High Dislocation Cumulative Risk in THA versus Hemiarthroplasty for Fractures

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Abstract

Background Although not all elderly patients with femoral neck fractures are candidates for THA, active, mentally competent, independent patients achieve the most durable functional scores with THA compared with hemiarthroplasty. However, a relatively high frequency of early or late dislocation could reduce the potential benefits with THA.

Questions/purposes We asked whether the incidence of first-time, recurrent dislocation, and revision differed in patients with hip fractures having THA or hemiarthroplasty.

Patients and Methods We retrospectively reviewed 380 patients with hip fractures (380 hips) who underwent THAs between 1995 and 1999, and compared them with 412 patients with hip fractures (412 hips) who underwent hemiarthroplasties between 1990 and 1994. The mean followup was 8 years (range, 1–20 years).

Results THA had a higher early risk of first-time dislocation and a higher late risk: 19 (4.5%) of the 412 hips treated with hemiarthroplasty had at least one dislocation whereas 30 (8.1%) of the 380 hips treated with THA had at

least one dislocation. The cumulative number of dislocations at the most recent followup (first time and recurrent dislocations) was 58 (13%) for the 380 THAs and 22 (5%) for the 412 hemiarthroplasties. At the 10-year followup, eight THAs (2%) had revision (six recurrent dislocations, two loosening), and 42 hemiarthroplasties (10%) had revision (40 acetabular protrusions, one recurrent dislocation).

Conclusions The risk of revision for recurrent dislocation increases with THA, but it remains lower than the risk of revision for wear of cartilage and acetabular protrusion in hemiarthroplasty.

Level of Evidence Level III, therapeutic study. See the Guidelines for Authors for a complete description of levels of evidence.

Introduction

Several studies [2, 4, 18, 19] suggest THA provides the best function for elderly patients after displaced femoral neck fractures. Although not all elderly patients with displaced femoral neck fractures are candidates for THA, active, mentally competent, independent patients achieve the most predictable and durable functional scores with THA. THA conferred superior short-term clinical functional scores and fewer complications when compared with hemiarthroplasty in a prospectively, randomized study [2] of mobile, independent patients with a displaced fracture of the femoral neck. Although patients with displaced femoral neck fractures who underwent hemiarthroplasties and THAs experienced reduced function 3 years later compared with preoperative levels [2], patients in the THA group had less deterioration and maintained preoperative

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Each author certifies that his institution approved the human protocol for this investigation, that all investigations were conducted in conformity with ethical principles of research.

This work was performed at the Hospital Henri Mondor.

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walking distances better than patients with hemiarthroplasties [2].

However, in these patients, the incidence of dislocation ranges from 2% to 9% after THA [3, 4, 15, 17, 26], partly because of different durations of followup for this specific endpoint. Thus, the better clinical functional scores with THA could be offset by an increased risk of dislocation as compared with hemiarthroplasty [14].

Therefore, we compared patients with femoral neck fractures treated with THA or hemiarthroplasty to determine whether (1) the incidence of first-time dislocation as a function of time differed between the two groups, (2) the type of arthroplasties (THA or hemiarthroplasty) influenced the cumulative long-term risk of dislocation, and (3) the types of arthroplasty influenced revision.

Patients and Materials

We compared the first 380 patients receiving THAs using a cemented polyethylene (PE) acetabular liner and cemented femoral stem (CeraVer, France) at our institution between 1995 and the end of 1999 with 412 patients who underwent hemiarthroplasties (bipolar or hemipolar hemiarthroplasty) before this date (1990–1994). From 1995 to 1999, we also treated 42 patients with hemiarthroplasties, and from 1990 to 1999, 123 patients underwent internal fixation or other methods. The indication for internal fixation was age younger than 65 years. The indications for THA were: (1) patients older than 65 years, (2) active patient, and (3) independent at home. The indications for hemiarthroplasty were: (1) patients older than 65 years, (2) nonactive patient, (3) nonindependent at home, and (4) patients who were cognitively or neurologically impaired. The contraindications for surgery (26 patients from 1990 to 1999) were: (1) nonambulatory patients, and (2) patients with contraindication to anesthesia. No patients were recalled specifically for this study; all data were obtained from medical records and radiographs.

