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Paper #17: Posterior Hip Precautions Do Not Impact Early Recovery in Primary Total Hip Arthroplasty: A Multicenter, Randomized, Controlled Study

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Abstract

Background: Posterior hip precautions have been routinely prescribed to decrease dislocation rates. The purpose of this study was to determine if the absence of hip precautions improved early recovery after total hip arthroplasty via the posterolateral approach.

METHODS: Patients undergoing total hip arthroplasty via the posterolateral approach at three centers were enrolled. Patients meeting the selection criteria were randomized to Standard Hip Precautions (SHP) or No Hip Precautions (NHP) for six weeks following surgery. HOOS Jr., health state visual analog score, and rate of pain scores were recorded preoperatively and in subsequent postoperative visits; dislocation episodes were also noted. Standard statistical analysis was performed.

RESULTS: From 2016–2017, 159 patients were randomized to SHP and 154 patients were randomized to NHP. Controlling for the center at which the surgery was performed, the only difference in outcome scores between the two groups was at two weeks; the NHP group had a lower HOOS Jr. score when compared to the SHP group ($p=0.03$). There was no difference in outcome scores at any other time points when compared to preoperative assessments. In the SHP group, there were two recorded dislocations (1.3%) and one in the NHP group 0.7% ($p=0.62$).

CONCLUSION: In this multicenter, randomized, controlled study, the absence of hip precautions in the postoperative period did not improve subjective outcomes which may be explained by the

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self-limiting behavior of NHP patients. Further, with the numbers available for the study, there was no difference in the rate of dislocation between the two groups.

Keywords

hip precautions; posterior total hip arthroplasty; outcomes

Introduction

Total hip arthroplasty (THA) is considered one of the most successful orthopaedic surgeries. The improvements in pain, mobility, and quality of life have led to a projected increased demand for the procedure that is expected to eclipse 160% growth by the year 2030.[1] A small number of THA patients will experience complications inherent to surgical procedures; hip dislocation is an explicit complication of total hip arthroplasty. The 2016 New Zealand Joint Registry indicated that dislocation is the number one cause for revision of a total hip arthroplasty ahead of aseptic loosening of the acetabular or femoral components and infection.[2] The contributing factors to hip stability and dislocation include surgical approach/technique, component positioning, leg length and offset restoration, femoral head size, and neurologic/muscle function status of the patient.[3–5] With advances in bearing surface materials and improved soft tissue reconstruction and surgical technique, the reported incidence of dislocation ranges from less than 0.2% to 2% in the uncomplicated primary THA setting.[6–9] Most dislocations (60–70%) occur within the first four to six weeks postoperatively. After one year, dislocation rates plateau to a relatively low constant over the life of the implant.[10–17]

In an attempt to decrease these early dislocations, most surgeons adopted hip precautions as the standard for postoperative care. A recent survey of the American Association of Hip and Knee Surgeons (AAHKS) and Canadian Arthroplasty Society (CAS) indicated that 44% of surgeons performing the posterolateral approach in North America prescribe hip precautions postoperatively to all of their patients. These precautions are typically kept in place for five to six weeks[18] but can be practiced as long as three months.[19, 20] For the posterolateral approach, the precautions focus to limit internal rotation, adduction, and flexion of the hip (with some minor variations depending on the surgical approach utilized). Generally, patients are taught not to bend at the hip past 90 degrees and to avoid twisting or crossing their legs. They are encouraged to sit with their hips higher than their knees, sleep on their back with a pillow between their knees, and avoid low car and toilet seats. Through computer modeling, these positions of risk led to increased dislocation rates; therefore, the implementation of precautions provided theoretical safety for these patients.[21] This information is usually given to the patient pre- and postoperatively by the orthopaedic surgeon, occupational and physical therapists, and nurse educators.

