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Functional Outcomes and Mortality Vary among Different Types of Hip Fractures:

A Function of Patient Characteristics

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Abstract

A review of prospectively collected data was done to compare functional outcomes and mortality among patients with different hip fracture types. Five hundred thirty-seven elderly patients who sustained a hip fracture were followed up prospectively. Orthopaedists blinded to treatment and outcome radiographically classified the fractures as either: (1) nondisplaced or impacted femoral neck; (2) displaced femoral neck; (3) stable intertrochanteric; or (4) unstable intertrochanteric fracture. Functional independence measure scores were calculated for preinjury function and at 2- and 6-month followups. Comorbidities, operative details, postoperative complications, and deaths were recorded. Six-month mortality was lowest for patients with nondisplaced femoral neck fractures (5.7%) and highest for patients with displaced femoral neck fractures (15.8%), but multivariate analysis only identified preinjury function as an independent predictor of mortality. All preinjury and followup functional independence measure scores were greatest for patients with nondisplaced femoral neck fractures and least for patients with unstable intertrochanteric fractures. However, multivariate analysis identified only patient age and preinjury functional independence measure scores as independent predictors of functional outcome. These data show differences in mortality and functional outcomes among fracture types that can be attributed to differences in functional status before injury.

Hip fractures are associated with notable morbidity and mortality in elderly patients. The incidence of hip fractures seems to be increasing as the population ages.^{38,59} Many studies have investigated the functional outcomes and mortality of hip fractures in elderly patients, identifying predictors of outcome from patient and treatment characteristics.^{3-7,9,11,12,15,17,19-27,29-31,33-37,40-42,44,46-51,53-55,57,58,62-70} These studies either have included all types of hip fractures grouped together^{4,6,7,11,15,17,19,21,24-27,30,31,33,34,36,37,40,42,46-49,51,53-55,62,65-68,70} or have included only select types of hip fractures.^{12,20,23,41,44,57,58,64,69} However, patients with hip fractures are not a homogeneous group. Displacement of a femoral neck fracture is an important determinant of treatment,² as is the estimated stability of an intertrochanteric fracture.³⁹ Most hip fractures can be classified into one of four categories: (1) nondisplaced or impacted femoral neck fracture; (2) displaced femoral neck fracture; (3) stable intertrochanteric fracture; and (4) unstable intertrochanteric fracture. We subdivide femoral neck fractures as displaced or nondisplaced, rather than Garden Types I to IV, because of the poor interrater reliability¹⁴ and lack of major clinical importance

of the complete Garden classification.^{2,10} Intertrochanteric fractures can be defined as stable or unstable based on the involvement of the medial cortex, according to the recommendations of the Orthopaedic Trauma Association.⁵⁶ Despite the wealth of outcomes research in patients with hip fractures, little is known about the outcomes of these different types of fractures.

The current study prospectively followed elderly patients with fractures of the hip, classified into the four types described above. Information regarding age, comorbidities, and preinjury functional status was tested as predictors of fracture type. These variables and fracture type were tested as predictors of mortality and functional outcome at 2 and 6 months. We hypothesized that mortality and functional outcome vary with type of hip fracture, but that differences in outcome among patients with different fracture types was attributable to differences in baseline health and function among the populations of patients sustaining each fracture type.

MATERIALS AND METHODS

This prospective investigation was done in four major hospitals in New York City. All patients older than 50 years presenting with an acute femoral neck or intertrochanteric fracture were considered for inclusion in the study. Patients with bilateral hip fractures, pathologic fractures, major concomitant injuries, previous ipsilateral hip fractures or surgery, and fractures involving the pelvis, subtrochanteric region, or femoral shaft were excluded from the study. Patients for whom operative treatment was contraindicated also were excluded from the study. Patients or their legal healthcare proxies gave informed consent to participate in the study, which received approval from the Institutional Review Boards of the individual hospitals. At regular intervals, three orthopaedic surgeons, blinded to treatment and outcome, reviewed initial radiographs and classified the fractures as (1) nondisplaced or impacted femoral neck; (2) displaced femoral neck; (3) stable intertrochanteric; or (4) unstable intertrochanteric. Stability of intertrochanteric fractures was based on the integrity of the medial cortex, according to the recommendations of the Orthopaedic Trauma Association.⁵⁶

