

Effects of Preoperative and Postoperative Physiotherapy on Functional Outcome of Patients Undergoing Total Hip Arthroplasty

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Abstract: Total hip replacement (THA) is one of the common surgeries that aims to improve patients' pain and functional abilities with end stage hip osteoarthritis. The aim of this study was to assess the role of pre and postoperative physiotherapy in this patients' category. Patients awaiting THA (n=45) from both genders were assigned at random to one of three equal study groups. First is pre- post group (PPG) where patients received both pre and postoperative physiotherapy. Second is post only group (POG) where patient received only postoperative physical therapy. Third is control group, receiving usual care. Patients function was assessed using Harris hip score (HHS) at 6 weeks, 1-day preoperatively, 3, 6 months then 1-year postoperatively. Results showed improved HHS in through all evaluations in PPG patients, while it improved over all postoperative evaluations in POG and control patients. Groups comparisons showed significantly higher HHS in PPG compared to POG and control 1-day preoperatively. Further, significantly higher HHS in PPG and POG compared to control at 3 and 6 months postoperatively. While at 1- year evaluations all groups had insignificantly different HHS. It could be concluded that preoperative physiotherapy has good preoperative effects that makes it "likely to use" intervention upon agreement of medical and rehabilitation team and patients. Postoperative physiotherapy remains a main postoperative intervention in patients undergoing THA for its favorable effects on early function improvement.

Keywords: Total hip replacement, Harris hip score, preoperative physiotherapy, postoperative physiotherapy

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I. Introduction

Total hip arthroplasty (THA) became a reliable surgical procedure to relieve pain, enhance mobility, restore function and to achieve a more independent living among patients with hip osteoarthritis and chronic hip pain who would otherwise be substantially disabled¹. It is considered one of the most common and successful modern orthopedic operations². The timing of surgery depends on many factors, of which the most important is the presence of pain, the functional abilities of the patient, x-ray findings and the failure to respond to conservative medical treatment and physical therapy³.

Traditionally the outcomes of joints arthroplasties have been evaluated on basis of morbidity/mortality and surgical complications. However, the outcome assessment after orthopedics surgery relies on patient satisfaction and enhancements in the quality of life not on the implant stability or other surgery related indicators. Therefore, the main goals of THA became to relieve pain and to improve the functional abilities of the patient. Better functional outcomes lead to increased independence and enhanced quality of life⁴.

Physiotherapy has been a component of care for patient undertaking THA that deals with pain and function⁵. When reviewing THA researches that confirmed a relatively long-standing impairment and functional disability following THA, the need for physiotherapy becomes clear⁶⁻⁸. Despite this, the value of preoperative physiotherapy in patients undertaking THA is controversial. Some authors reported improved functional scores in patients who received preoperative physiotherapy^{9, 10}. On the contrary, some researchers reported that preoperative physiotherapy is not useful in improving health related quality of life and dysfunction for patients who undertake THA^{11, 12}. Likewise, the researches pertinent to rehabilitation following THA provide relatively low- level evidence of the effectiveness of post-operative physical therapy on patients functions and quality of life¹³⁻¹⁵, as well as limited therapeutic validity¹⁶.

In this study, we aimed to assess and compare the functional outcomes of combined pre and postoperative physiotherapy, versus postoperative only physiotherapy, or no physiotherapy in patients undertaking THA. Evaluation was carried out over five time points (6 weeks preoperatively and 1- day preoperatively, then at 3-months, 6-months, and 1-year time points postoperatively). We hypothesized that achieved functional outcomes will be similar in the groups over all evaluation time points.

II. Materials And Methods

This study was a randomized controlled trial. Forty-five patients who undertook elective unilateral primary THA at a University hospital in the period from June 2014 to June 2015 participated. Patients from both genders were illegible to participate. Aged ranged between 40-65 years old. Patients were specifically excluded if they having a contralateral THA, severe cardiopulmonary disease, associated knee osteoarthritis, malignancy, or a history of revision surgery. Patients with neurological, cardiac, or psychiatric disorders that clearly decrease patient function had also been excluded. Based on these criteria, Patients were initially selected from the registry of patients scheduled for surgery where 52 patients were eligible to participate in this study. Eligible patients were contacted during their follow up visits to the orthopedic outpatients' clinic. However, some patients 13.45% (N=7), did not consent to participate due to lack of interest. Forty five patients awaiting THA agreed to participate in the study. Patients were randomly allocated to one of the three study groups (15 patients each). First group received physical therapy pre operatively and post operatively "pre and post-surgical group (PPG)". Second was the post- surgical only group (POG) who received no physical therapy pre surgical but received post-surgical physical therapy. Third was control group who did not received physical therapy at all apart from the inpatient usual care protocol during hospital stay. Random allocation was determined prior to data collection based on random integer set generator (Random.org). The program generated three sets of the numbers from 1-45 without repetition (numbers represents the order of patients recruitment). We used a blind draw among the three sets of patients to identify the group where each set of patients was included. Patients were blinded to the treatment of interest. Surgical procedure was 6 weeks later to enrollment for all patients. Ethical approval was obtained from a University hospital (Jordan University Hospital, Amman, Jordan). The patients were informed about the nature of the study procedures and patients were asked to sign consent to participate prior to onset of data collection.

