Decreasing Incidence of Femoral Neck Fractures in the Medicare Population

KENNETH MACKINLAY, MD; THOMAS FALLS, MD; EDMUND LAU, MS; JUDD DAY, PhD; STEVEN KURTZ, PhD; KEVIN ONG, PhD; ARTHUR MALKANI, MD

abstract
Full article available online at Healio.com/Orthopedics

This study was designed to evaluate trends in incidence and treatment patterns for intracapsular hip fractures and to evaluate risk factors for complications and mortality. Patients with an intracapsular hip fracture who underwent internal fixation, hemiarthroplasty, or total hip arthroplasty (THA) were identified from a 5% nationwide sample of Medicare data (1998-2007). The authors identified 41,053 patients with intracapsular hip fractures between 1998 and 2007. The number of intracapsular hip fractures treated with internal fixation, hemiarthroplasty, or THA decreased by 21.8%, from 4602 in 1998 to 3601 in 2007. In 2007, 54.3% of patients with an intracapsular hip fracture were treated with hemiarthroplasty, compared with 41.2% who were treated with internal fixation and 4.5% who were treated with THA. Compared with internal fixation, hemiarthroplasty had higher adjusted risks of dislocation (+98%) and infection (+53%) at 90 days and higher rates of death (+8%) and reoperation (+33%) at 1 year. Patients who underwent THA had a higher risk of complications at 90 days compared with those who underwent hemiarthroplasty, with 114%, 39%, and 123% greater risk of dislocation, deep venous thrombosis, and mechanical complications, respectively. At 1 year, patients treated with THA had a 42% lower mortality risk and an 85% lower risk of reoperation compared with those who underwent internal fixation. Primary THA is performed more often in younger patients with fewer comorbidities. The incidence of intracapsular hip fracture decreased by 21.8% over the past decade. This decrease is likely the result of multiple factors, most significantly increased awareness and medical management of osteoporosis.
Recent evidence suggests that there may be an overall decrease in the total number of hip fractures in the United States. Even as the number of hip fractures is on the decline, however, estimates of the 1-year mortality rate after hip fracture range from 14% to 36%. More than 90% of hip fractures occur in those older than 65 years, and the average age for a patient with a hip fracture is more than 80 years. Cost analysis from the past decade placed the annual health care costs associated with caring for patients with hip fractures at $10.3 to $15.2 billion. Significant efforts over the past several decades have been aimed at preventing fragility fractures in the elderly, particularly hip fractures. Bone mineral density screening, calcium and vitamin D supplementation, exercise and mobility programs, and bisphosphonate therapy have all been used to address the growing problem of hip fractures among the aging population, particularly in women.

As the population continues to age in a healthier manner, the spectrum of patients with hip fractures widens to include both active, healthy patients and extremely elderly patients with significant comorbidities. Although extracapsular hip fractures are an increasing problem and tend to occur more frequently in the elderly, intracapsular fractures require special consideration, given the potential for vascular disruption to the femoral head. For nondisplaced fractures, multiple internal fixation constructs have been proposed, including cancellous screws and sliding hip screws. However, no clear evidence shows the superiority of any one technique. For displaced fractures, replacement of the femoral head is often necessary because of the high risk of osteonecrosis or nonunion as a result of damage to the vascular supply of the femoral head. Hemiarthroplasty and total hip arthroplasty (THA) were found to be good alternatives to internal fixation with displaced fractures and have increased in popularity as treatment modalities in recent years. The goal of this study was to evaluate patients with intracapsular hip fracture from the Medicare claims records from 1998 to 2007 to determine trends in hip fracture incidence, treatment, and complications.