On each patient's arrival at the hospital, a designated nurse practitioner interviewed the patient and/or primary caregiver. Data were recorded concerning nature and timing of the injury, cognitive status, medical history, prefracture residence and assistance, and prefracture functional independence. The functional independence was determined by the standardized Functional Independence Measure (FIM), a 14-item questionnaire that rates independence on a scale from one to seven in the following four categories: self-care, sphincter control, transfers, and locomotion.²⁸ Sphincter control was not included in the analysis in this study, because it was deemed unlikely to be influenced by fracture specifics. Subtotal scores for each area and the sum score for overall independence were calculated. The maximum possible score for overall FIM is 90, with maximum possible scores of 14, 21, and 42 for locomotion, transfer, and self-care, respectively. Medical comorbidities, obtained by interview and by review of the medical record, were grouped as neurologic, cardiovascular, pulmonary, dialysis, cirrhosis, or diabetes. The number of medical comorbidities also was recorded. Physical findings on examination by the admitting medical physician and laboratory data also were recorded but were not included in the current analysis.

All patients were treated operatively. For patients with nondisplaced or impacted femoral neck fractures, the operative treatment consisted of percutaneous or open placement of three or four cannulated cancellous screws. Patients with displaced femoral neck fractures were treated with cemented or cementless hemiarthroplasty. Patients with intertrochanteric fractures had their fractures stabilized with open reduction and internal fixation using a sliding hip screw device. For all patients, physical therapy was begun with weightbearing as tolerated as soon as the patient was medically stable. The length of surgery and anesthesia, and estimated blood loss

and the type of anesthesia (regional or general) were recorded for each patient. At discharge, each chart was rereviewed for occurrence of postoperative complications such as wound infection or hematoma, deep venous thrombosis, cardiorespiratory events, and pneumonia. All postoperative transfusions were recorded, including the number of units transfused.

At 2 and 6 months after hospital discharge, the patients and/or primary caregivers were interviewed by telephone by a trained, FIM-certified research assistant blinded to fracture type, treatment type, and prefracture function. The same FIM questionnaire was administered by telephone at followup as was administered in person at the time of admission. Interchangeable use of the FIM instrument as an in-person and telephone questionnaire was validated.⁶¹ For the followups, only the FIM scores of survivors were included. Mortality was recorded, as was need for rehospitalization in the intervening period. At each time, FIM scores again were assessed and calculated as described previously. State vital registries and hospital records also were used to identify mortalities.

Statistical Methods

Differences in preinjury patient characteristics among the four fracture groups were identified with ANOVA for continuous variables and chi square for nominal variables. Differences in scores for overall FIM, locomotion FIM, and transfer FIM were assessed between the times (prefracture, 2 months, and 6 months) using paired t tests. Differences in scores among fracture groups at each point were detected with ANOVA. Multiple linear regression was used to determine independent predictors of FIM score at 2 months and 6 months followup. Multiple logistic regression was used to determine independent predictors of mortality at 6 months, and occurrence of postoperative complications. Differences were considered significant at a p value < 0.05. All calculations were done using Statview v. 5.0 (SAS Systems, Cary, NC).

RESULTS

Between August 1997 and August 1998, 804 patients were admitted to the four hospitals with a diagnosis of hip fracture. Of the 650 patients (81%) who met eligibility criteria, informed consent was obtained for 571 patients (88%). Initial radiographs were available for independent, blinded classification of fracture type for 537 patients (94%). Nondisplaced femoral neck fractures occurred in younger patients more often than did displaced femoral neck fractures ($p = 0.005$), stable intertrochanteric fractures ($p = 0.002$), or unstable intertrochanteric fractures ($p < 0.001$) (ANOVA). The gender and ethnic distributions did not vary among the four groups (Table 1).

