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CLINICAL RESEARCH

Revision Surgery Occurs Frequently After Percutaneous Fixation of Stable Femoral Neck Fractures in Elderly Patients

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Abstract

Background Femoral neck fractures are a major public health problem. Multiple-screw fixation is the most commonly used surgical technique for the treatment of stable femoral neck fractures.

Questions/purposes We determined (1) the proportion of hips that had conversion surgery to THA, and (2) the proportion of hips that underwent repeat fracture surgery after percutaneous screw fixation of stable (Garden Stages I and II) femoral neck fractures in patients older than 65 years and the causes of these reoperations.

Methods We performed a retrospective study of all patients older than 65 years with stable femoral neck fractures secondary to low-energy trauma treated surgically at our institution between 2005 and 2008. We identified 121 fractures in 120 patients older than 65 years as stable (Garden Stage I or II); all were treated with percutaneous, cannulated screw fixation in an inverted triangle without performing a capsulotomy or aspiration of the fracture hematoma at the time of surgery. The average age of the patients at the time of fracture was 80 years (range, 65–100 years). Radiographs, operative reports, and medical records were reviewed. Fracture union, nonunion, osteonecrosis, intraarticular hardware, loss of fixation, and conversion to arthroplasty were noted. Followup averaged 11 months (range, 0–5 years) because all patients were included, including those who died. The mortality rate was 40% for all patients at the time of review.

Results Twelve patients (10%) underwent conversion surgery to THA at a mean of 9 months after the index fracture repair (range, 2–24 months); the indications for conversion to THA included osteonecrosis, nonunion, and loss of fixation. Two others had periimplant subtrochanteric femur fractures treated by surgical repair with cephalomedullary nails and two patients had removal of hardware.

Conclusions Revision surgery after osteosynthesis for stable femoral neck fractures was more frequent in this series than previously has been reported. The reasons for this higher frequency of reoperation may be related to poor bone quality, patient age, and some technical factors, which leads us to believe other treatment options such as nonoperative management or hemiarthroplasty may be viable options for some of these patients.

Level of Evidence Level IV, therapeutic study.

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Each author certifies that the institutional review board of Lahey Clinic approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research.
This study was performed at Lahey Hospital and Medical Center (Burlington, MA, USA).

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Introduction

Femoral neck fractures are a major public health problem and a common injury encountered by orthopaedic surgeons. There are approximately 312,000 hip fractures

annually in the United States population and it is estimated that there will be 500,000 by 2040 [13]. Numerous studies have evaluated the epidemiology and clinical results of treatment of these injuries [1, 2, 4, 5, 8, 9, 11, 16–19, 24]. Hip fractures in the elderly are associated with nearly 50% mortality at 5 years and more than ½ of the elderly patients treated for a hip fracture are cognitively impaired [17, 36]. The annual cost for treatment of hip fractures is approximately USD 16 billion [18]. Treatment options for femoral neck fractures have been well studied, and the standard treatment in elderly patients who are fit for surgery is early medical optimization, acute surgical intervention, and early mobilization to achieve an optimal functional outcome and avoid medical complications [21, 22, 34]. Although there is some debate regarding specific surgical techniques, there are areas of consensus [16, 17, 19, 23].

Complications in patients treated for stable femoral neck fractures can occur and generally fall into two categories [29]: general medical complications related to anesthesia and comorbidities and fracture complications such as nonunion, osteonecrosis, osteoarthritis, infection, implant failure, and technical failures.

In this study, we specifically sought to study the complications that result in reoperation and revision surgery after repair of stable femoral neck fractures. To do this, we determined (1) the proportion of hips that underwent conversion surgery to THA, and (2) the risk and causes of repeat fracture surgery after percutaneous screw fixation of stable femoral neck fractures in patients older than 65 years.

Patients and Methods

In an institutional review board-approved retrospective chart and radiographic review of all femoral neck fractures treated at our institution from 2005 to 2008, we identified 121 fractures in 120 patients older than 65 years as Garden Stage I or II (stable fractures) [12]. All were treated with percutaneous screw fixation using 6.5 or 7.3 mm cannulated screws in an inverted triangle. The average patient age was 80 years (range, 65–100 years). The followup averaged 11 months (range, 0–5 years), as all patients were included, including those who died early. At the time of this retrospective review, we found 42% (51/120) were deceased according to our electronic medical record, a minimum mortality rate of 42%. Of the patients who still were alive according to the medical record, 46 patients (38%) had fewer than 2 years of orthopaedic followup.