In the hemiarthroplasty group (412 patients), 201 patients were men and 211 were women, with an average age of 80 years (range, 65–92 years) and a diagnosis of neck fracture. All patients received a cemented arthroplasty (280 bipolar, 132 unipolar hemiarthroplasties), performed between 1990 and 1994 at the same hospital. The 90-day mortality for patients undergoing hemiarthroplasty for hip fracture was 2.6%. Forty patients died before their 5-year followup and eight had revision surgeries for infection. Additionally, 63 of the 412 patients were lost to followup after 5 years. This left 309 of the 412 patients (75%) with a followup of 5 years, 201 (49%) with a followup of 10 years, 87 (21%) with 15 years, and 32 (8%) with 20 years. We examined their records at their most

recent followup or before their death. The average followup, as reported in medical records, was 9 years (range, 1–20 years). Surgeons performed surgery using a posterolateral approach and general anesthesia. The stems were always the same (CeraVer Osteal, Roissy, France), made of anodized titanium alloy (TiAl6V4), smooth, and always cemented. Surgeons fixed femoral components with cement (Palacos® G; Heraeus Medical GmbH, Hanau, Germany) containing antibiotics (gentamicin).

The THA group consisted of 380 patients (175 men, 205 women), with an average age of 79 years (range, 64–90 years). Between 1995 and 1999, all patients received a cemented THA at the same hospital. The 90-day mortality in these patients undergoing THA for hip fracture was 2.8%. Thirty patients died before their 5-year followup. Nine patients had revision surgeries for infection, and 51 of the 380 patients were lost to followup after 5 years. This left 299 of the 380 patients (79%) with a minimum followup of 5 years, 191 (50%) with a followup of 10 years, and 98 (26%) with 15 years. The average followup (as reported in medical records) was 7 years (range, 1–15 years). Surgeons performed this surgery using the same technique, general anesthesia, and stems (also cemented) as used in the hemiarthroplasty group. The conventional acetabular component was a standard PE cup manufactured by CeraVer (all cemented). The alumina head was 32 mm in diameter and anchored through a Morse taper.

Age and gender proportions were similar in the two groups (mean age of 80 years in the hemiarthroplasty group versus 79 years in the THA group).

For postoperative rehabilitation, no patient wore a hip spica cast to minimize the possibility of hip dislocation. We encouraged patients to be upright with weightbearing after surgery. Range of motion of the hip and knees began immediately, and ambulation progressed as tolerated according to the ability of each patient (usually after 48 hours). Medical doctors supervised the physiotherapy for 3 weeks to 45 days.

The followups were at 3, 6, and 12 months, then annually thereafter. At each visit, patients had clinical and radiologic evaluations. The usual hip-rating scores do not reflect the function of THA well in patients with hip fractures because the age or medical status may affect the functional variables. The preoperative and postoperative walking status of patients was graded as unable to walk, able to walk indoors only, able to walk about the community, and able to walk an unlimited distance. All patients, except the eight with hip infections, subjectively showed improved ambulation (they were able to walk about the community or able to walk an unlimited distance) after surgery. Every year until the most recent followup, plain radiographs (AP and lateral views) were obtained. From the charts, we determined whether there were any

dislocations (posterior or anterior) or revisions for recurrent dislocation, loosening, or wear of cartilage for hemiarthroplasties. We routinely evaluated patients, in person or via a standardized letter or telephone questionnaire, at 2 to 3 months postoperatively, at 1, 2, and 5 years, and then at each subsequent 5-year interval until revision or death. At each time, we specifically asked patients whether they had experienced dislocation of the hip. We did not consider a sensation of subluxation of the hip to be sufficiently specific to represent an episode of hip instability, and only considered a complete hip dislocation requiring reduction to be a dislocation event.

