SYMPOSIUM: ADVANCED TECHNIQUES FOR REHABILITATION AFTER TOTAL HIP AND KNEE ARTHROPLASTY

# Newer Anesthesia and Rehabilitation Protocols Enable Outpatient Hip Replacement in Selected Patients

Richard A. Berger MD, Sheila A. Sanders RN,
Elizabeth S. Thill RN, Scott M. Sporer MD,
Craig Della Valle MD

**Abstract** Advancements in the surgical approach, anesthetic technique, and the initiation of rapid rehabilitation protocols have decreased the duration of hospitalization and subsequent length of recovery following elective total hip arthroplasty. We assessed the feasibility and safety of outpatient total hip arthroplasty in 150 consecutive patients. A comprehensive perioperative anesthesia and rehabilitation protocol including preoperative teaching, regional anesthesia, and preemptive oral analgesia and antiemetic therapy was implemented around a minimally invasive surgical technique. A rapid rehabilitation pathway was started immediately after surgery and patients had the option of being discharged to home the day of surgery if standard discharge criteria were met. All 150 patients were discharged to home the day of surgery, at which time 131 patients were able to walk without assistive devices. Thirty-eight patients required some additional intervention outside the pathway to resolve nausea, hypotension, or sedation prior to discharge. There were no readmissions for pain, nausea, or hypotension yet there was one readmission for fracture and nine emergency room evaluations in the three month perioperative period. This anesthetic and rehabilitation protocol allowed outpatient total hip arthroplasty to be routinely performed in these consecutive patients undergoing primary total hip arthroplasty. With current reimbursement approaches the modest savings to the hospital in length of stay may be outweighed by the additional costs of personnel, thereby making this outpatient system more expensive to implement.

**Level of Evidence:** Level IV, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

## Introduction

Historically, inpatient hospitalization frequently exceeded several weeks following total hip arthroplasty. Subsequent refinement in surgical techniques with decreased anesthesia time and the implementation of clinical pathways has substantially reduced the length of stays for primary total hip and knee replacements to a few days [15–17, 19, 20, 23]. As total hip replacement has become a widespread standardized procedure, there has been continued interest from patients—and pressure from third-party payers—to further decrease both the length of hospitalization and the recovery period.

Until recently, total joint arthroplasty had not been considered amenable to outpatient surgery given the substantial pain, impaired mobility, and concern over medical morbidities associated with this major surgical procedure. However, the application of specialized clinical pathways, regional anesthesia, and minimally invasive surgical techniques have allowed unicompartmental knee arthroplasty, total knee arthroplasty, and total hip arthroplasty to be performed in selected patients on an outpatient basis

R. A. Berger (✉), S. A. Sanders, E. S. Thill,
S. M. Sporer, C. Della Valle
Department of Orthopaedic Surgery, Rush Medical College,
Rush-Presbyterian-St. Luke's Medical Center, 1725 West
Harrison Street, Suite 1063, Chicago, IL 60612, USA
e-mail: r.a.berger@sbcglobal.net

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[2–6, 22, 25]. However, to consistently allow total hip replacement to be performed on an outpatient basis, it is necessary to develop and implement novel clinical pathways including improved anesthetic techniques, more effective perioperative pain and nausea management, and more rapid rehabilitation protocols. Furthermore, it is critical to be able to modify and adapt the pathways when problems are encountered.

To assess the feasibility and safety of outpatient total hip arthroplasty, we developed and implemented a comprehensive perioperative management protocol that included intensive preoperative teaching, the use of regional anesthesia, and preemptive oral analgesia and antiemetics [3, 4, 25]. In addition, a dedicated nurse clinician managed these patients immediately postoperatively to rapidly respond to problems that could potentially delay discharge including nausea, hypotension, dizziness, and oversedation.

The purposes of this paper were to (1) report the experience of performing outpatient total hip arthroplasty using this novel protocol in a group of 150 consecutive patients undergoing primary THA, (2) identify the common perioperative challenges encountered with same-day discharge, (3) identify the frequency and causes of readmission, and (4) identify the postoperative complications.