Procedures

Surgical procedures were done for patient in all groups using posterior approach. Multiple surgeons operated patients in the current study. Further, several prostheses types were used. Besides, either cemented or Cementless fixations were used. All patients received a set of instructions including: avoiding activities that might cause pain or induce prosthesis instability, assistive walking aids for the duration recommended by operating surgeons, adjustment of seats (regular and toilet seats) and bed height, grab bars, and adaptive equipment to assist in performing actives without jeopardizing joints' stability, patient safety and/or increased pain.

Evaluation of functional outcome

Patients were evaluated 6-weeks and 1-day preopratively, then 3-months, 6-months, and 1-year periods post-surgery. Harris hip score (HHS) was used to evaluate the surgical outcomes of THA through comparing patients scores at two pre- surgery and 3 post- surgery follow ups. William H. Harris originally developed the HHS in 1969 to assess the outcomes of hip arthroplasty for patient with traumatic arthritis¹⁷. The score has a maximum of 100 points (best possible outcome) covering pain domain (1-item/0–44points), function domain (7-items/0–47points), absence of deformity domain (1-item/4points), and range of motion domain (2-items/5points). Functional domain is further split into daily activities (14 points) and gait (33 points)¹⁸.

The pain domain measures pain intensity, tolerance, and use of pain medication. The function domain splits into daily activities namely; stairs climbing, entering public transportation, sitting, and wearing socks and shoes and socks. While, the score of the gait subdomain depends on presence of limping, need for support, and walking distance tolerated by the patient). Deformity domain assess hip flexion, adduction, internal rotation, and discrepancies in lower limb length. Range of motion domain (ROM) assesses hip flexion in sagittal plane, frontal plane movements (abduction/adduction), and transverse plan movements (internal/external rotations). The higher the value of HHS, the better the function. A total score of 90 or more is considered excellent, while the range 80 to less than 90 is good, 70 to less than 80 is fair and less than 70 is poor^{17, 18}.

The scores of pain domain and hip function domain (daily activities and gait subdomains) were obtained through a face-to-face interview. On the other hand, the deformity and range of motion domains were evaluated using a tape measure and goniometer. A senior physical therapist, blinded to patients' groups and intervention differences, undertook all the interviews and measurements.

Interventions

Patients in the first group received preoperative physical therapy as a home based exercises program for 6 weeks pre- surgery. Patients performed stretching exercises of hip and knee flexors and hip adductors, where they held each stretching for 20 seconds and repeated it twice per session^{10, 12}. Further, from supine position, patients perform straight leg raising (SLR) exercise¹², static co-contractions of thigh and gluteal muscles, heels slide on bed, bridging, and hip abduction. Then, from standing, they performed mini- squats in non-painful range, and hip extension and abduction of the involved hip while standing on the non-involved side. These set of exercises were performed without external resistance, twice daily for 10 repetitions each¹⁹.

Patients in all groups received usual postoperative care during their hospital stay that ranged between 7-11 days (10 days on average). During hospital stay emphasize was to achieve bed mobility, patients should transfer from supine to sitting, then to standing. Further, they start ambulation using assistive devices as appropriate²⁰.

Later, Both PPG and POG groups followed a home based program four 12 weeks post-surgery. Following discharge, exercises were home-based. These exercises included ankle pumps, hip and knee flexion and extension, gluteal setting and pelvic tilting exercises from supine. From prone patients performed hip extension, and knee flexion. Further, from standing patients carried out hip flexion and extension, and abduction exercises. All exercises were performed without resistance, and were repeated 10 times twice daily^{21, 22}.

Statistical analysis

All analyses were carried out by using SPSS software (IBM SPSS Inc., Chicago; Version 22.00). Descriptive data for the scale variables of patients in the 3 groups are shown as means and SD, and compared using ANOVA. Nominal data, gender and side of surgery, are shown as frequencies per group and compared using Chi Square.

