



EFFECT OF PREOPERATIVE PHYSICAL EDUCATION ON POSTOPERATIVE OUTCOME IN PATIENTS WITH TOTAL HIP REPLACEMENT – A PROSPECTIVE COHORT STUDY

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SUMMARY – Hip osteoarthritis is the leading cause of hip pain around the world. Patients are aiming to relieve pain as fast as possible and return to everyday activities. The aim of the study was to investigate the effect of preoperative physical education on postoperative rehabilitation in patients after total hip arthroplasty (THA). There were 60 patients divided in two equal groups. One group underwent 3-day preoperative education and the other did not. The two groups were compared according to their preoperative and postoperative visual analog scale (VAS), range of motion (ROM), Harris Hip Score (HHS), Western Ontario and McMaster Universities Arthritis Index (WOMAC), and 36-Item Short Form Survey (SF-36). Patient general characteristics were similar in the two groups. Patients that received preoperative training had lower VAS scores, greater ROM, higher HHS and lower WOMAC score on postoperative day 42 ($p < 0.05$ all). These patients had no complications. There were no between-group differences in the SF-36 questionnaire. In conclusion, patients that underwent preoperative rehabilitation protocol before THA had lower pain and disability scores and better functional outcomes.

Key words: *Arthroplasty; Replacement; Hip; Education; Exercise; Preoperative care; Rehabilitation*

Introduction

Joint osteoarthritis is the leading cause of pain and disability in the world, with the hip and knee joints affected most frequently¹. Osteoarthritis of the hip is characterized by the presence of pain, limited range of motion and limping, which consequently leads to difficulties in performing daily activities². To improve overall everyday mobility and reduce pain, patients

undergo total hip replacement (THR) surgery³. The demands of patients are very high, as they want faster recovery and return to everyday activities⁴. Consequently, ever more preoperative rehabilitation programs aim to speed up the recovery phase of patients^{5,6}. Preoperative physiotherapy is one of the possible ways to speed up the whole process by improving muscle strength and educating the patient about the disease and behavior after the surgery. Physiotherapist has a role during the preoperative phase to teach the patient how to verticalize, do therapeutic exercises, and walk with an orthopedic device⁷. Results differ among various studies. Some emphasize that preoperative physical education

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is not useful at all, whereas others show that preoperative physical therapy reduced hospital stay and complications while improving functionality⁸⁻¹⁰. The objective of this study was to assess the effect of preoperative physical education on recovery of patients after THR surgery. The hypothesis of the study was that preoperative physical education improved postoperative functional recovery of patients after THR.

Patients and Methods

The study was conducted at the Department of Orthopedics and Department of Physical Medicine and Rehabilitation, Mostar University Clinical Hospital, from January 1, 2021 until January 1, 2023. There were 60 patients divided into two equal groups. All patients were assigned a number and allocated to groups using a random number generator. One group received preoperative physical education, while the other did not and served as a control group. Sample size was determined using the sample size calculator (<https://clincalc.com/>). All procedures were performed in accordance with ethical standards laid down in the 1975 Declaration of Helsinki and its later amendments. The research was approved by the institutional Ethics Board.

We included patients with primary osteoarthritis of hip, Kellgren-Lawrence grade III and IV, older than 65. We excluded patients with osteoarthritis of other joints in lower extremity, patients with secondary osteoarthritis, patients that had earlier hip operations, and patients with severe cardiovascular, pulmonary, or neurological diseases that could affect rehabilitation.

The experimental group consisted of 30 patients that underwent a three-day preoperative education protocol. Preoperative education was performed at the Department of Physical Medicine and Rehabilitation. On the first day, patients were educated about breathing exercises, circulation exercises, and exercises for strengthening pelvitrochanteric and thigh musculature. On the second day, patients were educated about bed positioning, sitting, and walking with an orthopedic device (walker or crutches). The third day of education consisted of education about using the toilet, walking up and down the stairs, and correctly behaving in everyday activities.

The control group had 30 patients that underwent regular postoperative rehabilitation.