Despite the implementation of hip precautions, improvement in dislocation rates has not been shown in the literature.[7, 9, 19, 22, 23] The discussion of precautions after total hip arthroplasty is still a prevalent part of the postoperative care of total hip arthroplasties.[20] However, no studies highlighting the benefits of postoperative restrictions have been published.[23, 24]

The purpose of this study was to examine if the absence of hip precautions improved early recovery after total hip arthroplasty via the posterolateral approach and if these results could be reproduced across separate institutions. We hypothesized that hip precautions produce inferior short-term outcomes and, as a secondary measure, that they do not significantly prevent hip dislocation.

Methods

This multicenter, randomized clinical trial (Clinical trials.gov NCT03341442) was conducted with six surgeons at three different centers between April 2016 and December 2017. Approval from the Institutional Review Board was obtained (IRB; #1512934414).

Patient Screening

All patients scheduled to undergo elective total hip arthroplasty via the posterolateral approach were listed in a screening log provided to each institution through REDCap (Research Electronic Data Capture, hosted by the West Virginia Clinical and Translational Science Institute, WVCTSI). Patients attended the preoperative education offered by each institution and were assessed for eligibility for the study. For this study, specific inclusion and exclusion criteria were outlined to eliminate patients deemed high risk for dislocation and to provide a more homogenous patient cohort. Figure 1 demonstrates the trial outlined according to CONSORT guidelines. Patients randomized to one of the intervention arms but not undergoing a total hip via the mini-posterior approach were removed from analysis.

The inclusion criteria for this study were age greater than 18 years old but less than 90 years old receiving a primary total hip arthroplasty via the posterolateral approach. The exclusion criteria were age less than 18 years old or older than 90 years, prior enrollment in this study (i.e., staged bilateral patients), cognitive disorders, neuromuscular spasticity disorders, femoral neck fractures, connective tissue disorders, history of substance abuse, dual mobility implant, or the use of a constrained implant.

Patients meeting eligibility criteria were informed about the study by approved study personnel at each site. Patients who consented were assigned to a group through a predetermined block randomization schedule for each site. The block randomization schedule was created using JMP statistical software (SAS, Cary, NC). A block randomization scheme was utilized to ensure approximately equal distribution of the control and intervention groups at all time points. The patient and surgeon were aware of the randomization at the time of surgery. Patients were randomized to either a standard hip precautions (SHP) group (control group) or no hip precautions (NHP) group (intervention group). Hip precautions were defined as no hip flexion greater than 90 degrees, no internal rotation of the hip, and no adduction of the hip. Once consented, the participants completed a HOOS Jr. questionnaire, visual analog scale (VAS) (Health State) questionnaire, and a rate of pain worksheet. The staff at each site collected the demographic form and calculated the Charlson comorbidity index (CCI). The de-identified data were shared with the primary institution (WVU) through an online secure data collection software, REDCap.

Surgery and Hospital Stay

Patients were admitted to the hospital for surgery per the standard of care at each site. The patient underwent a total hip arthroplasty via the mini-posterior approach; all sites performed routine repair of the posterior capsule and short external rotators.[25] At the time of surgery, the surgeons recorded the American Society of Anesthesiologists (ASA) classification, cup size, and femoral head size. Patients participated in physical therapy per the standard routine of the institution. Patients randomized to the intervention group (NHP) had signage placed in their room identifying them so they would not to be restricted by posterior hip precautions. This information was also included in the discharge summary and any physical therapy prescriptions provided to the patient.

Follow-up after Surgery

Patients had routine visits of two weeks, six weeks, three to six months, and one year postoperatively. At each follow-up appointment, the patient completed the HOOS Jr. questionnaire, the VAS (Health State) questionnaire, and a rate of pain worksheet. At the two-and six-week follow-up appointments, the patients were asked about hip precautions practiced (supplemental material). At the six-week follow-up, standard radiographs were obtained and the abduction and anteversion of the acetabular component were recorded.[26, 27] Study personnel also completed a dislocation survey at the six-week, three- to six-month, and one-year follow-up appointments. Patients were asked if they had experienced a dislocated hip since their last visit, the date of the dislocation if one occurred, whether or not the dislocation required an open reduction, what procedure was needed to perform the open reduction, how many closed reductions were required, had the patient discontinued walking aids, and the date the walking aids were discontinued.

