

# Primary Total Hip Arthroplasty Using an Anterior Approach and a Fracture Table

## Short-term Results From a Community Hospital

Steven T. Woolson, MD,\* Michael A. Pouliot, BA,† and James I. Huddleston, MD\*

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**Abstract:** There are no data regarding the efficacy and safety of minimally invasive hip arthroplasty technique performed by community practice orthopedists. The early clinical and radiographic results of primary total hip arthroplasty using a minimally invasive anterior approach to the hip performed on a fracture table were studied. Two hundred thirty-one consecutive patients (247 hips) of 5 community practice surgeons were studied. The average surgical time (164 minutes) and estimated blood loss (858 mL) were more than double, and the major complication rate (9%) was 6 times that reported by an innovator of the procedure. However, no postoperative dislocations occurred. Adequate training is critical to reduce the risk of complications during the learning experience of minimally invasive hip arthroplasty procedures by community practice surgeons. **Keywords:** anterior approach, fracture table, orthopedists.

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Innovators of minimally invasive total hip arthroplasty have claimed that these procedures result in significant short-term benefits to the patient [1,2]. These benefits are reportedly based on the premise that minimally invasive techniques cause less soft tissue damage and lead to a quicker recovery time with less pain. The complication rates of minimally invasive posterior hip arthroplasty performed by joint arthroplasty specialists compared with standard incision approaches have been found to be similar [1-4].

An advantage of the anterior approach to the hip is the reduction of postoperative dislocation, a result confirmed by studies of standard incision anterior approaches [5,6]. There are several cohort studies of anterior minimally invasive hip arthroplasty using a fracture table [7,8], but there are no randomized, prospective, or lesser-quality comparative studies of this approach to a standard total hip approach. Importantly, we are not aware of any published studies regarding any minimally invasive joint arthroplasty techniques performed by community practice general orthopedists. We determined the in-hospital and short-term results of a small incision anterior approach in a consecutive series of patients undergoing primary total hip arthroplasty at a single community hospital by 5 surgeons.

### Materials and Methods

The short-term results of a consecutive series of the patients of 5 surgeons who underwent primary total hip arthroplasty from an anterior approach

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*From the \*Department of Orthopedic Surgery, Stanford University Medical Center, Stanford, California; and †Stanford University School of Medicine, Stanford, California.*

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Reprint requests: Steven T. Woolson, MD, Department of Orthopedic Surgery, Stanford University Medical Center, 300 Pasteur Drive, MC 5331, Stanford, CA 94305.

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using a fracture table for a period of 2 years were studied. Four of the 5 community practice surgeons at one hospital began using this new minimally invasive procedure exclusively for all of their primary hip arthroplasty procedures after October 2004, and the remaining surgeon started to use the technique in October 2005. All of these surgeons had been in practice for more than 10 years and had performed all of their hip arthroplasties using a standard posterior approach since their residency training. Four of the 5 surgeons trained for this minimally invasive procedure by visiting one of the innovators of the technique and observing the procedure, and the fifth surgeon had no formal preceptorship. No cadaver or laboratory training was done by these surgeons before their use of the technique in patients. Institutional review board approval was obtained from the hospital and medical practice group of 2 of the surgeons for this retrospective review. To eliminate bias, all data were collected retrospectively by 2 of us (STW, MAP) who did not participate in any of the procedures.

The procedure was performed with the patient supine on a fracture table (OSI Profix, Union City, Calif) with the affected leg attached to a mobile spar that applied traction and rotated or angulated the leg. An anterior incision 8 to 10 cm in length was made, which was located several centimeters posterior and distal to the anterior superior iliac spine and directed toward a point several centimeters anterior to the greater trochanter. The interval between the tensor fascia lata and the sartorius and rectus femoris muscles was used to expose the hip joint capsule. After the capsule was opened, the femoral head was dislocated anteriorly by traction with a corkscrew that was inserted into the femoral head and external rotation of the extremity. The femoral neck was osteotomized, the acetabulum prepared, and its component inserted. Fluoroscopy was used in all of these patients to assess proper reaming of the socket and to determine correct acetabular and femoral component positioning. The femur was prepared by exposing the femoral neck with the assistance of a sterile trochanteric hook connected to the fracture table through the drapes that brought the femur anteriorly with a mechanical jack, whereas the leg was positioned by rotating the leg with the fracture table to 90° of external rotation and placing the hip into extension and adduction. The piriformis and obturator internus tendon insertions on the greater trochanter were released, if necessary, for better exposure of the femur. Because straight reaming of the femoral canal can be difficult from this approach, femoral components that only require femoral broaching are better suited

