Operative Intervention for Geriatric Hip Fracture: Does Type of Surgery Affect Hospital Length of Stay?

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Abstract

Hip fractures are the most costly fall-related fractures. Differences in hospital length of stay (LOS) based on type of surgery could have major financial implications in a potential bundled payment system in which all hip fractures are reimbursed a standard amount.

We conducted a study to analyze differences in hospital LOS and costs for total hip arthroplasty (THA), hemiarthroplasty (HA), cephalomedullary nailing, open reduction and internal fixation (ORIF), and closed reduction and percutaneous pinning (CRPP). Through retrospective chart review, 615 patients over age 60 years across a 9-year period at an urban level I trauma center were identified. Mean LOS and costs for hip fracture repair were 6.91 days and $30,011.25, respectively. HA/THA was associated with the longest mean LOS (7.43 days) and highest costs ($33,657.90). After several patient factors were adjusted for, ORIF was associated with 0.84 fewer in-patient days and $3805.20 less in hospitalization costs compared with HA/THA ($P = .042$). CRPP was associated with 1.63 fewer days and $7383.90 less in costs than HA/THA ($P = .0076$).

Our results provide insight into the financial implications of hip fracture fixation and identify targets for quality improvement initiatives to improve efficiency of resource utilization.

Hip fractures, the most severe and costly fall-related fractures, account for 350,000 hospital admissions per year.[1] The majority of hip fractures result from low-impact falls, typically in patients over age 60 years. In fact, the increase in hip fracture with age is nearly exponential.[2,3] With the predicted aging of our population, hip fractures will continue to increase in volume. Between 2000 and 2050, the elderly US population will increase by 135%,[4] proportionately increasing the number of projected hip fractures. Considering that hip fractures account for 72% of total costs in terms of orthopedic fracture care in the elderly, the dramatic rise in hip fractures is of great concern for future costs of health care delivery in this field.[5-7]

In an effort to move toward a value-based system in which costs are reduced while quality of care is maintained, Medicare recently unveiled a new bundled payment system of reimbursement. Through this system, hospitals will be reimbursed for treatment provided to Medicare beneficiaries based on the expected costs of care, instead of through the traditional fee-for-service model. Given this development, orthopedic surgeons will need to develop interventions that reduce costs while maintaining quality of care after hip fracture surgery.

One of the most significant ramifications of a value-based system is that reimbursement for hip fractures may be standardized based on a single diagnosis regardless of the actual costs associated with treatment.[8] In hip fracture cases, however, a wide range of factors, including degree of communition of the bone, presence of medical comorbidities,[9] and amount of soft-tissue injury, can dramatically increase recovery time. In fact, one of the most important determinants of treatment costs related to hospital length of stay (LOS) is whether the fracture is a femoral neck or intertrochanteric fracture.[10,11] Type of fracture is a significant determinant of surgical options, and these can dramatically change patient outcomes and costs of surgical care.[12-16] In addition, hospital recovery time or LOS can vary widely based on type of surgery. As hospitalization costs account for 44% of the direct medical costs for hip fractures,[17] differences in LOS can have major financial implications in a value-based system of reimbursement in which all forms of hip fracture are reimbursed a standard amount.

We conducted a study to analyze differences in hospital LOS for different forms of hip fracture repair to determine the potential financial repercussions of a bundled payment model of reimbursement. By performing a retrospective chart review at a large, level I trauma center, we were able to compare LOS and associated costs for total hip arthroplasty (THA), hemiarthroplasty (HA), cephalomedullary nailing (CMN), open

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reduction and internal fixation (ORIF), and closed reduction and percutaneous pinning (CRPP).

Materials and Methods

After receiving institutional review board approval for this study, we retrospectively reviewed all hip fracture cases treated at a level I trauma center between January 2000 and December 2009. *Current Procedural Terminology* (CPT) codes were searched for cases of low-energy falls that caused hip fractures that were resolved with THA, HA, CMN, ORIF, or CRPP. Patients who underwent HA or THA were grouped for analysis. Patients who were over age 60 years and had acetabular, proximal femoral, trochanteric, or femoral neck fractures were included in our search. Patients who had incomplete medical records or did not meet the age criterion were excluded from analysis.