Since HHS is an ordinal scale, non-parametric statistics were used for analysis. Kruskal- Wallis test was used to test variation of the HHS among the 3 groups. Post hoc analysis was applied when significant differences were detected among groups. Freidman test was used to assess the variation in outcomes of the HHS among the 5 evaluation times within each group. Post hoc tests were applied when significant differences were detected among evaluation times. P-value <0.05 is considered significant.

III. Results

The patients' demographic and clinical data is shown in table-1. No significant differences were detected among patients in the 3 groups regarding age, weight, height, body mass index (BMI), gender, and side of surgery. Analysis of scores differences among groups was done using Kruskal- Wallis test (Table 2 and figure 1). The HHS was significantly different among groups at evaluations 2 (1- day pre-operatively), 3 (3 months post-operatively), and 4 (6 months post-operatively). Post hoc in evaluation 2 showed significantly higher HHS in PPG compared to the other 2 groups. At evaluations 3 and 4, HHS of groups PPG and POG were significantly higher than control group. However, HHS scores of PPG and POG did not differ significantly at either 3 or 6 months. At evaluations 1 and 5, which were baseline (6 weeks pre-operative) and one-year post-operative respectively, no significant differences were found among HHS scores of the 3 groups.

Table1. Summary of patients' demographic and clinical characteristics.

Parameters	Groups		
	PPG	POG	Control
Males (N) %	5 (33.33%)	5 (33.33%)	6 (40.00%)
Females (N) %	10 (66.67%)	10 (66.67%)	9 (60.00%)
χ^2 (Sig.)	1.667 (0.197)	1.667 (0.197)	0.600(0.439)
THA Side (N) %			
Right	8	9	11
Left	7	6	4
χ^2 (Sig.)	0.067 (0.796)	0.600 (0.439)	3.267 (0.071)
Fixation			
Cemented	4	5	7
Cementless	11	10	8
χ^2 (Sig.)	3.267 (0.071)	1.667 (0.197)	0.067 (0.796)
Age (Years) (Mean ± SD)	56.67 (± 7.18)	55.13 (± 7.33)	54.87 (± 6.44)
f- stat. (Sig.)	0.290 (0.750)		
Weight (km) (Mean ± SD)	82.81 (±8.64)	80.73 (±9.03)	83.79(±10.52)
f- stat. (Sig.)	0.411 (0.665)		
Height (cm) (Mean ± SD)	174.19 (±6.68)	173.14(±7.24)	175.83(±8.61)
f- stat. (Sig.)	0.480(0.622)		
BMI (Kg/m²) (Mean ± SD)	27.25(±1.92)	26.88(±2.05)	27.06(±2.39)
f- stat. (Sig.)	0.111(0.895)		

P<0.05. Abbreviations: THA (Total Hip Arthroplasty); BMI (Body Mass Index)

Table 2: Comparison of total HHS among the groups in the 5 evaluation times

Evaluation Times	HHS total score Kruskal- Wallis test	Pairwise comparisons	Post Hoc Stat. (p-value)
Evaluation 1 (6 weeks pre- operative)	$\chi^2 (2) = 0.313, p=0.855$	PPG –POG	NA
		PPG- Control	NA
		POG- Control	NA
Evaluation 2 (1 day pre- operative)	$\chi^2 (2) = 15.096, p=0.001^*$	PPG –POG	3.489 (0.001)*
		PPG- Control	3.225 (0.004)*
		POG- Control	- 0.264 (1.000)
Evaluation 3 (3 months post- operative)	$\chi^2 (2) = 23.350, p=0.000^*$	PPG –POG	1.003 (0.948)
		PPG- Control	4.595 (0.000)*
		POG- Control	3.592 (0.001)*
Evaluation 4 (6 months post- operative)	$\chi^2 (2) = 17.802, p=0.000^*$	PPG –POG	0.434 (1.000)
		PPG- Control	3.852 (0.000)*
		POG- Control	3.417 (0.002)*
Evaluation 5 (1- year post- operative)	$\chi^2 (2) = 2.011, p=0.366$	PPG –POG	NA
		PPG- Control	NA
		POG- Control	NA

