



## Original research

## Early results of displaced femoral neck fragility fractures treated with supercapsular percutaneous-assisted total hip arthroplasty

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## ABSTRACT

**Background:** Total hip arthroplasty (THA) is the preferred treatment for displaced femoral neck fractures in select patients, although dislocation remains a concern. In some studies, the supercapsular percutaneously assisted (SuperPATH) approach has demonstrated early mobilization, short hospital stay, and low dislocation rates in primary THA, but there are little data on its use for fractures. This study describes the perioperative outcomes and early dislocation rate of SuperPATH THA for displaced femoral neck fragility fractures.

**Methods:** A retrospective review was performed of previous ambulatory patients with a displaced femoral neck fragility fracture treated with THA using the SuperPATH approach. Demographic data, time to ambulation, length of stay, and in-hospital complications during the hospital stay and follow-up period were recorded. Phone interviews were conducted to check for dislocations 1 year after surgery. **Results:** Thirty-seven consecutive patients were included with an average age of 75.0 years. Hospital stay averaged 5.5 days, and patients were discharged on average postoperative day 3.6. About 83.8% of patients were ambulatory by postoperative day 1, and 94.6% ambulatory before discharge. Twenty-seven percent of patients were discharged home, 46% to inpatient rehabilitation, 24% to skilled nursing facility, and 1 patient to hospice. At follow-up, there was no symptomatic heterotopic ossification and no infections. Thirty-two patients were available for telephone interviews at 1 year, with no dislocations reported.

**Conclusions:** In this small cohort, the SuperPATH approach for THA appears to be safe and effective for use in femoral neck fragility fractures, resulting in early ambulation and a low dislocation rate.

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## Introduction

The optimal treatment of displaced femoral neck fractures in the geriatric patient remains controversial. The American Academy of Orthopedic Surgeons recommend total hip arthroplasty (THA) over hemiarthroplasty in properly selected patients due to studies

demonstrating less pain, improved patient-reported outcomes, and lower revision rates [1–5]. However, THA for femoral neck fracture also has an elevated risk of dislocation compared to hemiarthroplasty [6–8].

The etiology of dislocation is multifactorial and may be influenced by both patient-specific and surgical factors. Patient-specific factors include gender, cognitive disorders, alcoholism, age, soft tissue laxity, as well as a diagnosis of femoral neck fracture [9]. Surgical factors include component position, offset, head size, liner choice, and surgical approach [9,10]. Dislocation rates have decreased as larger diameter heads have become more popular, but surgical approach remains an important modifiable risk factor [11]. Some studies have reported dislocation rates as high as 9%–13% with the posterior approach, although a recent meta-analysis of 13,000 patients found this rate to be closer to 3.20% [10,12–16]. The

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anterolateral and direct anterior approaches have been used in order to minimize dislocation, but the anterolateral approach has been associated with abductor tendon injury and heterotopic ossification and the direct anterior approach has been associated with periprosthetic femur fracture, lateral femoral cutaneous nerve injury, wound complications, and a steep learning curve for the surgeon [17–22].

Minimally invasive surgical (MIS) approaches have become more popular for elective THA secondary to the potential for decreased muscular damage, pain, blood loss, and time to mobilization [23–26]. The supercapsular percutaneously assisted total hip (SuperPATH; MicroPort Orthopedics Inc., Arlington, TN, USA) approach is one such technique that shares some similarities with the traditional posterior approach. In the SuperPATH technique, the hip is approached from the superior aspect through the interval between the gluteus medius and piriformis, as well as through a percutaneous portal [27,28]. The operation is performed via a posterosuperior capsular incision without disrupting the short external rotator muscles and without dislocating the hip, thus theoretically reducing the risk of dislocation and assisting in quicker recovery.

Early reports of the SuperPATH technique for elective THA have demonstrated early mobilization, short hospital stay, and low rates of dislocation and other complications [29,30]. A recent case series demonstrated feasibility of the approach for hemiarthroplasty, but there are little data on use of this approach for THA for femoral neck fractures [31].

The purpose of this case series is to describe the postoperative time to ambulation, length of stay, discharge destination, and early dislocation rate of previous ambulatory geriatric patients with a displaced femoral neck fragility fracture who were treated with a THA via the SuperPATH approach. We hypothesized that a majority (>50%) of patients would be ambulatory before hospital discharge and that there would be a low (<5%) rate of dislocation.

## Material and methods

Approval was obtained through the institutional review board for a retrospective chart review and telephone interviews. All consecutive femoral neck fragility fractures treated by the senior author at a single center using the SuperPATH THA approach between January 2014 and April 2016 were reviewed.