**Table 1.** Patient Demographics

	Study Group
No. of hips	247
No. of patients	231
Average age, range (y)	67.7 (36-90)
Average height (cm)	169
Average weight, range (kg)	81 (41-148)
Average ASA score	
No. of patients	2.5
ASA 1	12
ASA 2	100
ASA 3	111
ASA 4	8
Sex, male/female	90/141
Preoperative diagnosis, no. of hips	
OA	210
ON	20
FNFX	6
CDH	2
RA	4
Miscellaneous	5
No. of hips per surgeon	
1	103
2	76
3	17
4	25
5	26

OA, osteoarthritis; ON, osteonecrosis; FNFX, femoral neck fracture; CDH, congenital hip dislocation; RA, rheumatoid arthritis.

to this approach [9]. After the femoral trial was inserted and the trial femoral head was reduced, fluoroscopy was used to obtain hard copy images of both hips that were superimposed by the surgeon to determine the leg lengths and femoral offset. Anterior hip stability was checked by externally rotating the hip in extension using the fracture table. A hardcopy fluoroscopic radiograph of the hip was obtained at the end of the procedure in place of obtaining a postoperative anteroposterior pelvis radiograph in the recovery room. Postoperatively, none of the patients were required to maintain standard dislocation precautions.

The study group included 231 consecutive unselected patients who had 247 hip arthroplasties. The demographic characteristics of the patients are listed in Table 1. The average age was 68 years, the average weight was 81 kg, and 61% of the patients were female. The distribution of the American Society of Anesthesiologists (ASA) scores [10] is listed in Table 1, and 85% of the patients had a preoperative diagnosis of osteoarthritis. Only one surgeon had had a case volume of more than one hip arthroplasty per month before beginning this technique. This surgeon performed approximately 30 hip arthroplasties each year before changing technique.

The implants used varied according to each surgeon's preference, but all acetabular components were press-fit cementless porous-coated types, with

**Table 2.** Surgical Data

	Study Group
No. of hips	247
Bearing surfaces, no. of hips	
MOP	148
COC	58
MOM (% hard on hard bearings)	41 (40)
Femoral head diameter, no. of hips	
28 mm	68
32 or 36 mm (%)	179 (72)
Prosthesis fixation, no. of hips	
Cementless (%)	205 (83)
Hybrid	42
Type of anesthesia, no. of hips	
Regional (%)	101 (41)
General	146
Postoperative weight bearing status, no. of hips	
FWB (%)	237 (96)
PWB	10

MOP, metal on polyethylene; COC, ceramic on ceramic; MOM, metal on metal; FWB, full weight bearing; PWB, partial weight bearing.

or without screw fixation. The femoral components that were used consisted of a single chrome-cobalt cemented stem (42 hips) (Summit; Depuy, Warsaw, Ind) and 205 cementless titanium alloy stems including 77 Summit (Depuy), 72 Accolade (Stryker, Kalamazoo, Mich), 22 Versys ML Taper (Zimmer, Warsaw, Ind), 19 Corail HA coated (Depuy), 12 Trilock, and 3 SROM (Depuy). Forty percent of the implant bearing surfaces that were used were hard on hard (ceramic on ceramic or metal on metal), 83% of the hips had cementless femoral fixation, and 96% of patients were allowed to bear full weight postoperatively (Table 2). The femoral head diameter was more than 28 mm in 72% of hips.

An anteroposterior view of the pelvis was available for only 151 (61%) patients, and this film was measured for the acetabular component abduction angle. This angle was determined from lines parallel to the face of the cup and to the interteardrop line. However, because there were multiple types of femoral components and criteria for assessment of fit and fill, this outcome could not be determined.