Power Analysis

Other authors have reported a minimally clinically important difference (MCID) of a change in the interval score for the HOOS Jr. ranging from 9 to 18.[28, 29] At our institution, we have previously established a standard deviation of 17 for collected HOOS Jr. scores in the first six weeks postoperatively, a power of 0.9 with an MCID of 9 with 75 patients per group. If an MCID of 18 is assumed, a power of 0.9 is achieved with 20 patients per group. Therefore, we aimed for 150 patients per group to account for attrition and missing documentation given the multi-institutional design of this trial.

Statistical Analysis

Standard comparisons with a student t-test were performed when the data were normally distributed. A Wilcoxon rank-sum test was conducted when groups were not normally distributed. Analysis of variance (ANOVA) was performed controlling for site location. Friedman's test to assess differences for each individual component of the HOOS Jr. was performed. Statistical significance was set at $p < 0.05$.

Results

We found no difference in the demographics or characteristics of the patient populations enrolled in this study. (Table 1)

HOOS Jr.

In the evaluation of HOOS Jr. interval scores when compared at the time intervals, the only interval that had marginal significance was the comparison of the SHP and NHP groups at the two-week follow-up. In using a two-sided independent t-test, no significant difference ($p=0.1375$) was found between the two groups at baseline. When controlling for the location of surgery, a difference evaluating the two week least means square SHP 68.24 and NHP 64.37 resulted in a significant difference of $p=0.02$. All other time points (six weeks, three to six months, and one year) demonstrated no significant difference ($p>0.2828$). (Figure 2a) When those individuals described as noncompliant were accounted for, this difference decreased to a non-statistically significant ($p=0.27$) value; NHP 65.56.

An analysis of all groups indicated a response profile that demonstrated that, regardless of group assignment, the interval score from baseline to each time point improved significantly ($p<0.001$) with the improvement over baseline for two week 20.35 ($SD\pm 1.04$), six week 33.56 ($SD\pm 1.098$), three to six months 37.41 ($SD\pm 1.17$), and one year 42.28 ($SD\pm 1.46$). When comparing the reported HOOS Jr. scores for each individual question, the only differences noted between SHP and NHP were at the two-week mark for questions five and six which address Lying in Bed ($p=0.017$, Question 5) and Sitting ($p=0.0012$, Question 6).

VAS Score

There was no difference for VAS score at baseline between the two groups ($p=0.834$) or at each subsequent time period ($p>0.1765$) which remained true when controlling for each site at which surgery was performed. Again, a fixed effect was realized with improvements of the VAS score at each time period; the VAS improved 2.3 at two weeks ($SD\pm 1.48$), 10.0 at six weeks ($SD\pm 1.43$), 9.02 at 3–6 months ($SD\pm 1.61$), and 9.16 at one year ($SD\pm 1.9$). Each time point was significantly improved when compared to the baseline ($p<0.0039$). (Figure 2b)

Rate of Pain

There was no difference in the rate of pain between the two groups at baseline or at each time point ($p>0.1$). The rate of pain response profiles, compared to pain at baseline, improved at each time point with the overall pain decreasing by 3.6 ($SD\pm 0.19$) at two weeks, 5.0 ($SD\pm 0.18$) at six weeks, 5.5 ($SD\pm 0.17$) at three to six months, and 5.5 ($SD\pm 0.21$) at one year; each time interval improvement was significant ($p<0.001$). (Figure 2c)

Time to discontinuing walking aids was not significant ($p=0.84$) between the NHP and SHP groups.