We reviewed patient charts in our institutional electronic medical records database to collect these data: date of birth, age, sex, date of admission, date of discharge, American Society of Anesthesiologists (ASA) Physical Status score, complications, height, weight, start and stop times of procedure, whether or not the procedure was an emergent procedure, days from admission to surgery, 90-day readmissions, days from surgery to discharge, and general category of operation. We also recorded individual comorbidities, including prior myocardial infarction, dysrhythmia, atrial fibrillation, congestive heart failure, heart block, cerebrovascular disease, chronic obstructive pulmonary disease, emphysema, current smoking status, smoking history, renal disease, dialysis, cancer, and diabetes. Duration of surgery was calculated from recorded start and stop times. Body mass index was calculated using height and weight recorded during initial stay. LOS was recorded as the difference between the admission and discharge dates.

Mean total cost to the hospital ($4530/d patient was hospitalized) was obtained from the institution's financial services. All fractional LOS values were rounded to the nearest whole number and multiplied by the per diem cost. Student t test was used to compare mean LOS and costs of HA/THA with those of all the other procedures. Additional tests were run to analyze differences in LOS and type of surgeries performed throughout the 9-year period. A multivariate regression model controlling for ASA score, body mass index, age, sex, and comorbidities was developed to analyze differences in LOS and costs for patients who underwent HA/THA versus CMN, ORIF, and CRPP. Significance was set at $P = .05$.

Results

Our search identified 720 patients who were over age 60 years and underwent operative fixation for hip fracture at our level I trauma center between 2000 and 2009. Of these 720 patients, 105 who had incomplete charts or did not meet the age criteria were excluded, leaving 615 patients (with complete records of isolated low-energy hip fractures) for analysis.

Table 1 lists the demographics of our patient population. The majority of patients had undergone ORIF (30.24%) or HA/THA (45.69%). CRPP was the least common procedure (9.92%) after CMN (14.15%). Mean age was 78.4 years; the majority of patients were between 75 and 89 years of age. Mean hospital LOS was 6.91 days. The majority of patients (n = 414; 67.32%) were female. ASA scores had a narrow distribution, with most patients assigned a score of 3. The readmission rate was significantly higher for HA/THA (39.1%) than for ORIF (28.5%; $P = .02$) and CRPP (24.6%; $P = .04$).

Table 1. Population Demographic Information

	n	%
Age, y		
60-64	76	12.36
65-69	67	10.89
70-74	77	12.52
75-79	108	17.56
80-84	107	17.40
85-89	104	16.91
>90	76	12.36
Sex		
Male	201	32.68
Female	414	67.32
American Society of Anesthesiologists (ASA) score		
1	1	0.16
2	58	9.43
3	420	68.29
4	134	21.79
5	2	0.33
Treatment		
Hemiarthroplasty/total hip arthroplasty	281	45.69
Cephalomedullary nail	87	14.15
Open reduction and internal fixation	186	30.24
Closed reduction and percutaneous pinning	61	9.92
Miscellaneous		
Patients, N	615	—
Mean age, y	78.4	—
Mean body mass index	24.68	—
Mean hospital length of stay, d	6.91	—
Mean ASA score	3.13	—
Readmission		
Hemiarthroplasty/total hip arthroplasty	110	39.1
Cephalomedullary nail	25	28.7
Open reduction and internal fixation	53	28.5
Closed reduction and percutaneous pinning	15	24.6

Table 2 lists mean LOS and associated costs for each procedure compared with HA/THA. Mean LOS for all patients was 6.91 days, with associated hospitalization costs of $30,011.25. Patients who underwent HA/THA had the longest mean LOS (7.43 days) and highest mean hospitalization costs ($33,657.90). In comparison, patients who underwent ORIF had a mean LOS of 6.59 days with $29,852.70 in costs ($P = .04$). CRPP also had a significantly ($P < .003$) shorter LOS (5.59 days) and lower costs ($25,322.70). Although CMN had a mean LOS of 6.89 days and $31,211.70 in costs, the difference in LOS was not significantly different from that of HA/THA. The proportion of surgeries that were HA/THA, CMN, ORIF, and CRPP did not change significantly through the 9-year period ($P = .19$). Similarly, mean LOS did not change significantly for any of the types of surgery through this period (**Table 3**).