The first day of preoperative rehabilitation consisted of breathing exercises, circulation exercises, and exercises for strengthening pelvitrochanteric and

thigh musculature. Breathing exercises were done in lying position. Hands were placed on the base of the ribcage. The patient was instructed by the therapist to slowly inhale, hold for a few seconds, and then exhale pronouncing s, sh or f. After that, the patient was placed on side with the knees flexed. One hand was placed on the belly and another on the thorax inhaling through the nose and exhaling through the mouth. Then circulation exercises were performed by ankle pumping. The patient was lying on the back with relaxed leg pulling towards the head, then towards the heel. The exercise was done 10 times every hour preferably. Then strengthening exercises were done. The patient was lying and contracting feet straight with knees pushing to the bed contracting calf, thigh and gluteus. Second exercise was performed with the patient supine and pushing a towel with the feet. Afterwards, the patient was put a pillow between the legs and contracted feet towards them. Then followed exercise with the feet contracted and lifting the leg from the bed. Then the patient was sitting on the bed pulling the feet. Then the patient was supine with flexed knees and feet on the bed, lifting the pelvis and held it so. All repetitions were held for 5 seconds.

The second day, patients were educated about bed positioning, sitting, and walking with an orthopedic device (walker or crutches). This day, the usual methods and protocols were used for teaching.

The third day of education consisted of education about using the toilet, walking up and down the stairs, and correctly behaving in everyday activities. Patients were given usual instructions about restricted movements in their everyday life.

Postoperatively, patients were educated according to the standard protocol. Ankle exercises, isometric quadriceps contraction, inner range quadriceps contraction, hip and knee bending, hip abduction and bridging were performed. Exercises were done 3 times daily with 10 repetitions.

The hip range of motion (ROM), Harris Hip Score (HHS), Western Ontario and McMaster Universities Arthritis Index (WOMAC) and 36-Item Short Form Survey (SF-36) were measured in all patients on the day of surgery, then on postoperative days 12 and 42. All patients signed informed consent for the study.

Nominal data were presented by frequency and percentage. Frequencies of nominal variables were analyzed using the χ^2 -test. All continuous data were expressed as mean \pm standard deviation. Data distribution for continuous variables was determined

using the Kolmogorov-Smirnov test. If the distribution was normal, statistical significance of continuous variables between the groups was analyzed by Student's t-test, and in case of non-normal distribution by Mann-Whitney U test. Results were analyzed using the SPSS version 26.0 (SPSS, Chicago, IL, USA) and Excel computer program (Microsoft Office Excel 2019). All tests were two-tailed and $p < 0.05$ was considered statistically significant. There were no missing data as all were collected under researcher's supervision.

Results

There were 60 patients divided into two equal groups. There were no differences between the groups according to their general characteristics, i.e., body mass index, age, and gender distribution (Table 1). On day 42, educated patients had significantly lower

values on the VAS pain scale, as shown in Table 2. HHS was significantly higher in the group of educated patients (Table 2). WOMAC scores were significantly lower in educated patients (Table 2). ROM was also higher in educated patients. Flexion, extension, and adduction were significantly greater in educated group (Table 3). We compared maximal ROM considered as hip flexion higher than 85° . On day 42, maximal ROM achieved 69% of patients in educated group ($p < 0.05$). There were no significant differences in the SF-36 questionnaire between the groups (Table 4). Significantly more educated patients walked using crutches ($p < 0.05$). Unlike educated group where no complications were recorded, they did occur in non-educated group (4 prosthesis dislocations and one death due to thromboembolic incident) ($p < 0.05$).

Table 1. Patient demographic characteristics according to preoperative education

	Educated	Non-educated
Body mass index (kg/m ²)	28.9±2.8	29±4.1
Age (years)	69±7	71±6
Gender, n (%)	Male	9 (30)
	Female	21 (70)
		8 (26.7)
		22 (73.3)

Table 2. Comparison of VAS pain scale, HHS and WOMAC score between educated and non-educated patients preoperatively and on days 12 and 42 postoperatively

VAS	Preoperatively	Day 12	Day 42
Educated	8.3±1.6	1.8±1.1	0.1±0.3
Non-educated	8.27±1.9	2.3±1.1	0.48±0.6
Mann-Whitney	444.500	331.500	282.000
p	0.933	0.102	<0.05
HHS			
Educated	38±17	53±12	80±4
Non-educated	35±19	50±10	75±6
Mann-Whitney	0.742*	309	218.500
p	0.461	0.056	<0.05
WOMAC			
Educated	58±18	32±6	14±3
Non-educated	53±19	34±6	23±6
Mann-Whitney	0.917*	313.000	82
p	0.363	0.064	<0.05

VAS = visual analog scale; HHS = Harris Hip Score; WOMAC = Western Ontario and McMaster Universities Arthritis Index