**Materials and Methods**

Administrative claims data from a 5% nationwide sample of Medicare beneficiaries between 1998 and 2007 were used to identify patients with intracapsular hip fracture *International Classification of Diseases, 9th revision, Clinical Modification* (ICD-9-CM) codes 733.14, 820.0, and 820.1. The Medicare database was used previously to conduct longitudinal studies of revision and complication risk after total joint arthroplasty. Patients with intracapsular hip fracture who underwent internal fixation, hemiarthroplasty, or primary total hip THA were identified with relevant Current Procedural Terminology (CPT-4) codes from claims submitted by physicians (Part B claims records). For this study, CPT-4 codes 27235, 27236 (without ICD-9-CM 81.52), 27244, and 27245 were used to identify internal fixation procedures; CPT-4 codes 27125 and 27236 (with ICD-9-CM code 81.52) were used for hemiarthroplasty; and CPT-4 code 27130 was used for primary THA.

Patients younger than 65 years, those who were enrolled in a managed care program, and those who were not enrolled for a full year before the fracture were excluded from the study. Patients younger than 65 years who enroll in Medicare qualify for benefits because of disability or end-stage renal disease. Expenditures from managed care enrollees are not submitted to the Centers for Medicare and Medicaid Services for payment. Therefore, claims from these beneficiaries were not available from the database. A full year of enrollment was required to allow evaluation of comorbidities for all patients in the 12 months before the fracture. After treatment for intracapsular fracture, patients were tracked longitudinally for up to 1 year. Patients who had complications or who died were identified with relevant diagnosis and procedure codes (Table 1). Complications included deep venous thrombosis (DVT), dislocation, infection, mechanical complications, malunion/nonunion, pulmonary embolism, cardiac complications, conversion to hip

---

**Table 1**

<table>
<thead>
<tr>
<th>Complication Diagnosis and Procedure Codes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Complication</strong></td>
</tr>
<tr>
<td>Cardiac complications</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
</tr>
<tr>
<td>Dislocation</td>
</tr>
<tr>
<td>Infection</td>
</tr>
<tr>
<td>Mechanical complications</td>
</tr>
<tr>
<td>Malunion/nonunion</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
</tr>
<tr>
<td>Reoperation with subsequent internal fixation</td>
</tr>
<tr>
<td>Conversion to hip replacement</td>
</tr>
<tr>
<td>Revision total hip arthroplasty</td>
</tr>
</tbody>
</table>

replacement (or revision hip replacement for those undergoing primary THA), and reoperation with subsequent internal fixation.

Patients who died without encountering complications were considered censored. Each beneficiary’s enrollment status and date of death were identified in the annual Medicare denominator files to determine mortality rates. The cumulative incidence of these complications was computed for up to 90 days postsurgery, except for malunion/nonunion, conversion to hip replacement (or revision hip replacement), reoperation with subsequent internal fixation, and mortality, which were computed for up to 1 year postsurgery. Multivariate Cox regression was used to evaluate the relative risk of these complications and mortality between the various treatment groups. The Cox regression analyses were adjusted for age, sex, race, comorbidity (Charlson comorbidity), site of service (inpatient, outpatient), year of procedure, period (1998-2002, 2003-2007), and socioeconomic status. The health status of each patient was determined using the Charlson comorbidity index score,\(^18\) which was based on each patient’s diagnoses in the 12 months before treatment. Patients were categorized according to overall degree of comorbidity as follows: 0 (none), 1 to 2 (low), 3 to 4 (moderate), and 5 (high). Each patient’s Medicare buy-in status was used as a proxy for socioeconomic status because it identified patients whose Medicare premiums and deductibles were subsidized by the state because of their financial status.

**RESULTS**

The authors identified 41,053 patients with intracapsular hip fracture who were treated with internal fixation, hemiarthroplasty, or THA from the 5% Medicare dataset between 1998 and 2007 (Figure). During this period, the overall number of intracapsular hip fractures treated with internal fixation, hemiarthroplasty, or THA decreased gradually by 21.8% from 4602 in 1998 to 3601 in 2007. During the same period, the proportion of intracapsular hip fractures treated with hemiarthroplasty showed a slight increase and the proportion treated with internal fixation showed a slight decrease. In 2007, 54.3% of patients were treated with hemiarthroplasty compared with 41.2% who were treated with internal fixation and 4.5% who were treated with THA.