Comorbidity varied among patients with each fracture type. More patients who had a displaced femoral neck fracture had coexisting cardiovascular disease than did patients who sustained either a stable ($p = 0.017$) or unstable ($p = 0.031$) intertrochanteric fracture (chi square). Neurologic comorbidity was present in more patients with unstable intertrochanteric fractures than in patients with nondisplaced femoral neck fractures ($p = 0.038$, chi square). There were no differences among the four fracture groups in prevalence of renal failure (dialysis), diabetes, chronic obstructive pulmonary disease, cirrhosis, or delirium at admission. Similarly, there were no differences among the groups in the mean number of affected organ systems involved.

Preinjury functional status varied among the patient populations with each fracture type (Table 2). Patients who sustained nondisplaced femoral neck fractures had higher preinjury overall FIM ($p = 0.046$), locomotion FIM ($p = 0.022$), and transfer FIM ($p = 0.045$) scores than patients who sustained unstable intertrochanteric fractures (ANOVA). No differences were observed for these scores among the other fracture types or for self-care FIM scores among any of the fracture types.

Operative details varied among the four groups (Table 3). The estimated blood loss during surgery was lower (all p values < 0.001 , ANOVA) for patients with nondisplaced femoral neck fractures than for patients with other fracture types. Surgical blood loss for patients with unstable intertrochanteric fractures was greater than that for patients with stable intertrochanteric fractures ($p < 0.001$, ANOVA). Similarly, operative times were less for patients with nondisplaced femoral neck fractures than for patients with displaced femoral neck ($p < 0.001$), stable intertrochanteric ($p = 0.002$), or unstable intertrochanteric ($p < 0.001$) fractures (ANOVA). Operative times for patients with displaced femoral neck fractures also were greater than that for patients with stable ($p = 0.008$) or unstable ($p = 0.013$) intertrochanteric fractures (ANOVA). There were no differences among the fracture groups in distribution of regional and general anesthesia.

Postoperative complications were encountered in more patients with unstable intertrochanteric fractures (37.6%) than in patients with nondisplaced (17.1%, $p = 0.001$) or displaced (25.4%, $p = 0.010$) femoral neck fractures (chi square). However, there were no differences among the fracture groups in the incidence of major complications. More patients with unstable intertrochanteric fractures required at least one postoperative transfusion than did patients with any other fracture type ($p < 0.001$, chi square). Patients with nondisplaced femoral neck fractures required transfusion less often than all other patients ($p < 0.001$, chi square). However, in the patients who received a transfusion, there were no differences among the four groups in the number of units transfused.

Although mortality varied among the four groups, fracture type was not an independent predictor of mortality (Table 4). The in-hospital mortality was 1.8% overall and did not vary considerably among the four fracture groups. Among all variables, no independent predictors of in-hospital mortality were identified by multiple logistic regression. Mortality at 6 months was 13.5% overall. The lowest mortality rate (5.7%) was among patients with nondisplaced femoral neck fractures, and the highest mortality rate (15.8%) was in patients with displaced femoral neck fractures ($p < 0.037$, chi square). This difference between fracture types, however, did not survive multiple logistic regression. Of all independent variables, only preinjury overall FIM score independently predicted mortality at 6 months ($p < 0.001$). Patient age, gender, number and type of comorbidities, anesthesia type, operative time, blood loss, postoperative complications, and transfusions did not affect mortality.

Function at 2 months after fracture varied with fracture type. Patients with nondisplaced femoral neck fractures had higher overall, locomotion, transfer, and self-care FIM scores than did patients with unstable intertrochanteric fractures ($p = 0.003$, 0.013, 0.004, and 0.004, respectively) (ANOVA). Also, patients with stable intertrochanteric fractures had better locomotion FIM scores at 2 months than did patients with unstable intertrochanteric fractures ($p = 0.019$, ANOVA).