## Materials and Methods

We prospectively followed 150 consecutive patients undergoing primary THA performed by a single surgeon (RAB) between May 2003 and December 2004 using a new protocol. During this period, the surgeon performed a total of 535 primary THAs in patients without a history of previous surgery to the affected hip. Patients were selected for enrollment in this study based on defined IRB inclusion criteria which included patients undergoing primary THA without a history of previous hip surgery who were between 40 and 75 years of age. There were 447 patients who met these criteria. We excluded patients with a history (within 1 year) of myocardial infarction, pulmonary embolism, or chronic anticoagulant therapy. In addition, patients were excluded if they had a body mass index greater than 40, or if they had three or more medical comorbidities that were poorly controlled. A family support system was not necessary for inclusion in this study. Three hundred ninety-four of the 535 patients (74%) met these inclusion criteria; however the protocol additionally called for the THA to be performed as the first case of the day, resulting in 150 patients who were enrolled in the study. All 150 patients were followed for a minimum of 3 months. The study was IRB-approved.

Although initial enrollment in the study was random (the first criteria-meeting patient to schedule a primary THA on a given day was selected for inclusion), some patients either declined participation because of expected discharge on the day of the procedure or were unable to commit to the frequent outpatient visits required for participation. Further, some patients specifically requested participation in the outpatient pathway (based on knowledge from another patient or other source) and thus creating a selection bias for motivated patients. Patients were not selected for enrollment based upon the surgeon's perception of the technical ease of the procedure or based upon the expectation that the patient would perform well postoperatively.

Of the 150 patients enrolled in this study, 38 were women (25.3%) and 112 were men (74.7%). The average age of the patients was 58 years (range, 41–75 years). Thirty-six patients were over 65 years of age (24%), 75 patients were between 50 and 65 years of age (50%), and 39 patients were under 50 years of age (26%). The average weight of the women was 158 pounds (range, 101–186 pounds) and the average weight of the men was 212 pounds (range, 140–345 pounds). The BMI averaged 30.4 for the men (range, 22.5–39) and 28 for the women (range, 20.6–35.8). The preoperative diagnosis was osteoarthritis in 142 patients (94.7%), developmental dysplasia of the hip in five patients (3.3%), and osteonecrosis in three patients (2%).

All patients were enrolled in a comprehensive clinical pathway (Berger et al. [2–6], Sanders et al. [25]) that included preoperative, intraoperative, and postoperative care. This pathway was a combined effort of the surgical team, anesthesia, nursing, physical therapy, occupational therapy, and discharge planners. At each step in the process, critical points that could delay the patient's discharge were identified and addressed. This included tangible postoperative problems such as hypotension, nausea, pain control, and impaired ambulation. In addition, patients' apprehensions about same-day discharge, which included fears of increased pain, increased complications, delayed recovery, or dependence on others, were identified and addressed.

Preoperatively, the patients attended a class taught by a nurse [25], who explained the potential complications of THA and delineated the entire expected hospital course and postoperative care. Patients were reassured that their pain would be controlled, that they would be carefully monitored for complications or delayed recovery due to early discharge, and that they would be able to ambulate independently after surgery. Following this class, patients had a single physical therapy session for instruction in gait training with crutches, with weight bearing as tolerated. Patients were also evaluated by an internist and donated two units of blood prior to surgery. Prior to surgery, a hospital discharge planner called the patient at home to ensure that appropriate arrangements for discharge had been made, including someone to take him or her home at discharge.

On the morning of surgery, 40 mg of Bextra (valdecoxib; Pfizer, Princeton, NJ) or 400 mg of Celebrex (celecoxib; Pfizer, Princeton, NJ) and 10 mg of OxyContin (oxycodone hydrochloride controlled release; Purdue Pharma, Stamford, CT) were administered orally. An epidural anesthetic without narcotic additives was used unless it technically could not be inserted. Placement of the epidural catheter failed in three cases, whereupon general anesthesia was administered. The use of both intravenous and epidural narcotics was avoided. Diprivan (propofol; AstraZeneca Pharmaceuticals, Wilmington, DE), a short-acting sedative, was titrated during the case for sedation. Four mg of Zofran (ondansetron hydrochloride; Glaxo SmithKline, Philadelphia, PA) and 10 mg of Reglan (metoclopramide; Wyeth Pharmaceuticals, Madison, NJ) were administered intravenously during the case to decrease nausea. Patients were also kept well-hydrated to prevent postoperative hypotension and subsequent nausea. A Foley catheter was inserted in all cases; we used a Foley in all patients to help monitor fluid status as well as to eliminate the concern for urinary retention. Prophylactic intravenous antibiotics were administered prior to the skin incision. One hundred forty-five of the 150 patients had an epidural anesthetic, three had general anesthesia (due to an inability to successfully enter the epidural space), and two had epidural anesthesia with a short period of general anesthesia to achieve adequate muscle relaxation to facilitate final reduction of the hip.