Table 3. Comparison of the range of motion between educated and non-educated patients preoperatively and on day 12 and day 42 postoperatively

	Educated	Non-educated	p ^a
Preoperatively			
Flexion	68±7	71±12	0.109
Extension	-13±4	-14±6	0.247
Abduction	16±5	18±6	0.261
Adduction	9±5	6±3	<0.05
Day 12			
Flexion	67±11	66±12	0.963
Extension	-7±5	-9±5	0.164
Abduction	19±4	22±5	<0.05
Adduction	8±30	11±5	<0.05
Day 42			
Flexion	88±2	84±5	<0.05
Extension	6±4	0±4	<0.05
Abduction	29±3	29±4	0.752
Adduction	13±4	16±5	<0.05 ^b

^aMann-Whitney test; ^bStudent's t- test

Table 4. 36-Item Short Form Survey results

	Educated	Non-educated	p
Preoperatively			
Physical role	28.3±18.7	26±23.8	0.499
Physical functioning	14.2±26.8	10±21.4	0.427
Energy	42.17±18.3	42.5±16.2	0.882
Mental health	59.5±23.9	54.7±16.7	0.191
Social functioning	55±25.6	50.8±23.7	0.454
Pain	32±18.2	29.1±18.7	0.550
Overall health	58±22.9	58.4±11.8	0.568
Emotional role	15.6±31.2	17.8±32.4	0.634
Day 12			
Physical role	21.5±12.5	23.6±15.8	0.896
Physical functioning	3.3±18.3	6±22.8	0.550
Energy	42.3±20	44.6±17.7	0.784
Mental health	62.5±22.1	55.3±16	0.063
Social functioning	48.1±25.4	43±24.6	0.398
Pain	59.1±14.4	58.8±13.2	0.785
Overall health	62.8±20.1	64±11.3	0.663
Emotional role	21.1±40.5	15±34.1	0.516
Day 42			
Physical role	69.5±7.4	72.9±11.3	0.06
Physical functioning	90±22.4	90.5±21.6	0.983
Energy	51.5±17.5	44.3±12.9	0.679
Mental health	66.7±21	58.2±15	0.122
Social functioning	77.6±20.6	81.1±9.4	0.193
Pain	95.5±8	94.7±10.8	0.805
Overall health	63.3±16.4	63.9±14.9	0.930

Discussion

Rehabilitation is one of the most important factors that affect patient satisfaction after THR. Hospital stay, regaining strength, ROM, functionality, and quality of life depend on the quality of rehabilitation. Correct rehabilitation prevents unwanted consequences in the early postoperative period¹¹. Long lasting and short-term preoperative rehabilitation protocols have been described. We wanted to make a protocol that would not be too long and tiring for patients because it is easier to follow directions from a therapist and to keep the track of patients. We also wanted to make a protocol that does not waste much healthcare system resources. Our study found that our preoperative protocol improved outcomes after THR based on pain, ROM, HHS, and WOMAC scores.

Pain is one of the main factors that affect a patient's decision on surgery. Besides that, pain limits their everyday functionality¹². Results of our study showed that educated patients had significantly lower VAS pain scores, i.e., they were almost painless, 42 days postoperatively. On the other hand, the study by Soeters *et al.* found no improvement in pain scores after preoperative physical rehabilitation¹³. They had poor results probably because they had one-time one-on-one patient education. We consider that it is too short, and does not give the patient enough time to meet the therapist and be educated about their rehabilitation. By relieving the pain, we completed one of our main goals.

Removing pain is not enough to make patients fully satisfied. They need better ROM to fulfill their everyday functionality. Our results are consistent with the study by Gilbey *et al.*, where they found that preoperative rehabilitation was effective in improving early recovery of physical function after total hip arthroplasty⁵. Our study showed that 69% of educated patients and 31% of non-educated patients achieved their maximal ROM. Maximal ROM was considered if hip flexion was above 85°.

Our study found that HHS was better in the educated group on postoperative day 42. Similarly, Gocen *et al.* found improvement of HHS in a group that received 8-week preoperative rehabilitation⁸. We claim that it is too long and exhausting both for the healthcare system and the patients. We achieved the same results with only three-day intensive program. On the other hand, the study conducted by Gilbey *et al.* suggested that the relative benefit from preoperative

exercises was not apparent after 12-month follow-up⁵. Even with those statements, patients receive benefits by earlier return to their everyday activities with only three days of preoperative rehabilitation, thus they have fewer complications, as we proved in our study. The longer time needed to return to activities increases the risk of thromboembolic incidents, and weaker musculature leads to easier prosthesis dislocation, consequently prolonging the recovery period^{14,15}.