Inclusion criteria were previous ambulatory patients with displaced femoral neck fractures secondary to a low-energy mechanism of injury who were treated with THA. Exclusion criteria were nonambulatory status prior to injury, hemiarthroplasty, and pathologic fracture. Femoral stems were chosen based on the evolving preferences of the surgeon, and included Microport Profemur Renaissance, Gladiator, Profemur Z, and Perfecta IMC Slim Neck. All patients received the Microport Dynasty shell and polyethylene liner.

The treating surgeon routinely uses the SuperPATH technique on all elective primary THAs and for most femoral neck fractures. The SuperPATH approach is performed in a similar manner for femoral neck fractures as for elective THA. However, while the senior author prefers to ream and broach prior to making the femoral neck cut on elective cases, for hip fractures the surgeon removes the fractured femoral head and neck prior to femoral preparation and subsequently makes a neck cut at the appropriate level. Postoperatively, there are no specific hip precautions nor assistive devices recommended other than a rolling walker.

The hospital database was reviewed for demographic data, time to surgery, time to ambulation, length of hospital stay, time from surgery to discharge, major and minor complications during admission, and disposition at discharge (home, rehabilitation facility, or skilled nursing facility). Ambulatory was defined as taking

any number of steps with a physical therapist. Current number of dislocations was confirmed with phone interviews at 1 year after surgery.

## Results

There were 37 cases performed during the study interval and all met inclusion criteria. The mean patient age was 75 years (51–95). There were 29 female and 8 male patients. Sixteen cases were right side and 21 were left. Average body mass index was 24.1 (Table 1).

Average operative time from incision to dressing was 2 hours 17 minutes. Femoral head component size averaged  $35.3 \pm 1.6$  (32–40). Seven stems were cemented, and 30 were press-fit. Estimated blood loss averaged  $370.3 \pm 169.0$  mL. Patients experienced an average intraoperative decrease in hemoglobin of 1.6 g/dL. Two patients received intraoperative transfusions: 1 received 4 units of packed red blood cells and 1 unit of fresh frozen plasma, and another received 2 units of packed red blood cells. Of note, the patient who received 4 units was thrombocytopenic secondary to an underlying malignancy. One patient received a transfusion 20 days postoperatively for anemia.

On postoperative day 1, 83.8% (31) of patients were ambulatory and 94.6% (35) of patients were ambulatory before discharge. The average number of days to ambulation was 1.3 for patients who were able to ambulate before discharge (0–5 days). The average distance ambulated on postoperative day 1 was 70.8 feet. The average number of hospital days from admission until surgery was 1.8 (0–6). Patients spent an average of 5.5 days in the hospital inpatient setting (2–9), and were on average discharged on postoperative day 3.6 (2–8) (Table 2).

Of discharge destinations, 27.0% of patients were discharged home, 45.9% to inpatient rehabilitation, 24.3% to skilled nursing facility, and 1 to hospice (Table 3). Average length of follow-up was 369 days (53–892) for 83.8% of patients; the rest were lost to follow-up shortly after hospital discharge.

During postoperative follow-up, there were no incidents of symptomatic heterotopic ossification and no superficial or deep wound infections. There were 4 cases of intraoperative non-displaced calcar fracture: 3 in cementless stems and 1 in a cemented stem; all were successfully treated with cerclage cables. Postoperative medical complications included 1 case of respiratory failure and subsequent discharge to hospice, 5 cases of urinary retention, 1 case of atrial fibrillation, and 1 case of delirium.

At 1 year, 32 patients were available for telephone follow-up. In these patients, there were no dislocation events nor need for revision surgeries, and all remained ambulatory. Review of the medical records found no documentation of dislocation in the remaining patients who were unavailable for follow-up.

## Discussion

This series describes the successful use of a tissue-sparing approach for THA as a treatment for femoral neck fractures in an elderly population. Dislocation is a significant complication of arthroplasty for femoral neck fractures, with rates higher for THA than hemiarthroplasty [6,7,32]. Most notable from our study is the absence of dislocation, supporting the premise that the SuperPATH approach may reduce the risk for this patient population, though

**Table 1**  
Patient characteristics (n = 37).

Age	75.0
% Female	78.4
% Left	56.8
Body mass index	24.1

**Table 2**  
Hospital outcomes.

Ambulatory prior to discharge (% of patients)	94.6
Days to ambulation	1.3
Distance ambulated on POD 1 (ft.)	70.8
Days to surgery	1.8
Hospital days	5.5
Days from surgery to discharge	3.6
Operative time (min)	137.0
Intraoperative blood loss (mL)	370.3
Intraoperative hemoglobin drop (g/dL)	1.6

POD, postoperative day.

we note that sufficiently powered comparative studies are needed to verify this hypothesis.