Intraoperatively, the epidural infusion and Propofol were titrated to achieve the minimum analgesia necessary for performance of the procedure. The adjunctive use of general anesthesia was administered if the regional block did not provide adequate analgesia or if the regional technique did not allow proper relaxation to perform the arthroplasty or reduce the hip. A cementless total hip was used in all cases. All 150 patients had a cementless, hemispherical, porous-coated acetabular reconstruction. This hemispheric component has a commercially pure titanium shell covered with a commercially pure titanium fiber-metal mesh and has multiple holes for supplemental screw fixation. The acetabular component was inserted with a 2-mm press-fit by implanting a component that was 2 mm larger than the last reamer used to prepare the acetabulum. Two supplemental screws were used in all cases. An insert made of UHMWPE that was cross-linked was fastened into the shell. The inner diameter was 32 mm in all cases. All 150 patients had a full porous-coated stem. A 32-mm head was used in all cases. In cases with a modular head, one of five neck lengths was used. These components were inserted using a minimally invasive technique that minimizes damage to muscle and tendons with prosthetic insertion [1–3]. The patients had one of their own units of autologous blood transfused intraoperatively at the end of surgery regardless of the surgical blood loss. The mean surgical time was 99 minutes (range, 66–141 minutes). The mean estimated blood loss was 266 cc (range, 100–1000 cc).

In the recovery room, a second dose of Zofran was administered and the patient's second unit of autologous blood was transfused. The patient was kept well-hydrated to prevent postoperative hypotension and nausea. The epidural (fentanyl 10 μg/mL + 0.1% bupivacaine) was continued in the recovery room at 6 cc, 1 cc every 15 minutes with a 40 cc for 4-hour lock out.

Two hours after surgery, the Foley catheter was discontinued and 20 mg of OxyContin (10 mg of OxyContin for patients over 70 years of age or under 120 pounds) was given orally. Patients were allowed to take Norco 10/325 mg (Watson Pharmaceuticals, Corona, CA.) for breakthrough pain if needed. The epidural catheter was removed 4 hours postoperatively. The intravenous line was subsequently discontinued and the intravenous catheter was maintained with a heparin lock prior to physical therapy. Occupational and physical therapy were initiated 5 to 6 hours postoperatively. The patients were allowed weight bearing as tolerated and encouraged to rapidly advance to a cane or ambulate unassisted. One additional dose of intravenous antibiotics was administered following physical therapy. No additional antibiotics were given before discharge or while patients were at home.

A clinical nurse was immediately available to address any problems such as inadequate pain control, nausea, hypotension, dizziness, or oversedation. Breakthrough pain was first treated with hydrocodone 10/325 mg (5/325 for patients over 70 years of age or under 120 pounds); if this was insufficient, IV morphine, up to 10 mg and/or additional oral agents (Norco 10/325, OxyContin) were given. Nausea that was not positional was treated with 10 mg of Reglan and 4 mg of Zofran. Hypotension and positional dizziness were treated with an intravenous fluid bolus. Positional nausea or orthostatically induced nausea was treated with an intravenous fluid bolus and 10 mg of Reglan. Oversedation was usually treated by allowing for the effects of the medication to subside, however in severe cases Narcan (naloxone hydrochloride) was utilized.

Discharge was permitted when strict criteria were met. As a hospital requirement, all patients must complete a formal physical therapy protocol. This protocol requires that patients are able to independently transfer out of bed to a standing position and transfer into bed from a standing position. Additionally, they must be able to independently rise from a chair to a standing position and to sit from a standing position. Patients must also be able to walk 100 feet, and ascend and descend a full flight of stairs. The patient must exhibit stable vital signs, tolerate a regular diet, and have adequate pain control from oral analgesics.

Only after all of these criteria are met is the final criteria invoked—"does the patient feel comfortable going home?" When ready, all patients were discharged directly home from the hospital and were not discharged to another care facility.