Figure 1 provides the distribution of LOS for all 4 procedures. The interquartile range (IQR) for patients who underwent HA/THA was 4 to 9 days (median, 6 days). Patients who underwent CMN also had a median LOS of 6 days and an IQR of 4 to 8 days. Both ORIF (IQR, 4-8 days) and CRPP (IQR, 3-6 days) were associated with a median LOS of 5 days.

Figure 2 shows mean hospitalization costs based on type of procedure. HA/THA had the highest mean cost, $33,657.90, or $8335.20 more than CRPP ($25,322.70). Patients who underwent CMN had a mean cost of $31,211.70, versus $29,852.70 for patients who underwent ORIF.

Table 4 summarizes the multivariate analysis results. After ASA score, sex, age, and comorbidities were controlled for, there was an overall significant relationship involving surgical treatment, LOS, and associated hospitalization costs for HA/THA, ORIF, and CRPP. Compared with HA/THA, ORIF had $3805.20 less in costs ($P = .042$) and 0.84 fewer hospital days.

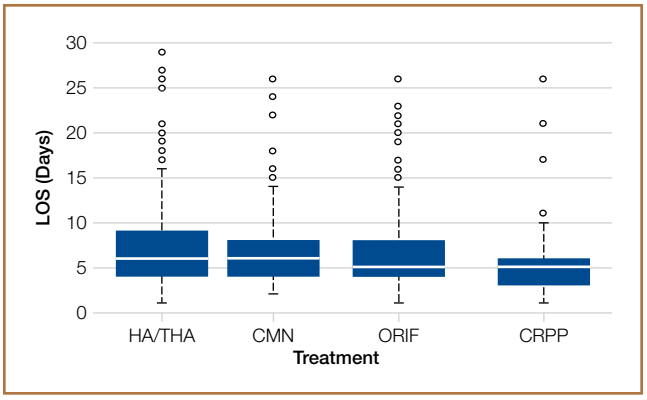

Figure 1. Box plot of treatment by hospital length of stay.

Abbreviations: CMN, cephalomedullary nail; CRPP, closed reduction and percutaneous pinning; HA/THA, hemiarthroplasty/total hip arthroplasty; LOS, length of stay; ORIF, open reduction and internal fixation.

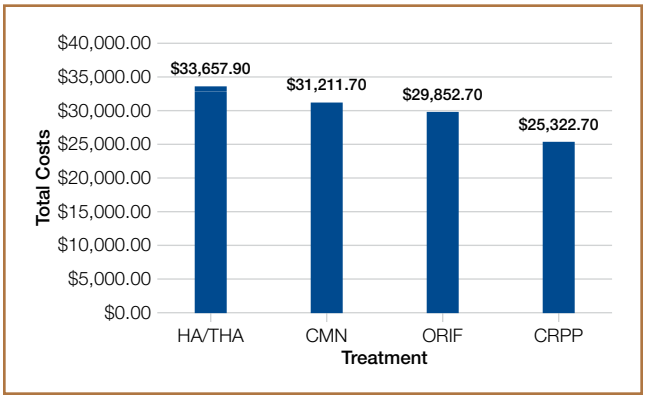

Figure 2. Treatment by costs of in-patient hospitalization.

Abbreviations: CMN, cephalomedullary nail; CRPP, closed reduction and percutaneous pinning; HA/THA, hemiarthroplasty/total hip arthroplasty; ORIF, open reduction and internal fixation.