P < 0.05; NA: not applicable, HHS: Harris hip score

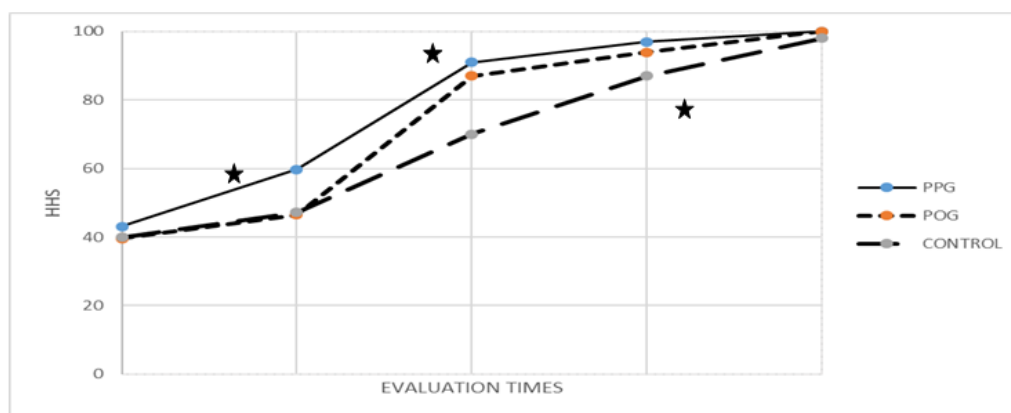


Figure (1): shows differences in median values of HHS over evaluation times among the 3 groups. (★) HHS differences were significant at P<0.05

PPG showed significantly different HHS among evaluation times $\chi^2 (2) = 73.046, p=0.000$. Within groups, Post hoc tests pairwise comparisons for HHS are showed in table 3. Tests showed significantly higher HHS comparing 1-day preoperative scores and all postoperative scores (3- months, 6-months, and 1- year postoperative) to baseline (6 weeks preoperative). Likewise, higher HHS was reported at the 3 postoperative evaluations (3- months, 6-months, and 1- year postoperative) compared to 1- day preoperative evaluation. Further, HHS at 6-months and 1- year postoperative evaluations were significantly higher compared to 3 months postoperative evaluation, and 1- year postoperative evaluation showed higher HHS compared to 6- months postoperative evaluation.

HHS significantly differs among the evaluation times in POG patients $\chi^2 (2) = 54.622, p=0.000$, as well as control group patients $\chi^2 (2) = 56.320, p=0.000$. Pairwise comparisons between different evaluation times showed the same pattern in both groups Non-statistical significance was detected between HHS of preoperative evaluations, 6 weeks and 1 day preoperative. While statistical significant differences were found between either preoperative evaluations (6 weeks and 1 day preoperative), and all postoperative evaluations (3 months, 6 months, and 1 year postoperative) in favor of the postoperative evaluations that showed higher scores. The 6 months postoperative evaluation showed statistically significant increase in HHS compared to 3 months postoperative evaluation. Likewise, the 1-year evaluation showed significantly higher HHS compared to either 3 months or 6 months evaluations.

Table 3: Pairwise comparisons among evaluation times within each group

Pairs	E1- E2 Z-stat p-value	E1- E3 Z-stat p-value	E1- E4 Z-stat p-value	E1 - E5 Z-stat p-value	E2- E3 Z-stat p-value	E2- E4 Z-stat p-value	E2- E5 Z-stat p-value	E3- E4 Z-stat p-value	E3- E5 Z-stat p-value	E4- E5 Z-stat p-value
Groups										
PPG	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-2.999 0.003*	-3.408 0.001*	-3.023 0.003*
POG	-1.603 0.109	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-2.891 0.004*	-3.411 0.001*	-3.130 0.002*
Control	-1.392 0.164	-3.294 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.408 0.001*	-3.409 0.001*	-3.412 0.001*	-3.415 0.001*

* P < 0.05. Abbreviations: E1= 6 weeks preoperative evaluation; E2= 1- day preoperative evaluation; E3= 3 months postoperative evaluation; E4= 6 months postoperative evaluation; E5= 1- year postoperative evaluation; stat= statistics

IV. Discussion

The results in this study showed that patients who received preoperative physical therapy (PPG) had significantly better HHS immediately (1- day) preoperatively compared to the patients who did not received preoperative physical therapy in the other 2 groups (POG and control). The significant difference seen preoperatively in the PPG did not extend to 3 and 6 months postoperatively when compared to patients in POG. At 3 and 6 months evaluations HHS were comparable whether patients received pre and postoperative physical therapy or those who received only postoperative physiotherapy. However, at the 3 and 6 months postoperative evaluations, patients who received physiotherapy, either PPG or POG, had significantly higher HHS compared to control patients. At the 1-year postoperative evaluation patients in the 3 groups showed similar HHS with non-significant differences among them. Within groups, analysis over different evaluation times showed a trend of significantly higher HHS when comparing successive evaluations. The exceptions for this trend were seen between evaluations 1 and 2 (6 weeks and 1 day preoperative) in groups POG and control, where there were non-significant differences between HHS between both evaluations

There is an agreement between the current results and the results reported in the earlier study by ²³ who found that the perioperative (pre and post) exercises program affected early functional improvement after primary hip OA. They compared a group of patients who received a pre and postoperative exercises program, similar to PPG in the present study, to a control group who received regular care. Unfortunately, they could not account for separate effects of pre or post exercises program alone. Besides, their postoperative follow up was only for 24 weeks.