Patient characteristics were generally comparable between treatment groups (Table 2). However, patients undergoing primary THA tended to be younger than those treated with internal fixation or hemiarthroplasty. Of patients undergoing primary THA, 16.2% were 65 to 69 years old and 18.3% were 85 years and older, compared with corresponding proportions of 6.8% (65-69 years old) and 35.8% (≥85 years old) for internal fixation and 5.2% (65-69 years old) and 38.6% (≥85 years old) for hemiarthroplasty. Patients undergoing primary THA also tended to have fewer comorbidities, with 31.8% having Charlson scores of 0 compared with 22.7% for those undergoing internal fixation and 23.1% for those undergoing hemiarthroplasty. Compared with patients treated with internal fixation, those treated with hemiarthroplasty had a higher adjusted risk of dislocation (+98%) and infection (+53%) at 90 days (Table 3) and a higher adjusted risk of death (+8%) and reoperation (+33%) at 1 year (Table 4). However, they had a lower adjusted risk of conversion to THA (-41%) at 1 year. Compared with those who underwent internal fixation, those treated with THA had a higher adjusted risk of dislocation (+325%), DVT (+40%), infection (+93%), and mechanical complications (+114%) at 90 days, but a lower adjusted risk of death (-37%) and reoperation (-80%) at 1 year. Patients who underwent THA also had a higher risk of complications at 90 days compared with those treated with hemiarthroplasty, with 114%, 39%, and 123% greater risk of dislocation, DVT, and mechanical complications, respectively. At 1 year, patients treated with THA had a 42% lower mortality risk and an 85% lower risk of reoperation compared with patients undergoing internal fixation. Of complications examined in this study, DVT and death were the most frequently reported
at 90 days and 1 year, respectively. The cumulative incidence of DVT at 90 days ranged from 6.16% to 8.70%, and the cumulative incidence of mortality at 1 year ranged from 14.4% to 27.7%.

**Discussion**

This study analyzed patients with intracapsular (femoral neck) fractures from a nationwide sample of Medicare claims data from 1998 to 2007 to determine trends in hip fracture incidence, treatment, and complications. Hip fracture treatment places a significant economic burden on the health care system. Literature from the past 2 decades has frequently predicted a significant increase in the total number of hip fractures that will be seen as populations in the developed world continue to age. By some reports, the total number of hip fractures globally is expected to triple by 2050. However, there are increasing reports that the incidence of hip fractures has plateaued or may even be decreasing. The current results showed a gradual 21.8% decline in the total number of intracapsular hip fractures surgically treated from 1998 to 2007. The decrease in fractures observed in the current study was consistent with a study in Finland spanning a similar time frame. In the Scandinavian study, a 25% reduction in femoral neck fractures was noted from 1997 to 2004.

The actual incidence of proximal femur fractures was shown to be falling from projected incidence rates by as much as 1.42% per year in women and 0.44% per year in men. There is a great deal of speculation as to why this trend of decreasing fracture incidence exists despite an aging population. Multiple theories for the potential decrease in the incidence of fractures have been proposed, including a healthier and more active aging population, increased average body weight, fracture prevention and screening programs, and the use of bisphosphonates and other newer pharmacotherapies.

Bisphosphonates are one of most studied groups of therapeutic agents approved for the prevention and treatment of postmenopausal osteoporosis, glucocorticoid-induced osteoporosis, and osteoporosis in men. These drugs vary in terms of their binding strength to bone surface and their ability to inhibit farnesyl pyrophosphate synthase, the targeted enzyme that, when inhibited, leads to osteoclast apoptosis and causes a subsequent decrease in bone resorption. Regardless of their differing properties, multiple prospective, randomized trials have shown that each is capable of reducing the risk of fragility fractures, not only vertebral fractures, a common end point of these studies, but also femoral neck fractures. Alendronate was explored in the Fracture Intervention Trial (FIT) in which patients received either bisphosphonate or placebo for 4 years. The incidence of proximal femur fractures decreased 36% in the alendronate group relative to the control group. More recently, the Fracture Intervention Trial Long-Term Extension (FLEX) examined patients in the FIT who received 5 years of treatment with alendronate and then randomized these patients to receive an additional 5 years of either continued alendronate treatment or the initiation of placebo. Although bone mineral density decreased in the placebo group, there was no difference in the risk of femoral neck fractures. Risedronate also significantly reduced the risk of hip fractures, especially in women with proven osteoporosis. A large study looking at the efficacy of risedronate involved 5445 women and considered the occurrence rate of hip fracture when risedronate vs placebo was administered for 3 years. Zoledronate, available only through intravenous administration, decreased the incidence of femoral neck fractures.
in a population of Chinese women. In this study, 242 patients were treated with 5 mg zoledronic acid once a year and 241 were treated with equivalent placebo.