Table 2. **Hospital Length of Stay (LOS) and Costs: Comparison of Hemiarthroplasty/Total Hip Arthroplasty With Other Types of Surgery**

	Cases (N = 615)	LOS, d	Costs, $	*P*
Hemiarthroplasty/total hip arthroplasty	281	7.43	33,657.90	—
Cephalomedullary nail	87	6.89	31,211.70	.348
Open reduction and internal fixation	186	6.59[a]	29,852.70	.04
Closed reduction and percutaneous pinning	61	5.59[a]	25,322.70	.003
Means	—	6.91	30,011.25	—

[a]Significantly different LOS and costs compared with hemiarthroplasty/total hip arthroplasty.

Table 3. **Hospital Length of Stay and Type of Surgery by Year**

	2001–2003			2004–2006			2007–2009			
Surgery	**n**	**%**	**LOS, d**	**n**	**%**	**LOS, d**	**n**	**%**	**LOS, d**	***P***
HA/THA	80	44.0	6.88	102	46.4	7.40	99	46.5	7.90	.324
CMN	16	8.8	6.88	45	20.5	6.51	26	12.2	7.58	.648
ORIF	59	32.4	6.27	56	25.5	6.57	71	33.3	6.86	.728
CRPP	27	14.8	6.00	17	7.7	6.24	17	8.0	4.29	.337

Abbreviations: HA/THA, hemiarthroplasty/total hip arthroplasty; CMN, cephalomedullary nail; ORIF, open reduction and internal fixation; CRPP, closed reduction and percutaneous pinning; LOS, length of stay.

Patients who underwent CRPP were hospitalized for significantly fewer days (1.63) and associated costs ($7383.90) ($P = .0076$). There was no significant difference in LOS and costs between HA/THA and CMN. Of the controlled variables, only ASA score ($P < .001$) and male sex ($P = .001$) were significantly associated with changes in LOS and costs. There was no significant association with comorbidities, LOS, or costs.

Discussion

In this study of surgical intervention in patients with hip fractures, we determined that HA/THA was associated with significantly increased hospital LOS and costs than ORIF and CRPP. Although arthroplasty had an increased mean LOS compared with CMN, the difference was not statistically significant. In addition to type of procedure, both male sex ($P = .001$) and preoperative ASA score ($P < .001$) were significant predictors of LOS and costs. These findings are supported by other studies in which preoperative functioning was found to be a strong predictor of increased LOS and costs among hip fracture patients,[18] most likely because of increased risk for complications.[19]

Although our study was the first to directly compare LOS and costs for HA/THA and CMN, other investigators have analyzed the effect of surgical complications on LOS for patients treated with THA, HA, and CMN. In a study on the effects of surgical complications on LOS after hip fracture surgery, Foss and colleagues[17] reported that the proportion of CMN patients (31%) with complications was larger than that of HA patients (19%) and THA patients (0%). They also reported that surgical complications were associated with significantly increased LOS during primary admission. Similarly, Edwards and colleagues[20] found that the infection risk was higher with CMN (3.1%) than with THA (0%) and HA (0%-2.3%) and that infections were associated with increased LOS ($P > .001$). However, further statistical analysis revealed that the odds of developing an infection were not significantly higher with CMN than with other studies.[20] Similarly, other studies have reported low rates of complications, including nonunion, with CMN.[21,22] In our study, we found no significant difference in LOS and costs for CMN and HA/THA after controlling for ASA score, which is known to be associated with a higher risk for complications.[18,19]

The largest difference in LOS and costs after controlling for potential confounding variables was between HA/THA and CRPP ($7383.90). To our knowledge, only one study has performed a comparative analysis of LOS for CRPP and other surgical treatments for hip fractures. For femoral neck fractures treated between 1990 and 1994, Fekete and colleagues[23] found that LOS was 14.9 days for ORIF cases and 12.1 days for CRPP cases—a difference of 2.8 days. In comparison, we found a 1-day difference in mean LOS between ORIF cases (6.59 days) and CRPP cases (5.59 days).