**Table 3.** Results

	Study Group
No. of hips	247
Average surgical time, range (min)	164 (81-378)
Average estimated surgical blood loss, range (mL)	858 (200-2500)
Average total blood replacement (U)	2.4
Average preoperative hematocrit (%)	36.5
Average postoperative hematocrit (%)	30.6
Average length of stay, range (d)	3.2 (1-18)

**Table 4.** Complications

	Study
No. of hips	247
No. of patients	231
Early minor complications—no. of hips (%):	8 (3)
hematoma, 4; calcar FX, 2; superficial infection, 2	
Dislocation, no. of hips (%)	0
Early major complications, no. of hips (%)	
Femoral shaft FX	2 (0.8)
Proximal femoral or GT FX	14 (5.7)
Deep infection	2
Nerve palsy	2
Immediate reoperation for leg length discrepancy	3
Total	23 (9)
Late complications	
Femoral revision within 1 y	3
Femoral subsidence within 1 y	5
Total femoral loosening	8 (3)

FX, fracture; GT FX, greater trochanteric fracture.

Major complications: femoral or greater trochanteric fracture, deep infection, nerve palsy, early reoperation, femoral component revision, or subsidence.

Femoral component alignment for varus or valgus angulation ( $\geq 5^\circ$ ) could be assessed for 91% patients who had radiographs of the pelvis or the hip. Femoral subsidence was measured from the vertical distance between the shoulder of the femoral component to the tip of the greater trochanter from the last follow-up radiograph compared with the initial postoperative x-ray value, after accounting for magnification error.

Follow-up clinical data were available for 96% of these patients and ranged from 2 weeks to 29 months (average, 8.4 months). Seventy-eight percent of this series of patients had minimum 3-month follow-up, but, because this was a study of community practice physicians who did not encourage regular follow-up visits for their patients, a significant number of patients had less than 3 months of follow-up. Because this was a retrospective study, there were no data available regarding the preoperative and postoperative clinical results of these patients from a hip scoring system. However, the sole purpose of the study was to determine the in-

**Table 5.** Radiographic Data

	Study Group
Average acetabular component abduction angle (range)	44 (33°-63°)
% Hips reviewed	61
Acetabular component abduction angle outliers, no. of hips	$\leq 30^\circ$ , 0 $\geq 50^\circ$ , 32
% Outliers	21
No. of femoral components in $\geq 5^\circ$ varus (%) [no. of hip x-rays reviewed]	18 (8) [226]

hospital and early postoperative results rather than the minimum 2-year follow-up results.

## Results

The average surgical time was extremely long at 164 minutes, and the average surgical estimated blood loss was also high (858 mL), with an average length of stay of 3.2 days. These patients received an average of 2.4 U of blood postoperatively, with most of the patients receiving 1 to 3 predonated autologous units (average, 1.7 U) (Table 3). Seventy-two percent of the patients were discharged home, 96% were not restricted in weight bearing, and no patient was asked to observe dislocation precautions.

The overall complication rate was 13% (31 of 247 hips), with 23 hips (9%) classified as having a major complication including 16 femoral shaft or trochanteric fractures, 2 deep infections requiring Girdlestone resection arthroplasties, 2 peroneal nerve injuries, and 3 immediate reoperations for leg length discrepancy (within 24 hours) (Table 4), but the incidence of postoperative dislocation was zero. The intraoperative proximal femoral or greater trochanteric fracture rate (6.5%) was high.

Radiographic analysis showed an average acetabular component abduction angle of 44.8° (Table 5), but 21% of the hips were outliers for cup abduction ( $\geq 50^\circ$ ) despite the use of fluoroscopy for all procedures. Eight patients (3%) developed femoral subsidence and/or loosening (5 with radiologic loosening or subsidence and 3 revisions for loosening) during this short follow-up period, but there were no acetabular failures.

Early femoral component loosening occurred in 3 hips that required revision within 1 year of the index procedure. Two of these patients had had a major

complication including a proximal femoral and a greater trochanteric fracture, and the third had loosening of a Corail implant requiring revision at 6 months. Five other hips demonstrated femoral subsidence of more than 10 mm within 1 year of the procedure, including a patient who had immediate reoperation for leg length discrepancy and another who had an intraoperative proximal femoral fracture. Thus, both intraoperative proximal femoral fractures resulted in early femoral component loosening.

We attempted to determine whether there was a trend for the 2 surgeons who had an adequate caseload to reduce their complication rates over time during this 2-year period (Table 6). When each surgeon's procedures were analyzed in a chronological manner in groups of 10 procedures, the number of major complications appeared to decrease after 30 to 50 procedures were performed; however, this trend was not confirmed from statistical analysis.