Upon discharge, patients continued taking Bextra 20 mg daily or Celebrex 200 mg for at least 2 weeks and gradually decreased their dose of OxyContin as needed; hydrocodone was taken as needed for breakthrough pain. All patients received aspirin 325 mg twice a day as deep venous thrombosis prophylaxis for 3 weeks. Patients were encouraged to resume activities as tolerated. There were no hip precautions used throughout the recovery. These patients were allowed to drive when they had stopped all narcotic medications. Home physical therapy was utilized until the patient could drive (typically within 1 week) at which time outpatient physical therapy was started. Visiting nursing care was not utilized. Patients were evaluated clinically and radiographically in the office at 1 week, 2 weeks, 6 weeks, and 3 months postoperatively. Clinical outcomes were assessed using the Harris Hip Score [13] preoperatively and at 6 weeks and 3 months postoperatively. Patient satisfaction was assessed at the 2-week office visit by a nurse clinician asking the question, "Would you be discharged home the same day and following the same clinical pathway again?" Continuous variables were compared using a paired student's t-test with a significance level of 0.05.

## Results

All 150 patients enrolled in the study successfully completed the protocol and all 150 were discharged home the same day. When questioned, 144 patients were satisfied they were able to (and chose to) go home the day of surgery. Six patients were not happy with their choice and believed they would have been better served having stayed in the hospital at least overnight. Of these six patients, five patients described postoperative nausea while one described postoperative pain as their desire to remain hospitalized.

Thirty-eight patients (25.3%) required additional treatment postoperatively from the nurse clinician due to nausea. Twelve patients required additional treatment for nausea without hypotension using Reglan to inhibit nausea and Zofran to prevent the nausea from recurring. In all 23 patients, the nausea resolved without a delay preventing same-day discharge. Ten patients had transient orthostatic hypotension without nausea that required the administration of a bolus of intravenous fluids. Two patients required repeated intravenous fluid bolus treatments that did delay the pathway; however, all 10 patients were eventually discharged the day of surgery. Nine patients had orthostatic

hypotension with nausea. These patients received an initial bolus of intravenous fluids and a dose of Reglan without Zofran. In six of these nine patients, the orthostatic hypotension with accompanying nausea resolved without preventing same-day discharge, while three patients required repeat treatments to alleviate both the orthostatic hypotension and accompanying nausea. All three patients who received general anesthesia for the entire surgery developed orthostatic hypotension with nausea postoperatively and required additional treatment as described above. Despite the delays in the same day discharge pathway, all three patients were discharged to home the day of surgery.

Seven patients were oversedated using this pathway due to a heightened sensitivity to narcotic medication. The oversedation resulted in a delayed initiation of physical therapy in all seven patients. In six of these seven patients, the oversedation resolved without treatment and offered minimal delay in the pathway for discharge; one patient required treatment with Narcan, which delayed the pathway. There were no cases of urinary retention despite the brief use of a Foley catheter (Fig. 1).

One hundred thirty-one of 150 patients were able to walk in the hospital prior to discharge without assistive devices. Of these 131 patients, 105 were discharged with a cane to use as needed while 26 chose to use no assistive devices. Of the 19 patients who could not walk in the hospital without assistive devices, 18 were discharged with crutches to use as needed while one chose to use a walker (as they had preoperatively) for balance problems. The average time to discontinue all assistive devices was 4.1 days (range, 0–22 days) in 149 patients. One patient who used a walker preoperatively eventually graduated to a four-prong cane, which she continues to use for balance problems.

One patient was readmitted in the first 3 months from this group of 150 patients. This patient, who has a history of radiation to his femur for lymphoma, fell down a flight
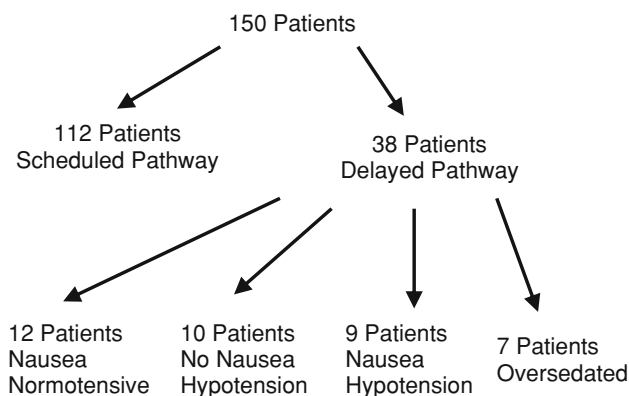


**Fig. 1** A flow diagram of the study is shown. Of the 150 patients enrolled, 38 patients had a delay in the pathway; seven were oversedated; nine had nausea and hypotension; 10 had hypotension without nausea; and 12 had nausea without hypotension.

of stairs 10 weeks postoperatively and sustained a periprosthetic fracture at the distal end of the stem.