Other studies of LOS and associated costs over a 2-year period have found that ORIF is overall more costly than HA/THA. For example, Keating and colleagues[13] compared total costs of care, including LOS, for healthy older patients with displaced intracapsular hip fractures treated with ORIF, bipolar HA, or THA. Although ORIF was initially less costly than HA/THA, overall ORIF costs over 2 years were significantly higher because of readmissions, which increased overall LOS. Similarly, in cases of displaced femoral fractures, Iorio and colleagues[15] found that LOS was 6.4 days for ORIF, 4.9 days for unipolar HA, 6.2 days for bipolar HA, and 5.5 days for cemented and hybrid THA. However, when overall projected costs were estimated, including the costs of rehabilitation and

Table 4. Results for Multivariate Analysis of Comorbidities and Hospital Length of Stay (LOS)

	LOS, d	Cost, $	*P*
Treatments Compared With Hemiarthroplasty/Total Hip Arthroplasty			
Cephalomedullary nail	–0.43	–1947.90	.421
Open reduction and internal fixation	–0.84	–3805.20	.042
Closed reduction and percutaneous pinning	–1.63	–7383.90	.0076
Controlled Variables			
American Society of Anesthesiologists class	1.88	8516.40	.0001
Body mass index	–0.022	–99.66	.517
Age	–0.013	–58.89	.4855
Male sex	1.24	5617.20	.00109
Comorbidities			
Current smoker	–2.39	–10,826.70	.111
Dialysis	3.38	15,311.40	.302
Hypertension	–0.031	–140.43	.974
Renal disease	–1.16	–5254.80	.498
Past smoker	0.19	860.70	.871
Myocardial infarction	1.24	5617.20	.442
Congestive heart failure	2.05	9286.50	.179
Chronic obstructive pulmonary disease	0.34	1540.20	.859
Atrial fibrillation	–1.52	–6885.60	.735
Heart block	–2.24	–10,147.20	.521
Cerebrovascular disease	–0.93	–4212.90	.653
Bleeding disorder	–1.4	–6342.00	.308
Emphysema	1.9	8607.00	.414
Cardiac dysrhythmia	–1.1	–4983.00	.449
Cancer	–0.9	–4077.00	.381
Diabetes	0.35	1585.50	.759

of (probable) revision arthroplasty, ORIF was estimated to cost more over a 2-year period because of the need for additional care and in-patient stays. In contrast, we found that hospitalization costs were $3805.20 lower for ORIF than for HA/THA, even after adjusting for comorbidities, and that ORIF had a lower overall readmission rate. Early discharge of patients who are at risk for subsequent complications may have played a significant role in increasing readmission rates for arthroplasty patients. These findings indicate the complexities involved in a bundled payment system of reimbursement, in which a single payment for both initial stay and related readmissions will force orthopedists to consider long-term hospitalization costs when deciding on length of postoperative care and the most cost-effective surgical treatment.

One of the limitations of this study is its retrospective design. Although selection of our sample from a single level I trauma center reduced differences in cost and patient care protocols between institutions, it also reduced the generalizability of our actual costs. In addition, for some patients, LOS may have increased because of delays in surgery or discharge, lack of operating room availability, or need for further medical clearance for additional procedures. Day of admission could also have significantly affected LOS. However, the effects of these confounding factors were reduced because of the large sample analyzed. As stated earlier, overall LOS depends on both initial in-patient stays and readmissions. Therefore, long-term prospective studies that compare LOS and associated costs for patients with hip fractures treated with ORIF, CRPP, HA/THA, and CMN are needed.

Conclusion

It has been recently suggested that hip fracture repair be included in the National Pilot Program on Payment Bundling, which will potentially reimburse orthopedic surgeons a standardized amount for hip fracture surgery regardless of actual treatment costs.[8] In this model, it will be essential to understand how type of fracture and surgical procedure can influence LOS and therefore hip fracture treatment costs. We found that, based on these factors, mean LOS ranged from 5.59 to 7.43 days, which translates to a cost range of $25,322.70 to $33,657.90. Before a standardized bundled payment system is implemented, further studies are needed to identify other factors that can significantly affect the cost of hip fracture repair.

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