Hip Precautions Practiced

The self-reported practice of hip precautions demonstrated 95% compliance in the SHP group at two weeks as compared to the NHP group which reported 39% compliance at two weeks ($p<0.001$). At six weeks, the number decreased to 90% for SHP and to 28% in the NHP ($p<0.001$). There was no difference when comparing the specific type of precaution practiced (flexion, adduction, rotation) in either group. (Table 2) In repeat analysis of HOOS

Jr. scores at two and six weeks when those reporting self-imposed restrictions were removed from analysis, there continued to be no difference between the groups ($p>0.13$).

Dislocations

There were two recorded dislocations (1.3%) in the SHP group and one dislocation (0.7%) recorded in the NHP group ($p=0.62$). All were the result of falls and were able to be reduced nonoperatively with a closed reduction. The cup position of all dislocations was recorded to be within the Lewinnek safe zone. (Figure 3)

Discussion

The demand for primary hip arthroplasty will continue to increase over the coming decade. [30] With this rise comes an increasing responsibility to examine all aspects of care surrounding total hip arthroplasty. In this study, we found that the absence of hip precautions did not impact the early recovery of patients undergoing total hip arthroplasty based on no significant differences in the HOOS Jr. scores, cessation of walking aids, or health state. Furthermore, with the numbers available for this study, we found no difference in the rate of postoperative dislocation.

The impact of hip precautions on the quickness of recovery is important. In an era where there is an emphasis on patient and surgeon demands for improved function and mobility at early time points, there is a need for continued assessment of different interventions. Barrett et al. and Taunton et al. reported a more rapid recovery in the early postoperative period of six weeks to three months when comparing the direct anterior approach to the mini-posterior approach.[31, 32] This timeframe coincides with the most frequent time period in which patients practice posterior hip precautions. Carli reports that nearly 64% of surgeons recommend precautions to all patients, while only 16% of surgeons using the direct anterior approach recommend any precautions to their patients.[18] The data from our study would suggest that the practice of precautions does not impact the perceived benefit or improved rate of recovery.

However, it has been demonstrated that patients *without* precautions do return to side sleeping sooner, drive earlier and more often, return to work sooner, and have a higher level of satisfaction in their recovery when compared to the restricted group.[8, 22] Peak et al. also found that there was an additional expenditure of \$655 per patient in the restricted group without accounting for any lost wages or time calculated. These costs were primarily related to additional equipment and devices required including an elevated toilet seat, abduction pillow, and an elevated chair.[9]

Numerous studies have found there is no benefit in using precautions postoperatively to decrease dislocation rates after THA.[9, 22, 23, 33–35] However, most of these studies focus on anterior based approaches (direct anterior, anterolateral, modified Hardinge)[9, 22] while few focus on the posterolateral approach.[31, 36] A prospective, comparative study with a historical control by Kornuijt et al. compared the rate of dislocation when minimal precautions were used and, while they demonstrated no difference, the authors acknowledged that the study was significantly underpowered ($n=108$) in the minimal

restrictions group.[36] A larger retrospective series (n=2275) by Gromov et al. found that removal of precautions did not lead to an increased risk of dislocation in the early postoperative period.[37] The compliance rate for adhering to precautions was not substantially evaluated as it was primarily a registry study. In this study, we found that participants reported 95% compliance when assigned to the SHP group. In fact, participants in the NHP group reported adhering to some form of hip precautions in 28% of the cases.

While the strengths of this study include a prospective, randomized, controlled design across three institutions, there are several limitations to this study. There is the potential for significant recall bias based on the questionnaires provided to the patients to recall the time to cessation of walking aids and the practice of specific hip precautions. The recorded compliance to hip precautions is certainly at risk for recall bias. Future consideration could record hip motions postoperatively with the use of accelerometer monitoring; the ability to provide accelerometer data would allow for more complete evaluation but may compromise data collection due to the cumbersome nature of the sensing equipment. The multi-institutional design of this study improves its generalizability. However, in addition, it allows for the introduction of variability in education by surgeons, physical therapists, and staff. Also, while the use of SHP is considered standard practice in many institutions, the introduction of a NHP protocol is certainly considered new at many institutions which could allow for outside influence or education from family members, media, or the internet. Also, the non-blinding of participants and surgeons could influence the patients, the placement of components, or the selection of implant sizes. However, we found that the relative size of implants was not different between groups and that the recorded anteversion of the NHP group was actually less than the SHP group ($p=0.02$).