Three of us (PH, MB, OP) evaluated all immediate postoperative radiographs and all radiographs at last followup to assess wear of the cartilage for hemiarthroplasties, and loosening of the cup for THA. We defined loosening of the socket as cup migration exceeding 5 mm, angular rotation exceeding 5°, and a continuous radiolucent line wider than 2 mm [6]. To assess cartilage wear we used the criteria of Baker et al. [2]. Cup position was assessed according to the acetabular position angle [22].

We expressed qualitative data (ie, gender) as counts and percentages within groups and quantitative data by mean standard deviation or range. We compared these qualitative data between the two groups using the Chi square test or Fisher's exact test. To estimate the cumulative probability of not having a dislocation in the whole series, we used the Kaplan-Meier survivorship analysis [13], with 95% confidence intervals (to deal with missing data). Differences in survival were determined using the log-rank test. We estimated the cumulative risk of dislocation as reported by Berry et al. [3] using the Kaplan-Meier method [13], and performed Kaplan-Meier survivorship analysis with revision attributable to recurrent dislocation, wear of cartilage, and acetabular protrusion for hemiarthroplasty, or loosening for THA as the endpoint.

Results

The incidence of first-time dislocation was lower in the hemiarthroplasty group and occurred in a shorter period after surgery. Patients who had a THA had a higher early risk of first time dislocation and a higher late risk (Fig. 1). Nineteen (4.5%) of the 412 hips treated with hemiarthroplasty were known to have had at least one dislocation. Seven (1.7%) dislocations occurred within 60 days after THA, nine occurred 67 to 180 days after arthroplasty, three occurred 6 to 24 months after arthroplasty, and none occurred more than 2 years after arthroplasty. When the data were stratified according to treatment (bipolar or unipolar hemiarthroplasty), we observed no difference ($p = 0.16$) in first-time dislocation percentage in patients

Fig. 1 Kaplan-Meier curves show failure as first-time dislocations. The survival rate without dislocation was greater ($p = 0.05$) for patients with THAs than for patients with hemiarthroplasties.

with a unipolar versus bipolar hemiarthroplasty. When treated with THA, 30 (8.1%) of the 380 hips had at least one dislocation. Nine first-time (2.3%) dislocations occurred within 60 days after arthroplasty, eight occurred 2 to 12 months after arthroplasty, seven occurred 1 to 10 years after arthroplasty, and six occurred more than 10 years after arthroplasty.

Recurrent hip dislocation and the cumulative risk of dislocation were greater with THA. Nine patients (nine hips) treated with THA had recurrent hip dislocations: four had two recurrent dislocations, two had three dislocations, one had four dislocations, and two had five dislocations. Therefore, the cumulative number of dislocations (first time and recurrent) for patients treated with 380 THAs was a total of 58 dislocations (13%) at the most recent followup. The cumulative risk of dislocation for surviving patients with THAs who did not have revision surgery was 3% (95% CI, 1.5%–4.5%) at 2 months and 6% (95% CI, 3%–9%) at 1 year. The risk then increased at a constant rate to approximately 0.5% every year, to 13% (95% CI, 9%–18%) at 15 years for patients who had not had a revision by this followup. Six THAs needed revision for recurrent dislocations. In the group of patients who underwent a hemiarthroplasty, the incidence of recurrent dislocations was lower (three patients with recurrent dislocations two times among 412 hips) than in the patients with a THA (nine of 380 patients). Therefore, the cumulative number of dislocations (first-time and recurrent dislocations) for patients treated with 412 hemiarthroplasties was lower ($p = 0.01$), with a total of 22 dislocations (5%) at the most recent followup. The cumulative risk of dislocation with hemiarthroplasty was 1% at 1 month, 1.9% at 1 year, and 5% (95% CI, 2%–6%) at 15 years (Fig. 2). Only one hip had revision for this problem.