In agreement with the current study, Wang et al. (24) conducted a systematic review with meta analysis to check the effects of preoperative rehabilitation on patients undertaking THA. They reported that the postoperative improvement of patient's function, in patients who performed preopetaive rehabilitation, was small and short- term to consider it clinically important. In support of this idea a previous study ¹² reported non-significant improvements in HHS between 2 groups of patients, one received pre and postoperative physical therapy till discharge, and the other took only postoperative physical therapy till discharge. In their study, they followed patients postoperatively at discharge, 3 and 12 months later. These results agreed with the current study where postoperative evaluations at 3, 6 and 12 months did not show significant differences between PPG and POG in HHS. Further, in agreement with the current results, previous studies ^{10, 25} showed improved patients' function following preoperative physiotherapy at preoperative evaluations. However, they reported non-significant differences between groups concerning postoperative functional recovery.

Ferrara et al. (11) conducted a study that compared a group of patients who received pre and postoperative physiotherapy to a control group who's patients received only postoperative physiotherapy. In contraversion with the current study, they found non-significant difference between groups in HHS at immediate preoperative evaluation. This controversy could be due to the shorter duration of preoperative program conducted in Ferrara's study (one months) compared to 6 weeks in the current study. It worth mention, however, that they agreed with the findings of the current study at postoperative evaluation where they reported non-significant differences between groups at their final evaluation, 3 months posoperatively. Likewise, Bitterli et al. (19) conducted a study that investigated the effects of preoperative exercises on patients awaiting THA. Patients in study and control groups received regular physiotherapy care postoperatively that was not standardized but differed according to the rehabilitation setting of each patient. Their results did not concur with the preopertaive functional improvements reported in the current study when comparing PPG versus POG and controls one day preoperatively. This contradiction may be related to the difference in functional evaluation scales; as they used Western Ontario and McMaster osteoarthritis index (WOMAC), while in the current study HHS was used in assessment.

Villadsen et al. (26), showed that preoperative exercises resulted in better early postoperative recovery in terms of ADL and pain in the intervention than in control group. This apparently contradicts the current study outcomes. The difference in between our study and Villadsen's is rather about reporting more than the actual results. In the current study the first postoperative evaluation was conducted at 3 months postoperatively, the same time where Villadsen et al. conducted their latest evaluation. At that time point both studies showed no longer significant differences comparing intervention and control groups. Besides, both intervention and control groups in the earlier study received postoperative physiotherapy, which resembles the results in the current study when comparing PPG and POG patients.

Postoperative physiotherapy exercises programs are documented for long as a part of postoperative management of patients with THA¹⁵. Studies in this topic for the past decade either compared different forms of exercises²², alternative treatment strategies; home-based or center based^{13, 20, 27} and combination of both²¹, or delayed start of exercises program^{5, 8}. The results of the current study supported the application of postoperative physiotherapy, both inpatient and post discharge, whether combined with preoperative physiotherapy or without it. The significant improvement in HHS at early follow ups (3 and 6 months) supported this idea.

Control group showed improvements in HHS following surgery in the current study which reached to be non-significantly different from the improvement in PPG and POG at 1 year evaluation. This could be related to the effects of the surgery, as THA is basically performed to improve pain and function in patients with end stage arthritis^{5, 28-30}. Moreover, the inpatient protocol introduced to the patients in the control group might have been a contributing factor in their functional improvement. Further, another suggested explanation of the non-significant difference between groups PPG and POG compared to controls at 1 year evaluation is the use of HHS in the evaluation. With this respect, it was reported earlier that some patients showed residual physical impairments, muscle weakness and gait deviations for as long as 1 to 2 years post THA^{31, 32}. That might make a difference between physiotherapy receivers and non-receivers and are not accounted for in the current study.

As a limitation in the current study, we did not consider the differences in functional outcomes due to different surgeons and hip prostheses used in operating patients in the study.

V. Conclusion

Within the context of the current study, preoperative physiotherapy preceding THA had favorable patient function preoperatively, but the results did not extend to postoperative evaluations. Postoperative physiotherapy enhanced postoperative function up to 6 months postoperatively, whether applied alone or following preoperative physiotherapy. Clinically, we suggest preoperative physiotherapy to be based on surgeon, therapist, and patient's judgment of interest. Current study agrees with previous opinion that postoperative physiotherapy continues to be a main part of patient postoperative care.

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