In an era where we continue to strive to improve patient recovery without jeopardizing safety, it is important that we continue to examine current practices. Improvements in the posterolateral approach including bearing surfaces allowing for large head sizes, meticulous soft tissue repair, and rapid recovery protocols have improved patient satisfaction and limited the number of dislocations postoperatively. In this multicenter, randomized, controlled study, the absence of hip precautions in the postoperative period did not improve subjective outcomes. Further, with the numbers available for the study, there was no difference in the rate of dislocation between the two groups.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Abbreviations

NHP	No Hip Precautions (intervention group)
SHP	Standard Hip Precautions
VAS	Visual Analog Scale

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CONSORT 2010 Flow Diagram

Figure 1. CONSORT diagram outlining the identification, enrollment, and allocation of patients to the two groups, standard hip precautions (SHP) and intervention group, no hip precautions (NHP).

HOOS Jr Scoring

Health State VAS

Figure 2.

Outcomes scores at preoperative, two-week, six-week, three- to six-month and one-year time period. a) Outlines the improvement demonstrated in HOOS Jr. scoring from preoperative assessments to one year postoperatively. b) Each time point demonstrated significant improvement in the VAS score when compared to baseline but there was no difference between the SHP and NHP groups c) The rate of pain improved similarly in each group when evaluated at each time point.

Radiographic Cup Position

	SHP	95% CI	NHP	95% CI	p value
Abduction angle (degrees)	42.5	41-43	42.6	41.3-44	0.94
Anteversion (degrees)	18.8	16-21	14.9	12.3-17	0.02
Dislocations	2		1		0.62

Figure 3.

The cup positions as measured on shoot through radiographs of the two groups demonstrated that the dislocations were within the range of the Lewinnek safe zone. The NHP group had a statistically lower cup anteversion angle as measured on shoot through radiographs ($p=0.02$).

Table 1.

Demographics of Standard Hip Precautions (SHP) and No Hip Precautions (NHP) groups.

	SHP	95% CI	NHP	95% CI	p value
Age (years)	63.3	61–64	63.2	62–64.8	0.95
BMI (kg/m ²)	30	29.3–31	31	30.2–32	0.15
Male (%)	56%		48.9%		0.2477
ASA	2.5		2.6		0.387
CCI	2.29		2.29		1
Cup size (mm)	52.95	52–53.8	52.06	51–52.95	0.156
Head size (mm)	35.3	34.9–35.7	34.7	34–35	0.054
Abduction angle (degrees)	42.5	41–43	42.6	41.3–44	0.94
Anteversion (degrees)	18.8	16–21	14.9	12.3–17	0.02
Dislocations	2		1		0.62

BMI: body mass index {weight (kg)/[height (m)]²}; ASA: American Society of Anesthesiologists classification; CCI; Charlson Comorbidity Index

Table 2.

Self-reported hip precautions practiced at two and six weeks postoperatively.

	SHP			NHP			
	n	Positive Recorded Responses	Percent	n	Positive Recorded Responses	Percent	p-value
<i>Hip Precautions Practiced</i>							
2 weeks	139	132	95%	127	49	39%	<0.001
6 weeks	115	104	90%	107	30	28	<0.001
<i>No Hip Flexion > 90</i>							
2 weeks	139	123	88	131	26	20	< 0.001
6 weeks	130	99	76	115	21	18	< 0.001
<i>No Internal Rotation</i>							
2 weeks	139	124	89	131	29	19	< 0.001
6 weeks	130	103	79	115	18	14	<0.001
<i>No Adduction</i>							
2 weeks	139	128	92	131	30	19	< 0.001
6 weeks	130	102	78	115	24	19	<0.001