## Discussion

There have been few reports of the results of minimally invasive hip arthroplasty performed by noninnovators [3,4,11,12] and no publications of the results of minimally invasive hip arthroplasty performed by community practice surgeons. This study was intended to determine the early postoperative outcomes of a minimally invasive total hip procedure in a consecutive series of patients at a single community hospital. It is important to determine the results of minimally invasive hip arthroplasty technique for community practice surgeons who perform a relatively low volume of hip arthroplasties per year, because most of the hip arthroplasties performed in the United States are done by general practice orthopedic surgeons, and their results may differ from the consistently positive reports published by joint arthroplasty specialists.

None of these 5 surgeons had fellowship training in total joint arthroplasty, and all of them changed their technique of total hip arthroplasty from a standard posterior approach to this new minimally invasive technique because of the desire to lower their dislocation rates and to compete with other surgeons who were promoting minimally invasive techniques. At the present time, this community hospital advertises that it offers state of the art minimally invasive hip arthroplasty technique. All of the surgeons abruptly switched to this anterior approach and began performing this procedure for all of their patients undergoing primary hip arthroplasty without regard to the complexity of the case

**Table 6.** Major Complication/Early Loosening Learning Curve

Procedure No.	No. of Major Complications	
	Surgeon 1	Surgeon 2
No. of THA	103	76
1-10	2	2
11-20	1	1
21-30	2	2
31-40	1	2
41-50	2	1
51-60	0	0
61-70	0	0
71-80	0	0
81-90	0	NA
91-103	2	NA
Total	10 (10%)	8 (11%)

THA = total hip arthroplasty; NA = not applicable.

in 2004 and 2005. Training in the technique for 4 of the surgeons was limited to a single visit to an innovator of the procedure to observe surgery. Critics of this study will note the fact that these surgeons did not have proper training in the technique, and, therefore, a high complication rate would be expected to occur. The authors agree with this criticism but feel that most of the private practice general orthopedists who perform hip arthroplasty will have less than optimal training in a new technique before beginning to perform it in their patients. The pressure on community practice surgeons to adopt minimally invasive techniques is great from publications in the lay press and Internet advertisement for these techniques that encourage patients to request them. Few community practice surgeons have the time or access to cadaver laboratories to perfect their surgical technique in a new procedure. All of the surgeons in our study had a low volume of total hip arthroplasty cases before beginning the new technique with 4 of 5 performing no more than one hip arthroplasty per month.

The switch to this anterior technique from a conventional posterior approach arthroplasty resulted in a higher volume of procedures for all of the surgeons, including one surgeon whose hip arthroplasty volume increased from 12 to 50 cases per year. The use of a minimally invasive procedure appeared to produce a dramatically positive marketing effect by increasing the number of hip arthroplasties that were performed by all 5 surgeons. All of the surgeons continue to use the technique for all primary hip arthroplasties at the time of this writing.

This retrospective study has several weaknesses, including the lack of a concurrent control group, short follow-up, and incomplete radiographic data. The study could only determine the in-hospital clinical results and early postoperative (3 months) complication rates of most of these patients because there were no data available regarding clinical hip scores. The percentage of patients who had a minimum of 3 months of follow-up was 78%, but this study was done to determine solely the in-hospital and short-term results of the procedure and not the 2-year minimum results. However, all patients had complete in-hospital data, and it is likely that the study underestimated the number of short-term failures, because not all patients had 3 months of follow-up. If all patients had had 2-year minimum follow-up, the results would undoubtedly have shown even higher complication and loosening/subsidence rates, and that would have only strengthened our conclusions, not changed them. Radiographic data were limited because of the lack

of standardized postoperative follow-up radiographs of these patients and the use of many types of femoral implants. Data collection consisted of review of the hospital records, outpatient clinical charts, and the available postoperative radiographs from each surgeon's office by 2 independent observers (STW, MAP). The strength of this study, however, was that it was of a consecutive unselected series of each surgeon's patients and that all patients had complete in-hospital data.