Two of the authors (AJM, MSK) performed radiographic review of all injury and followup postoperative films, and femoral neck fractures were categorized according to the Garden classification [12]. All fractures were treated with three screws. No capsulotomies or aspirations were performed at the time of surgery.

All patients were treated at our level II trauma center located in a suburban area. Seventy patients (58%) were categorized as minimally ambulatory, defined as limited to home ambulation or living in a nursing facility, and 95% of patients were classified as having an American Society of Anesthesiologists (ASA) score of 3 or 4. Of the 120 patients, 17 were transferred to our center for definitive treatment of their fracture. Patients underwent conversion surgery to THA based on their pain, functional ability, and radiographic failure of fixation. If patients showed signs of osteonecrosis, femoral neck shortening, osteoarthritis, or mechanical failure of fixation and infection was ruled out, then they were eligible for conversion surgery to THA. If patients were healthy enough and willing to proceed, we offered surgery. Periimplant fractures such as subtrochanteric fractures, and hardware irritation in healed fractures were not treated with arthroplasty.

Results

Twelve of the 120 patients (121 fractures) required THA for an overall rate of conversion to THA of 10%. Ten of these 12 patients (12 fractures) underwent conversion surgery during the first year; four during the first 3 months after surgery. Six patients (six fractures) had nonunions that resulted in a THA and three others had osteonecrosis develop with subsequent conversion to THA. The remaining three had osteoarthritis develop. The average time to THA was 9 months. All conversions were performed by an arthroplasty surgeon, and there was a bias to performing THA versus hemiarthroplasty. Eight of the 12 patients (67%) had cutout of fixation screws through the femoral head.

Four other patients (3%) had reoperation for implant-related complications for which conversion to an arthroplasty was not performed. Of these, two patients sustained a subtrochanteric femur fracture and were treated with cephalomedullary nails. The other two had the screws removed for implant-related complications. The overall reoperation rate, including conversions to THA and other reoperations, was 13% (16 of 121 fractures). Two other patients (2%) were considered to have loss of fixation secondary to nonunion but were treated nonoperatively secondary to medical reasons. One patient had some screw penetration of the femoral head at 4 years and another had early loss of fixation, but was medically unable to undergo conversion surgery. There were a total of 18 fractures (15%) with radiographic and clinical failure after fixation for a stable femoral neck fracture, but only 16 (13%) were in patients healthy enough to undergo a reoperation.

Discussion

Numerous studies have reported the rate of nonunion and osteonecrosis for stable femoral neck fractures to be less than 6% [5, 7, 8, 21, 28, 32, 35]. Most of these studies showed that percutaneous or in situ pinning is a safe procedure. However some studies focus on only nondisplaced or stable fractures and the global acceptance of in situ pinning for Garden Stages I and II femoral neck fractures [2, 5, 7, 8, 10, 15, 27, 28]. We aimed to evaluate the risk of (1) conversion to THA after in situ pinning of these fractures owing to osteonecrosis, osteoarthritis, femoral neck nonunion, and loss of fixation, and (2) revision surgery in a group of stable (Garden Stages I and II) femoral neck fractures treated with percutaneous pinning using cannulated screws. Ten percent of our patients underwent conversion surgery to THA, with the average time to THA at 9 months. There was an overall reoperation rate of 13%. Numbers of conversions to THA and reoperation rate are most likely low estimates in light of loss to followup. Reasons for the slightly higher rate of revision maybe related to the older patient population and poor bone quality.

This study had numerous limitations. First, we lost 46% of patients to followup before 2 years, and 40% of the cohort had died by 5 years; of those who died, we were missing information regarding reoperation for 60%, meaning that we had complete information regarding reoperation for only 24% of the 120 patients in the series. This suggests that our estimates for reoperation and conversion to THA are likely low, and may be considered a best-case scenario in terms of estimating the likelihood of reoperation in these patients. One patient underwent conversion surgery to THA at an outside institution, as we discovered through review of the medical records, and there may have been other patients who also underwent surgery at outside institutions. Our study design was retrospective, which contributed to our lack of followup data and our ability to evaluate functional outcome scoring, which is not routinely gathered for these patients. In addition, we did not explore the medical complications associated with these injuries or do a critical analysis of the technical placement of the screws, which could be a contributing factor to our increased conversion rate although none of the failures had screws observed out of the femoral head on the postoperative radiographs. During the period of study, the participating surgeons' used THA rather than hemiarthroplasty for patients undergoing conversion surgery to arthroplasty.