Although the preoperative WOMAC score was a little higher in the educated group, it was significantly reduced 42 days after surgery. Both groups reported disability improvement, but the educated were more successful. Gilbey *et al.* also found improvement in hip ROM and WOMAC score⁵; however, considering that it was the result of an 8-week program in contrast to our three-day protocol, we conclude that we made a short and efficient protocol based on return to everyday functioning as fast as possible. The study carried out in Korea found that better preoperative muscle strength was related to better postoperative results in total knee arthroplasty. Along with that, we conclude that preoperative muscle strengthening exercises lead to better results, as shown by our study. We also recorded better WOMAC scores in educated group, similar to this research where patients with better muscle strength had better postoperative scores¹⁶.

We did not find any differences regarding the SF-36 questionnaire. Our results were consistent with the study conducted by Rooks *et al.*¹⁷. The study conducted by Bitterli *et al.* found improvement in the global SF-36 index, but not in other categories, even though their program lasted for 6 weeks¹⁸. We recorded better scores in mental and social health of educated patients after the surgery, although these differences did not reach statistical significance. Our conclusion was that it was owing to the introduction to their rehabilitation. They knew what they could expect.

Limitations of our study were short follow-up time and not being able to track their hospital stay. We concluded that this was enough time for patients with successful return to their everyday functioning. At our hospital, all patients were staying at the hospital for 12 days after surgery for their wounds and rehabilitation to be tracked.

In conclusion, we made an effective and efficient preoperative rehabilitation program that improved the functional outcome scores of patients undergoing THR. We provided faster rehabilitation times and

faster return to everyday activities, thus reducing their hospital stay, as well as complications and costs. Based on our results, we accepted our hypothesis that patients who received preoperative physical education had better postoperative functional recovery after THR. Our goal was to make a patient-friendly program that was not exhausting for patients and healthcare system, and our results showed that we did it successfully. The program proved ideal for early rehabilitation period.

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Sažetak

UTJECAJ PRIJEOPERACIJSKE FIZIKALNE PODUKE NA POSLIJEOPERACIJSKI ISHOD NAKON UGRADNJE TOTALNE ENDOPROTEZE KUKA – PROSPEKTIVNO KOHORTNO ISTRAŽIVANJE

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Osteoartritis je vodeći uzrok boli u kuku diljem svijeta. Bolesnici se žele što brže riješiti boli i vratiti svakodnevnim aktivnostima. Cilj ovog istraživanja je bio utvrditi utjecaj prijeoperacijske fizikalne poduke na poslijeoperacijski rezultat kod bolesnika s totalnom endoprotezom kuka. U istraživanju je sudjelovalo 60 bolesnika podijeljenih u dvije podjednake skupine. Jedna skupina je prošla prijeoperacijsku poduku kroz trodnevni tečaj, dok je druga prošla samo poslijeoperacijsku rehabilitaciju. Usporedili smo bolesnike prema njihovim prijeoperacijskim i poslijeoperacijskim vrijednostima VAS (*visual analog scale*), opsega pokreta, HHS (*Harris Hip Score*), WOMAC (*Western Ontario and McMaster Universities Arthritis Index*) i SF-36 (*36-Item Short Form Survey*). Obje skupine bolesnika su imale slične generalne karakteristike. Bolesnici koji su prošli prijeoperacijsku poduku imali su niže vrijednosti ljestvice boli VAS, veći opseg pokreta, viši HHS i niži WOMAC 42. poslijeoperacijskog dana ($p < 0,05$ sve). U skupini bolesnika koji su prošli poduku nije zabilježena niti jedna komplikacija. Međutim, među dvjema skupinama nije bilo razlike u upitniku SF-36. U zaključku, bolesnici koji su prošli prijeoperacijski rehabilitacijski protokol prije totalne endoproteze kuka imali su niže rezultate na ljestvici boli, a postigli su i bolje funkcionalne rezultate.

Ključne riječi: *Aloartroplastika; Zamjena; Kuka; Poduka; Prijeoperacijska skrb; Rehabilitacija; Vježbanje*