The physiologic and anatomic rationale for our observations may stem from preserving and primarily closing the capsulotomy, as well as preservation of the short external rotators. Randomized prospective studies of MIS posterior approaches for hemiarthroplasty have not demonstrated reduced rates of dislocation, but in these studies the short external rotator muscles were sacrificed [33,34]. Another retrospective analysis of a modified, short external rotator-preserving posterior approach reported significantly lower dislocation rates than a standard posterior approach (0% vs 7.7%) [35].

Due to our observed low risk of dislocation, the senior author of this paper does not routinely recommend any hip precautions after THA. The SuperPATH approach may be especially beneficial for this older patient population in which adherence to hip precautions may be challenging and complicated by significant rates of dementia and postoperative delirium [36,37].

Another possible benefit of a tissue-sparing approach is decreased time to ambulation and subsequent reduction in complications related to delayed ambulation. In this series, 83.8% of patients were ambulatory on postoperative day 1 and 94.6% were ambulatory before discharge. In contrast, Unger et al [38] describe a series of 180 patients who underwent hemiarthroplasty for femoral neck fracture with the direct anterior approach, and found a 7.3% rate of previous ambulatory patients needing a wheelchair for mobilization at discharge. Time to ambulation after surgery has been shown to be an independent predictor of pneumonia, delirium, and length of hospital stay, and it is possible that adopting a tissue-sparing approach such as SuperPATH may reduce these complications [39].

Intraoperative periprosthetic fracture with press-fit implants is an inherent risk when operating on patients with a fragility fracture. There is some evidence that this risk may be elevated with MIS approaches for elective THA [40,41] as well as for femoral neck fractures [29,34,42,43]. In our series, there are 4 of 37 cases (10.1%) with intraoperative nondisplaced calcar fracture managed successfully with cerclage cabling. This rate is more common than the 5.4% of intraoperative femoral fracture for uncemented primary THA reported by Berry [44], but is consistent with the 7%–12% reported for arthroplasty for femoral neck fractures [45–47]. In contrast to other MIS techniques, the SuperPATH approach allows for calcar and subtrochanteric cerclage cable placement through a smaller secondary incision, making the treatment of intraoperative calcar fractures straightforward and without significant compromise of the capsule or short external rotators. Three of the 4 fractures were in cementless constructs. Rates of intraoperative

**Table 3**  
Discharge disposition.

Home	27.0%
Inpatient rehab	45.9%
SNF	24.3%
Hospice	2.7%

SNF, skilled nursing facility.

femoral fracture are lower for cemented femoral implants, and we hypothesize that using more cemented implants would have lowered rates in this series as well [44].

The transfusion rate in this series was 8%, similar to rates reported for other posterior-based minimally invasive approaches for THA [28,48]. This is lower than the 21.21% after THA reported by Browne et al [49] after examining the most recent US Nationwide Inpatient Sample. Other studies have found transfusion rates of up to 69% for arthroplasty for femoral neck fracture [50]. This study may support the premise that minimally invasive total joint arthroplasty may be associated with less need for transfusion, though larger studies are needed to confirm these results.

Average surgical time of 137 minutes was longer than reported rates for hemiarthroplasty and THA for femoral neck fractures [51]. However, this did not translate into an unacceptably high rate of infection, blood loss, need for transfusion, or other significant complications. The senior author was relatively new to practice during this study period, and there was a learning curve associated with transitioning to THA for femoral neck fracture. Current surgical times are significantly less.

Heterotopic ossification was not seen on follow-up radiographs, likely due to the absence of significant abductor trauma. This is in contrast to reported rates of up to 61% in the literature for THA [21,52–54]. Studies have shown that rates of heterotopic ossification may differ based on surgical approach with the anterolateral approach having higher rates in several studies [21,55]. To our knowledge, there have been no studies published examining rates of heterotopic ossification after the SuperPATH approach.

There are several limitations to the current study. This is a retrospective case series by a single surgeon who routinely uses the SuperPATH approach at a single institution, and thus outcomes may not be generalizable to the broader patient population and other practice settings. Without a control group undergoing an alternative approach, it may be difficult to isolate the effect of the SuperPATH technique. Hospital-wide protocols may differ among institutions, and patients at other institutions may not have resources that allow for rapid mobilization after surgery for hip fractures. All femoral heads were 32 mm or larger in our series, and nationwide data reveal that the rates of THA dislocation have decreased as larger diameter femoral heads have become more commonplace [11]. It is thus possible that femoral head size contributed to the absence of dislocation in this study.

## Conclusions

The described case series suggests that the SuperPATH approach for THA is safe and effective for use in femoral neck fragility fractures. Early mobilization and a low rate of dislocation was observed, which may be a consequence of minimal dissection and physiologic positioning throughout surgery. Future, larger studies comparing SuperPATH to more traditional approaches are needed to confirm these findings and directly compare outcomes. The senior author of this paper believes that surgeons considering a minimally invasive technique may find the SuperPATH approach accessible due to similarities with the traditional posterior approach.

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