Despite the proven benefits of these bisphosphonates, a growing body of literature suggests that bisphosphonate therapy is not benign. Atypical femoral fractures, most commonly in the subtrochanteric region, have been attributed to their use. Although less common than atypical fractures, osteonecrosis of the jaw has also been associated with bisphosphonate use. Despite the documented adverse effects, the occurrence rate, even in patients treated with bisphosphonates for up to 10 years, has been shown to be very low.

Denosumab has been gaining popularity and was found to be as effective as oral bisphosphonates. Another advantage of denosumab over bisphosphonates is the minimal side effect profile in which atypical fractures and osteonecrosis of the jaw are much less of a concern. The Fracture Reduction Evaluation of Denosumab in Osteoporosis Every 6 Months (FREEDOM) trial studied relative risk reduction of vertebral, nonvertebral, and hip fractures. The study included 7868 women with osteoporosis who were given an injection of either denosumab or placebo every 6 months for 3 years. There was a 68% relative risk reduction in vertebral fractures, a 20% reduction in nonvertebral fractures, and a 40% reduction in hip fractures in those receiving denosumab vs placebo.

Limitations
One limitation of the current study is the aggregation of all intracapsular hip fractures without delineation between displaced and nondisplaced fractures. Displacement is an important distinction, given the 30% to 50% risk of avascular necrosis or nonunion of displaced femoral neck fractures. Even in patients with displaced fractures, acceptable outcomes have been achieved with nonoperative treatment and early mobilization when life-threatening comorbidities precluded surgical management. This small subset of patients treated nonoperatively was not considered in the authors’ evaluation of treatment patterns and complications. Before the proliferation of hemiarthroplasty and THA, internal fixation of hip fractures was the predominant treatment modality. The study results indicated a gradual decline in the percentage of intracapsular hip fractures managed with internal fixation between 1998 and 2007. A recent Cochrane review comparing 30 randomized or partially randomized studies of internal fixation of intracapsular hip fractures did not show significantly superior results with various techniques.

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cumulative Incidence</th>
<th>Adjusted Risk Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal Fixation</td>
<td>Hemiarthroplasty</td>
</tr>
<tr>
<td>Cardiac</td>
<td>4.03%</td>
<td>4.30%</td>
</tr>
<tr>
<td>Dislocation</td>
<td>1.44%</td>
<td>2.77%</td>
</tr>
<tr>
<td>Deep venous thrombosis</td>
<td>6.30%</td>
<td>6.16%</td>
</tr>
<tr>
<td>Infection</td>
<td>1.38%</td>
<td>2.04%</td>
</tr>
<tr>
<td>Mechanical</td>
<td>2.48%</td>
<td>2.33%</td>
</tr>
<tr>
<td>Pulmonary embolism</td>
<td>2.04%</td>
<td>1.92%</td>
</tr>
</tbody>
</table>

Abbreviation: THA, total hip arthroplasty.