One patient developed a stress fracture 6 weeks postoperatively at the distal end of a 22-mm femoral stem. One patient developed pneumonia 10 weeks postoperatively. He subsequently developed a psoas abscess from his pneumonia and required irrigation and débridement of the abscess 3 months postoperatively. There were nine emergency room visits without readmission in the first 3 months. In the first week there were three visits: one for nausea-induced dehydration, one for anemia which required transfusion, and one for pain in a patient who refused to take any medication due to nausea. Between 1 and 4 weeks postoperatively, there were four emergency room visits without readmission: one for benign leg swelling, one for a urinary tract infection, one for a fall without injury, and one for face swelling from a medication reaction. Lastly, between 1 and 3 months postoperatively there were two visits: one for pneumonia (described above) and one for low blood pressure from too much blood pressure medication. All nine patients were treated in the emergency room without readmission. There were no other postoperative complications in this group of 150 patients. There were no clinically evident deep vein thromboses or pulmonary embolisms. There were no dislocations or other readmissions for any reason.

The mean Harris Hip score improved from 51 points preoperatively (range, 32–74 points) to a mean of 91 points at 6 weeks (range, 56–100 points; p < 0.01) and a mean of 95 points at 3 months (range, 62–100 points; p < 0.01).

## Discussion

Advancements in the surgical approach, anesthetic technique, and the initiation of rapid rehabilitation protocols have decreased the length of hospitalization and subsequent duration of recovery following elective total hip arthroplasty. The purposes of this paper were to (1) report the experience of performing outpatient total hip arthroplasty using this novel protocol in a group of 150 selected, consecutive patients undergoing primary THA, (2) identify the common perioperative challenges encountered with same-day discharge, (3) identify the frequency and causes of readmission, and (4) identify the postoperative complications.

Our study is limited by selection bias. We initially planned to randomly select patients for this protocol or a traditional inpatient stay. However, the study did not proceed to completion as a random selection, as several patients either requested overnight hospitalization or requested that they be enrolled on the pathway despite not being part of the study. While we did not select patients based on their meeting criteria for surgery as an outpatient, some bias crept into the study by some patients asking to be in the study while others declined. In addition, our hospital has traditionally had a young patient population for total hip replacement. The average age of our study group, 58 years with only 24% older than 65 years, is likely younger than the average age seen by many surgeons.

All 150 patients enrolled in this study were able to be discharged to home on the day of surgery and chose this option, demonstrating that for this group of healthy patients, outpatient THA is feasible. Furthermore, with only one readmission for a traumatic periprosthetic fracture and no major postdischarge complications in these patients, our results indicate that outpatient THA can be safely performed. Other authors have cited the implementation of specialized clinical pathways as not only decreasing the length of hospital stay in total joint replacement [15–17, 19, 20, 23] but also observed significantly decreased complications [5, 10, 14, 16]. Contrasting this well-documented trend, Parvizi et al. have suggested that reducing the length of stay might increase the medical complication rate to an unsafe level and therefore increase liability in patients undergoing traditional approaches to total joint replacement [21]. In that study, Parvizi et al. [21] noted that most of the major medical complications observed occurred in the first few days following traditional approaches, not the minimally invasive approaches described in this report. In the current study of patients undergoing a minimally invasive procedure, as well as other studies we have authored on outpatient minimally invasive total hip and knee replacement [2–6], we have documented that with minimally invasive approaches, a very short hospital stay or even outpatient joint arthroplasty is safe and therefore no increased liability exists. Furthermore, the study of Parvizi et al. suggests there is a limit to how quickly patients can be safely discharged with traditional approaches to total joint replacement. Our observations suggest this safety concern raised by that study, and the potential increased liability that it carries, is not transferable to the minimally invasive approaches that we describe in this report. This has been described for other orthopaedics operations that have moved to outpatient procedures with the introduction of minimally invasive techniques including arthroscopic meniscotomy [11, 12], anterior cruciate ligament reconstruction [7, 9, 26], and unicompartmental knee replacement [24]. This has been true in other surgical areas outside of orthopaedics as well; laparoscopic cholecystectomy is safer when performed as an outpatient compared to the traditional approach in which patients were admitted to the hospital [8].