At 6 months, although locomotion FIM scores differed among fracture types, fracture type was not an independent predictor of outcome. Patients who sustained an unstable intertrochanteric fracture had lower locomotion FIM scores than patients with stable intertrochanteric ($p = 0.017$) or nondisplaced femoral neck ($p = 0.020$) fractures (ANOVA). However, this effect of fracture type did not withstand multivariate analysis. In multiple linear regression analysis, preinjury overall FIM score was a strong independent predictor of 6-month overall, locomotion, transfer, and self-care FIM scores (all p values < 0.001 , multiple linear regression). Patient age was also an independent predictor of overall ($p = 0.004$), locomotion ($p = 0.010$), transfer ($p = 0.005$), and self-care ($p = 0.009$) FIM scores at 6 months. Preinjury locomotion FIM scores also independently predicted 6-month locomotion FIM scores ($p < 0.001$).

The mean loss in overall FIM score from preinjury to 6-month followup was 27%, without differences among the fracture groups. Similarly, there were no differences among the groups in mean loss of locomotion, transfer, or self-care FIM scores. Only 20.8% of all patients regained their preinjury overall FIM scores, whereas 35.5% of patients regained their preinjury locomotion FIM scores at 6 months. There were no differences between the four fracture groups in proportion of patients returning to baseline overall and locomotion function.

DISCUSSION

Functional outcome and mortality after hip fracture in elderly individuals have been investigated extensively in recent years. Many large studies have identified predictors of mortality and functional outcome after hip fracture. It was not our goal to replicate these results, but to describe the differences in mortality and functional outcome among four different types of hip fractures and determine whether those differences could withstand multivariate analysis. Knowledge of the outcomes of these different types of hip fractures bears two rewards. First, the potential identification of a subset of hip fractures for which outcomes suffer may indicate the need for improvement in treatment of those fractures. Second, different hip fractures must be proven equivalent in outcome to be grouped together in large outcomes studies.

To our knowledge, the current study is the only prospective study to date comparing nondisplaced femoral neck, displaced femoral neck, stable intertrochanteric, and unstable intertrochanteric fractures with respect to mortality and functional outcomes. We found no noteworthy differences among the four fracture groups in terms of in-hospital mortality. Six-month mortality in our study was lowest for patients with nondisplaced femoral neck fractures and highest for patients with displaced femoral neck fractures. Although this difference (5.7% versus 15.8%) reached statistical significance in univariate analysis, it did not persist in multivariate analysis. Only preinjury function independently predicted mortality in our study, as has been reported in other studies.^{24,58,67}

Functional outcome at 2 months was best for patients with nondisplaced femoral neck fractures and worst for patients with unstable intertrochanteric fractures in all areas of function measured, with considerable differences between these two types. Functional differences also were found at 2 months between patients with nondisplaced and displaced femoral neck fractures and between patients with stable and unstable intertrochanteric fractures. However, these differences did not remain at the 6-month followup. At 6 months, only locomotion function varied among fracture types, with patients with unstable intertrochanteric fractures having notably worse function than patients with stable intertrochanteric or nondisplaced femoral neck fractures. Multivariate analysis identified only patient age and preinjury function as independent predictors of function at 6 months. Patient age^{7,30,31,36,37,48} and preinjury function^{11,21,22,30,35-37,41,51,53,62,69} have been reported to predict functional outcome in other studies. Different fractures therefore may be associated with different levels of functional outcome, but only because they occur in different patient populations.