Surgical treatment of femoral neck fractures can fail due to nonunion, avascular necrosis, and implant-related complications such as periimplant fracture. The proportion of nondisplaced femoral neck fractures with nonunions was reported in one series to occur in 6.4%, and avascular necrosis in 5.8% [17]. These modes of failure can result in conversion to arthroplasty. Chiu and Lo [6] treated nondisplaced femoral neck fractures with Knowles pins and reported that 8.9% were converted to arthroplasty. A more recent study [8] evaluating in situ pinning with cannulated screws showed 7.7% of patients with these fractures underwent conversion surgery to arthroplasty. Hui et al. [15] reported that 19% (11/57) of hips underwent reoperation after in situ pinning of nondisplaced femoral neck fractures. In their study, THA was performed for four fractures and hemiarthroplasty was performed for another four [15]. They suggested that hemiarthroplasty might be a better treatment option than in situ pinning for these nondisplaced fractures in patients older than 80 years. Chen et al. [5] also reported a high rate of conversion to hemiarthroplasty at 16.2 % (six of 37) during the first 2 months postoperatively, but contrasted with the conclusions of Hui et al. [15] regarding a high rate of infection with hemiarthroplasty. Both studies [5, 15] evaluated octogenarians and were relatively small (57 and 37 patients, respectively). Other larger studies looking at all ages of patients with femoral neck fractures showed that 7% to 9% of hips had conversion surgery to arthroplasty (either hemiarthroplasty or THA) [3, 8, 25–27, 30]. Our results are similar to those of the larger studies, with 10% of hips undergoing conversion to THA [25].

The frequency of loss of fixation with multiple screws has been reported to be less than 5%, and is attributed to osteoporotic bone [29]. Hernigou and Besnard [14] reported that hardware complications and screw penetration, in a retrospective review of 60 patients, were approximately 10%. Studies that have focused on the evaluation of only nondisplaced femoral neck fractures reported nonunion and osteonecrosis occur in 1.6% to 22.5% of hips [2, 5–8, 10, 28, 31, 33], but various fixation methods were used in those studies. Studies using Knowles pins [7, 31], hook pins [33], and Watson-Jones nails [28] showed failure in 6% to 7% of hips, with the exception of the Watson-Jones nail [28], which had a combined nonunion and osteonecrosis rate of 28%. Recently, Murphy et al. [25], reported fewer reoperations for displaced and nondisplaced femoral neck fractures treated with hemiarthroplasty. Reoperations after internal fixation for nondisplaced femoral neck fractures in their study was 15.1%, which is similar to our rate; and they also reported that 3% had minor procedures such as screw removal for their nondisplaced fracture group and another 1.5% had a major reoperation. Other studies looking at nondisplaced femoral neck fractures had reoperation rates of 9% to 31% [3, 4, 11, 21, 24]. In these studies, the proportion of hips treated with nonarthroplasty procedures varied from 1.7% to 6%. Parker et al. [27] reported on 342 nondisplaced

fractures, and 11 patients (3%) had screws removed and two others had femoral fractures treated with additional fracture surgery, with another 37 patients (10%) having surgery that failed and who underwent conversion surgery to arthroplasty.

Subtrochanteric fractures have been reported for in situ pinning, and several studies, similar to ours, have a small number of patients with new femur fractures below the screws [6, 20, 21, 24]. However this is not common. Jansen et al. [20] reported subtrochanteric fractures to occur with in situ pinning approximately 3% of the time, which is in the range of our results. Bentley [2] found that 10% to 15% of patients with these nondisplaced fractures experienced displacement or failure, and he therefore recommended surgical stabilization with internal fixation. Surprisingly, the proportion of patients experiencing displacement in the study by Bentley [2] is similar to the rates in our study and in the study by Murphy et al. [25].

Stable femoral neck fractures generally are treated with percutaneous, in situ pinning with cannulated screws. In situ fixation is favored because it is a relatively quick and simple procedure and no reduction is necessary. However, we found a higher-than-expected number of patients undergoing repeat surgery and conversion surgery to THA at relatively short-term followup. Some studies have raised similar concerns [18, 24]. Treatment of these injuries appears to be more complex than previously thought, and there may be a role for either nonoperative treatment, a different fixation device or method such as a sliding hip screw or other fixed-angle device, or perhaps early arthroplasty in selected, although as yet uncharacterized patient populations. Given the public-health implications and costs associated with these injuries, additional study is required to identify patients at high risk for failed fracture fixation to reduce these early complication and reoperations rates.

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