The results from this study group were compared with those of an innovator of this technique from a recent cohort study. Matta et al [7] studied a series of 494 single-incision anterior approach hip arthroplasties using similar fixation technique and postoperative rehabilitation protocols (cementless fixation and full weight bearing without dislocation precautions). The average surgical time and blood loss of the community practice patients was more than twice that of this innovator. The percentage of cup outliers for a high abduction angle ( $>50^\circ$ ) for the community practice group was more than 5 $\times$  that of Matta et al. The major complication rate of this study group was extremely high (9% vs 1.4%) compared with this published cohort study as was the rate of femoral and greater trochanteric fractures (6.5% vs 1%). These data challenge the "minimal invasiveness" of this technique for the community practitioner. The marketing of the so-called minimally invasive technique by this community hospital raises serious ethical and moral questions that are not unique to this geographic area.

The use of intraoperative fluoroscopy for all these study patients did not result in a low percentage of outliers for either the acetabular abduction angle or femoral component alignment. The incidence of acetabular component outliers may not have been low, because it is difficult to obtain fluoroscopic images of the entire pelvis during the procedure and a pelvis x-ray is needed to accurately measure the cup abduction angle.

One of the main goals of changing to this technique by these community surgeons was to reduce the risk of postoperative dislocation, which has been reported as being very low ( $<1\%$ ) in 2 other publications on the anterior approach [7,12]. Although no dislocations occurred compared with a 0.6% rate for Matta, these data are difficult to interpret, because the size of the femoral heads used in Matta's series was not reported. The incidence of dislocation has been shown to decrease with the use of large femoral heads ( $>28$  mm in diameter) by others [6,13], and 72% of these patients had large-diameter femoral heads. There were also a relatively high percentage (40%) of patients who had hard

bearing surfaces (metal on metal or ceramic on ceramic) [14] that may also have contributed to reducing the dislocation rate.

Seven patients required early revision (7 hips, 3%), including 2 Girdlestone resection arthroplasties in a follow-up period that was not longer than 29 months. Five other hips are in jeopardy of revision with radiographic subsidence. The fact that the postoperative follow-up was short for most of the patients (32% had minimum 1 year follow-up) would indicate that the incidence of femoral component subsidence or loosening might have been underestimated in this study. The risk of a major fracture was high for this early experience in minimally invasive technique, and the 2 femoral shaft fractures that occurred resulted in femoral subsidence in one patient and reoperation for further fixation with subsequent deep infection requiring resection arthroplasty in the other. Most of the greater trochanteric and femoral shaft fractures occurred within the first year of these surgeons' experience, but 5 (31%) of 16 were in patients who had surgery during the second half of the study. The incidence of fractures dropped considerably after the first year of experience, probably from the more frequent use of release of the short external rotators during femoral exposure.

One of the surgeons had a very high complication rate of 31% (8 of 26 patients). Five of these 8 complications (19% or 5 of 26 hips) were major complications and included a deep infection after reoperation for an inadequately treated intraoperative femoral fracture, a revision for femoral loosening, 2 immediate reoperations for leg length discrepancy (one of whom had subsequent femoral loosening), and one greater trochanteric fracture requiring cable grip fixation. This surgeon had had no major complications in 14 consecutive hip arthroplasty patients who had had a standard posterior approach just before beginning this minimally invasive technique. The 2 surgeons with the highest volumes of anterior approach cases had complication rates more than twice as high as the 2 surgeons with the lowest volumes. The higher volume surgeons had a steep learning curve with a reduction in the risk of a serious complication apparent only after 30 to 50 cases. A 30 case learning curve is not insignificant for a surgeon who averages 1 to 2 hip arthroplasties per month. The ability to perform this minimally invasive procedure with an acceptable complication rate appears to vary greatly between surgeons. The absence of a learning curve or a steep curve was also found for another minimally invasive hip arthroplasty procedure, the

2-incision technique, as reported by Archibeck and White [15]. The complication rate of this anterior procedure may be unacceptably high for some surgeons who may have low complication rates for conventional hip arthroplasty.

Minimally invasive joint arthroplasty techniques have been claimed to be advantageous for patients in the early postoperative period, but there is no evidence that the long-term results of these procedures are improved by smaller incisions except for the length of the scar. The long-term results of the arthroplasty may be jeopardized by a major complication, including those complications that occur in patients who have surgery during the surgeon's early experience with a new technique. The serious nature of the complications that occurred during this anterior approach study brings into question whether the procedure is actually minimally invasive for community practice surgeons. This procedure may not be safe in the hands of surgeons who do not specialize in hip arthroplasty unless extensive training in the technique is done before performing the procedure on patients.

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