Several authors have postulated differences in the patient characteristics associated with different fracture types. Koval et al³² prospectively collected demographic data on 680 patients who sustained femoral neck or intertrochanteric fractures. Patients with intertrochanteric fractures were older and had worse preinjury function than those with femoral neck fractures. However, the study was limited to patients who were community dwelling, cognitively intact, and previously ambulatory. Displaced and nondisplaced femoral neck fractures were included together. Other studies similarly have compared femoral neck and intertrochanteric fractures and showed the latter to occur in older individuals with poorer function,^{1,22,43,52,60} whereas one report showed no differences between these two groups in preinjury mobility or health status,⁸ and another showed impaired functional status to predict femoral neck as opposed to

intertrochanteric fracture.¹³ In our study, patients who sustained a nondisplaced femoral neck fracture were considerably younger than patients who sustained a displaced femoral neck fracture or an intertrochanteric fracture. However, displaced femoral neck fractures occurred in patients of the same age range as stable and unstable intertrochanteric fractures. Therefore, it may be true that nondisplaced femoral neck fractures largely account for the age differences seen between femoral neck and intertrochanteric fractures, which may help to reconcile the conflicting aforementioned reports.

Few authors have published reports comparing outcomes of different types of hip fractures. Cipitria et al⁵ and Kenzora et al²⁹ retrospectively reviewed mortality rates for large numbers of hip fractures and reported that fracture type did not affect mortality. Most prospective studies comparing different fracture types have grouped hip fractures into femoral neck and intertrochanteric fractures or have included subtrochanteric fractures. Koval et al³⁵ found prefracture use of ambulatory aids, age older than 85 years, and intertrochanteric fracture to be independent predictors of poorer functional outcome. However, they did not investigate the differences between stable and unstable intertrochanteric fractures or between displaced and nondisplaced femoral neck fractures. Marottoli et al⁵⁰ reported fracture type to be an independent predictor of 6-month mortality in a study of 120 patients, but the study population included a group of patients with subtrochanteric fractures, 50% of whom died. Holt et al²² showed fracture type to be a weak predictor of ambulatory function. However, the study included subtrochanteric fractures and ipsilateral femoral shaft fractures, and ambulatory ability was measured at discharge from the initial hospitalization with no additional followup.

A potential limitation of this study is the length of followup, but mortality after hip fracture has been reported to approximate age-expected mortality in the general population after 6 months after fracture.^{47,68} Similarly, improvement in function seems to level off after approximately 6 months.⁷⁰ Concern regarding the use of proxies to obtain functional information also can be raised. However, Magaziner⁴⁵ reported kappa values greater than 0.6 for proxy-subject agreement in 13 of 14 tasks of daily living. Quantifying physical function in various tasks is difficult for the purposes of outcome comparisons. However, the use of the validated FIM¹⁶ in the hands of specifically trained clinicians has been reported to be reliable in a study of more than 1000 subjects.¹⁸ Moreover, agreement is high between in-person and telephone administration of the FIM instrument, with reported intraclass correlation ranging from 0.85-0.98 for the different FIM subsets.⁶¹ Finally, differentiation of stable and unstable intertrochanteric fractures is not as clear as that for displaced and nondisplaced femoral neck fractures. We did not test the interrater reliability of the system used to subdivide the intertrochanteric fractures, and such variability among the three observers used to classify the radiographs may have played a role in the difficulty detecting differences in outcome between the stable and unstable intertrochanteric fractures.

We have described differences in patient characteristics, preinjury function, mortality, and functional outcome among four major types of hip fracture: nondisplaced femoral neck, displaced femoral neck, stable intertrochanteric, and unstable intertrochanteric. Nondisplaced femoral neck fractures tended to occur in younger patients who functioned better, whereas unstable intertrochanteric fractures occurred in patients with worse preinjury function. Mortality was lowest for patients with nondisplaced femoral neck fractures and highest for patients with displaced femoral neck fractures. Six-month functional outcome was best for patients with nondisplaced femoral neck fractures and worst for patients with unstable intertrochanteric fractures. However, despite these findings, fracture type alone did not predict mortality or functional outcome. Only preinjury function independently predicted mortality and functional outcome. Therefore, the differences among the outcomes of these four types of hip fractures cannot be attributed to fracture characteristics, but rather to differences in preinjury patient characteristics. Regardless of the type of hip fracture, patients with poor