The two different types of arthroplasties influenced the number and reason (dislocation, wear of cartilage, or loosening) for revisions in the absence of infection: the number of revisions for infection was similar in the two

Fig. 2 The Kaplan-Meier curves show failure as the cumulative number of dislocations (first time and recurrent dislocations). The survival rate without recurrent dislocations was greater ($p = 0.01$) for patients with THAs than for those with hemiarthroplasties.

Fig. 3 The Kaplan-Meier curves show failure for aseptic revisions. The survival rate was greater ($p = 0.007$) for patients with THAs than for patients with hemiarthroplasties.

groups. With the absence of infection, the survival rate in the THA group was 100% at 5 years and 98% at 10 years, with revision attributable to recurrent dislocation (six cases) or loosening of the cup (two cases) as the endpoint. The number of revisions (Fig. 3) for any aseptic reason was greater ($p = 0.01$) for patients treated with hemiarthroplasty: only one patient had revision for recurrent dislocation at the 10-year followup, but 41 patients had revisions for THA (wear of cartilage) by this followup. With the absence of infection, the survival rate in the hemiarthroplasty group was 98% at 5 years and 90% at 10 years, with revision attributable to recurrent dislocation (one case) or wear of cartilage (41 cases) as the endpoint.

Discussion

THA has not been a common treatment for displaced intracapsular hip fractures. The choice of treatment in displaced femoral neck fractures was evaluated in a survey of the American Association of Hip and Knee surgeons in which only 13% listed THA as their preferred technique, compared with 85% listing hemiarthroplasty [12]. Many

patients who sustain this injury are not natural choices for THA; most are elderly, with limited mobility, and many have some degree of cognitive impairment. In addition to these considerations, the initial experience with THA for intracapsular fractures suggest rates of dislocation ranging from 2% to 9% [3, 4, 10, 15, 23, 26]. However, there is an accumulating body of evidence that supports the use of THA in suitable patients, and some studies [4, 9, 14, 18, 27] indicate function may be better than after other procedures, particularly hemiarthroplasty. To confirm or refute the reported higher rate of dislocation and recurrent dislocation in patients treated with THAs, we compared patients treated with hemiarthroplasty with patients treated with THA to determine the incidence of first-time dislocation, cumulative risk of dislocation, and influence of demographic factors. We chose patients who underwent surgery using the same surgical approach, and one implant design to minimize variables (different stem, head size, prosthetic neck geometry, and acetabular component design) that might confound analysis.

There are several limitations to this study. First, we did not randomize the patients into the two groups. However, we believe it is reasonable to compare the two groups, as we could identify (Table 1) only five studies in which a hemiarthroplasty with cement was compared with a THA with cement [2, 7, 9, 14, 18]. Second, the surgeons performed the two procedures at two different times; however, the surgeons were the same and used the same approaches and perioperative treatments. Third, we lost some patients to followup during this study, and others died. It is possible some patients had a dislocation treated at another hospital and did not report it owing to being cognitively impaired [10] when they became older. Another limit is that the dislocation rate may be affected by the lack of modularity (using 32-mm ceramic heads with limited neck lengths in our series), by other factors [1] than the choice of the implant, including orientation of the acetabular and femoral components, and leg length discrepancy, factors that were not analyzed in this study. The risk of dislocation also might be affected by the surgical approach [8], by the design such as dual-mobility cup and constrained liner, or by the size [21] of the femoral head. THA is a more complex procedure than hemiarthroplasty or fixation, and one concern could be the possibility that the mortality rate [16] would be higher. This did not occur in our series, and the 30-day mortality in another series [20] of more than 7000 patients undergoing THAs for a hip fracture is 2.4%, consistent with our observation. Two randomized trials showed similar mortality rates with THA compared with other treatment options [9, 18]. Therefore, it would seem that increasing age and medical comorbidities [16], rather than the magnitude of the surgical procedure, influence mortality.