*P < .05.
arthroplasty tends to lead to decreased rates of revision to THA, a higher incidence of infection, and a slightly higher mortality rate. Although it was not a variable in this study, hemiarthroplasty also led to similar functional outcomes and pain scores as internal fixation.11 This study showed that early dislocation rates were significantly higher with hemiarthroplasty. A recent prospective, randomized trial showed that pain scores were decreased with cemented hemiarthroplasty prostheses vs uncemented prostheses, but the reduction was no longer statistically significant after 2 years.36 Although there is a potential risk of cardiovascular collapse with the use of cement,36 its use has become the most common technique for hemiarthroplasty.11 The current study did not differentiate between cemented and cementless hemiarthroplasty, but cardiac events were not increased compared with internal fixation. Especially among younger, cognitively intact, and healthy elderly patients with displaced femoral neck fractures, THA is becoming a more popular primary treatment option than internal fixation or hemiarthroplasty.11,14,19 This finding correlates well with the current results; patients undergoing THA tended to be younger and healthier as measured by the Charlson co-morbidity index score. Studies comparing THA with hemiarthroplasty and internal fixation have not described a significant decrease in mortality rates among patients who underwent THA11,14,19; however, the current findings conflict with these results. Compared with both internal fixation and hemiarthroplasty, a statistically significant decrease was seen in 1-year mortality rates (adjusted risk ratio, 0.63 and 0.58, respectively) in patients who underwent THA.

Compared with internal fixation, THA has also provided better functional outcomes and lower rates of revision surgery.11,19 This is consistent with the current study findings that showed a greater than 5-fold reduction in the risk of reoperation with internal fixation compared with primary THA or hemiarthroplasty. Although THA has been shown to have a functional advantage compared with hemiarthroplasty (measured by Harris Hip Score), the dislocation rate for THA is significantly higher,19 which also correlates with the current findings. One limitation of concluding that THA leads to better functional outcomes than hemiarthroplasty is the cohort of patients used to make the assessment. In this study, patients undergoing THA were younger and healthier than those treated with hemiarthroplasty.11,14 However, a recent randomized, prospective study comparing THA with hemiarthroplasty showed better outcomes with THA, with no significant difference in age or functional, cognitive, or mobility status between the 2 groups.37 This study found a higher rate of early mechanical complications with THA compared with hemiarthroplasty or internal fixation. Treatment with THA for fracture has been shown to have good overall outcomes. However, compared with the use of THA for osteoarthritis, there is a small increase in the revision rate, primarily because of early dislocations, infections, and periprosthetic fractures.38 Revision to THA after primary internal fixation of femoral

### Table 4

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cumulative Incidence</th>
<th>Adjusted Risk Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Internal Fixation</td>
<td>Hemiarthroplasty</td>
</tr>
<tr>
<td>Death</td>
<td>26.1%</td>
<td>27.7%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malunion/non-union</td>
<td>2.78%</td>
<td>0.51%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conversion to hemiarthroplasty</td>
<td>3.57%</td>
<td>2.06%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reoperation with internal fixation</td>
<td>5.98%</td>
<td>8.06%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Revision THA</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Abbreviations: N/A, not applicable; THA, total hip arthroplasty. *P<.05.
As monetary factors increasingly influence the decision to undergo THA for treating primary intracapsular hip fracture, the cost-effectiveness of procedures must be taken into account when multiple treatment modalities are available. A recent study showed that, compared with the use of percutaneous cannulated screws, patients who undergo hemiarthroplasty after a displaced femoral neck fracture gain more quality-adjusted life years and the procedure is overall more cost-effective. As the trend to treat displaced intracapsular hip fractures with THA continues, evidence suggests that, compared with hemiarthroplasty, patients undergoing THA have better outcomes, including increased mobility and function with less pain. As with the current results, there is a higher rate of early dislocation with THA. However, overall, there is a decreased rate of revision surgery. In the long term, this correlates with better cost-effectiveness for THA vs hemiarthroplasty. Although there may be increased costs in the first 2 years after surgery because of early complications, such as dislocation, the overall decreased revision rate makes THA a potentially more cost-effective solution. However, THA may not be appropriate for all patients with intracapsular hip fracture.

**CONCLUSION**

Careful individualization of treatment is imperative, given the wide variety of accepted options based on fracture pattern and patient medical condition. As more evidence shows improved outcomes and better cost-effectiveness, THA may continue to increase in popularity as a treatment option for intracapsular hip fractures. Greater effort is required to decrease the incidence of DVT and pulmonary embolism in patients with femoral neck fractures and dislocation after THA.

**REFERENCES**