functional independence have difficulty coping with the challenge of a fracture of the hip. The orthopaedic, medical, and rehabilitative teams must pay close attention to the preinjury functional status of the patient with a hip fracture to generate appropriate prognostic goals and therapeutic strategies. Finally, patients with the four different types of hip fractures studied here can be enrolled together in future prospective studies investigating ways to improve mortality and functional outcomes.

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Fig 1.

Mean Functional Independence Measure (FIM) scores are shown for: (A) overall; (B) locomotion; (C) transfer; and (D) self-care categories for each hip fracture type at baseline, 2 months after injury, and 6 months after injury. Function was consistently highest for patients with nondisplaced femoral neck fractures and lowest for patients with unstable intertrochanteric fractures. Function consistently improved between 2 and 6 months after fracture, but did not return to preinjury levels.

TABLE 1.

Baseline Characteristics

Characteristics	Femoral Neck Fractures		Intertrochanteric Fractures	
	Nondisplaced	Displaced	Stable	Unstable
Patients(number)	70	181	108	178
Demographics				
Age(years)	78.4 ± 10.3	81.8 ± 8.8	82.5 ± 8.7	82.9 ± 7.9
Female(%)	86.7	80.1	81.5	81.5
Nonwhite(%)	8.6	8.8	7.4	7.3
Comorbidities				
Cardiovascular(%)	55.7	63.5	49.1	52.2
Neurologic(%)	22.9	29.8	32.4	36.5
Dialysis(%)	0.0	1.7	1.9	0.6
Diabetes(%)	14.3	16.0	15.7	23.0
COPD (%) ¹	14.3	11.0	15.7	14.0
Cirrhosis(%)	1.4	1.1	0.0	0.6
Delirium(%)	2.9	5.0	7.4	5.1
Systems(number)	1.1	1.2	1.2	1.3

¹ Chronic obstructive pulmonary disease

TABLE 2.

Preinjury Function

Functional Measures	Femoral Neck Fractures		Intertrochanteric Fractures	
	Nondisplaced	Displaced	Stable	Unstable
Overall FIM(max90) ^I	77.4 ± 15.6	74.1 ± 19.7	74.5 ± 19.5	72.0 ± 20.2
Locomotion FIM(max14) ^I	10.6 ± 3.3	10.0 ± 3.9	9.9 ± 3.9	9.4 ± 4.0
Transfer FIM(max21) ^I	17.6 ± 4.3	16.8 ± 5.0	17.0 ± 4.8	16.2 ± 5.1
Self-care FIM(max42) ^I	37.0 ± 7.3	35.5 ± 9.0	35.0 ± 9.4	34.7 ± 9.2

^I Functional independence measure

TABLE 3.**Treatment**

Treatment Factors	Femoral Neck Fractures		Intertrochanteric Fractures	
	Nondisplaced	Displaced	Stable	Unstable
Operative				
Estimated blood loss(cc)	69 ± 95	224 ± 134	169 ± 125	249 ± 178
Operative time(min)	91 ± 32	139 ± 38	119 ± 87	122 ± 44
General anesthesia(%)	35.6	45.2	43.2	43.2
Postoperative				
Complications(%)	17.1	25.4	28.7	37.6
Major complications(%)	7.1	11.6	10.2	10.7
Transfusions(%)	20.0	51.4	54.6	80.9

TABLE 4.

Mortality

Mortality Time	Femoral Neck Fractures		Intertrochanteric Fractures	
	Nondisplaced	Displaced	Stable	Unstable
In-Hospital Mortality(%)	0.0	2.2	2.8	1.1
6-Month Mortality(%)	5.7	15.8	12.8	13.8