Table 1. Comparison of THA and hemiarthroplasties

Study	Mean followup	THA		Hemiarthroplasties		
		Revision	Dislocation	Revision	Dislocation	Acetabular erosion
Dorr et al. [7]	2 years	0/39 0%	7/39 17%	0/37 0%	2/37 5.4%	0/37 0%
Baker et al. [2]	3 years	1/40 2%	3/40 7%	2/41 5%	0/41 0%	21/41 51%
Keating et al. [14]	2 years	6/69 7%	3/69 4%	5/111 5%	3/111 3%	NA
Macaulay et al. [18]	2 years	1/17 6%	1/17 6%	0/23 0%	2/23 0%	0/23 9%
Hedbeck et al. [9]	4 years	3/60 5%	0/60 0%	0/60 0%	0/60 0%	4/60 7%
Current study	8 years	8/380 2%	58/380 13%	42/412 10%	22/412 5%	41/412 10%

NA = non available.

Our data (Table 1) suggest that after THA there is a higher initial risk level for first-time dislocation that increases with time, and that, after hemiarthroplasty, the risk of first-time dislocation is lower and decreases after 6 months; thus, the longer patients are followed, there is a greater cumulative risk for patients who underwent THA compared with patients who underwent hemiarthroplasty in the treatment of fractures. Our cumulative risk of dislocation for patients with THAs is higher than expected. The fact that many studies of THA for femoral neck fractures have relatively short followup periods [7, 14, 18], often for only 2 years, might explain this. Hip dislocation rates in two studies [4, 14] are 2% and 4%, but with only 2 to 4 years followup, respectively. However, another series of 51 THAs [3] had cumulative rates of 6% at 10 years and 9% at 25 years. Our data are consistent with this observation.

The risk of revision for recurrent dislocation increased with THA, but it remained lower than the risk of revision for cartilage wear and acetabular protrusion in the hemiarthroplasty group. This conforms to the literature: acetabular erosion has been considered to occur with rates ranging from 2% [5] to 36% [25] with a unipolar design and from 0% [5] to 26% [24] for a bipolar design. Furthermore when acetabular erosion was graded, Baker et al. [2] reported a 66% rate of acetabular erosion. Hemiarthroplasty, regardless of type, does not seem to fulfill the active, independent patient's functional demands. Van Vugt et al. [28] concluded that their study group of independent living patients between 71 and 80 years old should not have a bipolar hemiarthroplasty owing to their higher risk of acetabular protrusion and loosening. Three studies [15, 17, 26] have longer-term followups and calculated 10- and 20-year survival of THAs after femoral neck

fractures. These studies indicate that the 10-year survival of THA is in excess of 90%. Tarasevicius et al. [26] reported 10-year survival rates greater than 90% for stems and cups in THAs in a series of 135 patients. Mabry et al. [17] reported 93% 10-year survival and 76% 20-year survival of Charnley cemented implants used to treat femoral neck nonunion. Lee et al. [15] reported survival rates of 95% at 5 years, 94% at 10 years, 89% at 15 years, and 84% at 20 years for cemented THAs used as a primary treatment for intracapsular hip fractures.

These findings have consequences concerning the treatment of hip fractures with arthroplasties. Reports that cite a dislocation rate after THA for fractures need to provide the time the authors followed the patients for the dislocation. This study raises one of the major issues related to the risk of dislocation in femoral neck fractures. A systematic review [11] showed that single-stage THA may lead to lower reoperation rates and better functional outcomes compared with hemiarthroplasty in patients with displaced femoral neck fractures. If the increased risk of dislocation is confirmed as compared with hemiarthroplasty, surgeons might consider THA if the risk of dislocation can be reduced either by modifying the surgical approach or considering alternative cup designs such as constrained liners and the dual-mobility cup. We have used only constrained liners or the dual-mobility cup since 2000 for patients with hip fractures needing THA.

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