In developing the clinical pathway, the team discovered many impediments to outpatient THA. The first was a misconception that patients wanted to stay in the hospital. Instead, patients are often afraid to go home. Based on patient feedback, there seem to be two main fears to same

day discharge: uncontrollable pain and dependency on others. Our data suggest a preemptive pain control strategy successfully managed patients' postoperative pain: no patient in this study stayed overnight due to pain, and in fact, no patient was delayed in the pathway due to pain or had to have rescue pain medication in the hospital. Furthermore, 131 of 150 patients could walk without an assistive device the day of surgery. Immediate physical therapy demonstrated to the majority of patients that they could be independent almost immediately.

Addressing and alleviating the patients' apprehensions about outpatient THA was facilitated by the study's comprehensive pathway, as evident by every patient opting to leave the hospital on the day of surgery. Furthermore, 144 of 150 patients were happy they chose to leave the day of surgery. The major problem that the other six patients encountered was neither pain nor disability, as they had expected, but medication-induced nausea. Therefore, additional antiemetics might be given or less perioperative pain medication might be used in the future. In fact, reducing perioperative pain medication is supported by the study's results: no patient had a clinical problem with pain in the hospital, while 28 of the 150 patients required additional treatment for nausea and oversedation from excessive pain medication.

While the protocols developed achieved the goal of outpatient THA, over 25% of the study's patients required some intervention from our clinical nurse to stay on the pathway. Therefore, to make outpatient THA more successful and widely practiced, a full-time clinician must be available to intervene and resolve the common problems of nausea, hypotension, and sedation early in the patient's hospital course; otherwise, the patient will be excessively delayed and unable to leave the day of surgery.

Several authors demonstrate that a decreased length of stay, by as much as 2 to 4 days, does not increase complications after total joint replacement [15, 18, 22]. In fact, other authors report decreasing the length of stay decreased complications, improved outcomes, and increased patient satisfaction in total joint replacement [10, 14, 17, 19]. Our data also demonstrate early discharge does not result in excessive readmissions or other postdischarge complications due to early discharge. Similar results have been reported in other situations now performed as outpatient procedures, such as arthroscopic meniscectomy [11, 12], anterior cruciate ligament reconstruction [7, 9, 26], and unicompartmental knee replacement [24].

While a cost analysis is beyond the scope of this paper, the obvious question remains about the cost of providing this level of dedicated and time-sensitive care to patients. Although this report did not evaluate hospital costs, from the hospital's perspective, the cost of treating these patients is somewhat less, as the length of stay is diminished with the other costs remaining similar to those patients with a traditional length of stay. A hospital receives payment either as a global fee (DRG), on a per diem basis, or via a combination where the front end is loaded and a small fee is paid per day thereafter. A hospital may negotiate payment with each insurance carrier. Therefore, depending on the negotiated payment for each carrier and the hospital's ability to move more patients through the hospital system with a decreased length of stay, the hospital may be financially helped or hurt by reducing the length of stay. However, it is most useful to focus on our patients and what is in their best interests. If a patient needs to stay in the hospital longer, then a longer stay is justified; however, if the patient is ambulatory, comfortable, medically stable and as we have shown, is not at an increased risk from an early discharge, then they should be allowed to be discharged when the aforementioned criteria have been met. However, there is a substantial cost for the dedicated nurse clinician and discharge planner required to work and monitor this protocol. The cost of these additional personnel is borne by the surgeon in our system; there is no way to bill for these additional services. Therefore, overall, the modest savings to the hospital in length of stay may be outweighed by the additional costs of personnel, thereby making this outpatient system more expensive to implement.

Our data demonstrate outpatient THA can be safely performed. However, many unanswered questions remain. What percentage of patients in a general practice can have outpatient THA? What are the most appropriate selection criteria for outpatient THA? Should outpatient THA be performed only at specialized high-volume centers, or can it be performed in a community practice setting? If outpatient THA is commonly adopted, will reimbursement to surgeons increase or decrease? Lastly, can—and should—this procedure be performed in outpatient centers where surgeon-owners have more control over the entire process? Until the medical community can provide unequivocal answers, medical professionals should proceed cautiously, carefully refining protocols and further defining the patient populations that may benefit from this approach. Until such time as there is additional information, we continue to use the protocol we instituted for this study. Individual surgeons, however, must determine if this protocol can be safely implemented in their own practice setting.

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