczyk et al (2007) where the results obtained by patients following endoprosthesis of the knee joint, who underwent rehabilitation after 8.5 months and 5.4 years following the operation, were compared. In these tests it was claimed that in both groups of patients there occurred an improvement in the functioning of the joint, somewhat more so in those who commenced rehabilitation within a year of the operation itself [9].

In the evaluation of the muscle strength acting on the knee joint there was confirmed the observations of other authors on the weakening of muscles in the non-operated on limb. This could have been brought about by several factors, amongst which the most often cited are degenerative alterations in the joint, as well as restriction in activeness resulting most often from sensations of pain [10] and disturbances in the mechanics of gait prior to arthroplasty, which



**Figure 6.** Movement of patients from group 2 in particular tests.

equally may be causes of muscle weakening [2]. In analysing the results obtained no statistically significant differences were noted in either of the two test groups, although there were noted better results for the group of individuals under the age of 65.

## CONCLUSIONS

1. The application of physiotherapeutic methods after the initial arthroplasty of the knee with the use of complete cemented endoprosthesis brought about good results in both age-groups of patients tested.
2. The results of physiotherapy evaluation were better in group 1, in which were patients aged under 65 though this was not statistically significant.

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