

# A comprehensive program for enhanced management of femoral neck fractures including an enhanced recovery after surgery program

## A retrospective study

Zheyu Huang, MD, Junhui Zhang, MD, Zhenglin Di, MD, Zhimin Zeng, MD\*

### Abstract

To retrospectively analyze the functional outcomes and complications in patients who underwent hip arthroplasty with enhanced recovery after surgery (ERAS) program for femoral neck fractures.

Between June 2015 and May 2019, 1138 patients with femoral neck fractures were treated in our department. According to the Garden classification system, 467 cases were type III and 671 cases were type IV with an average age of  $74.9 \pm 8.8$  years (range, 59–96 years). All patients underwent hip arthroplasty with ERAS. The clinical outcomes of these patients were retrospectively analyzed at the final follow-up using the Harris hip score (HHS).

The median follow-up was 21.2 months (range, 6–36 months). The mean time to surgery and the length of hospitalization after surgery were 2.4 and 2.2 days, respectively. Eight hundred and fifty-two patients (74.9%) were operated within 48 hours from admission, 1052 cases (92.4%) were discharged within 48 hours after surgery. Twelve patients (1.05%) were readmitted for prosthetic dislocation. None of the patients suffered from infection, periprosthetic fractures, and/or prosthetic loosening. The HHS at the final follow-up was  $92.7 \pm 7.6$ , with an excellent or good rate of 90.2%.

Patient-oriented ERAS optimizes the interventional measures during the perioperative period for geriatric patients with femoral neck fractures and can improve their short-term clinical outcomes without increased readmission rates.

**Abbreviations:** ERAS = enhanced recovery after surgery, HA = hemiarthroplasty, HHS = Harris hip score, LOS = length of hospital stays, THA = total hip arthroplasty.

**Keywords:** enhanced recovery after surgery, femoral neck fracture, hemiarthroplasty, replacement, total hip arthroplasty

## 1. Introduction

The incidence of femoral neck fractures has increased partly due to an increase in the number of geriatric patients, and it is estimated that treatment of geriatric hip fractures will consume a large amount of health care resources.<sup>[1]</sup> Femoral neck fractures can lead to catastrophic physical and functional impairment, and

the mortality rate within 1 year ranged from 19% to 41%.<sup>[2,3]</sup> Treatment is aimed at early recovery and prevention of secondary surgery for geriatric patients.<sup>[3]</sup> Total hip arthroplasty (THA) and hemiarthroplasty (HA) play an important role in enabling early weight bearing after surgery and decreasing the frequency of complications. Therefore, these techniques have been widely accepted by surgeons as preferred treatments for geriatric patients with femoral neck fractures. However, the various examinations required before arthroplasty often increase the length of hospital stays (LOS) before the operation, which significantly affect the prognosis after hip arthroplasty. Enhanced recovery after surgery (ERAS) has been widely used in the joint department. Theoretically, it has the benefits of reducing the stress response and improving the rate of patient-related satisfaction by optimizing the perioperative procedures.<sup>[4]</sup> The retrospective study analyzed the clinical data of geriatric patients with femoral neck fractures who underwent ERAS hip arthroplasty in our department, and evaluated the short-term clinical results.

## 2. Materials and methods

### 2.1. Study design

This study was approved by the Human Research Ethics Committee of our hospital (IRB: NO. L2020001). This study is a retrospective analysis of patients who underwent THA or HA for treatment of femoral neck fractures between June 2015 and May 2019 in our joint department. According to the Garden

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The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Department of Orthopaedic Surgery, Ningbo NO. 6 Hospital, Zhejiang, China.

\*Correspondence: Zhimin Zeng, Department of Orthopaedic Surgery, Ningbo NO. 6 Hospital, 1059 East Zhongshan Road, Ningbo, Zhejiang, China (e-mail: zhimin001@sina.com).

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**Table 1**  
**Preoperative comorbidities.**

	No. of patients (%)
Cardiovascular	375 (33.0%)
Diabetes	141 (12.4%)
Respiratory	73 (6.4%)
Anemia	328 (28.8%)
Neurological	36 (3.2%)
Anticoagulant drugs	104 (9.1%)

classification system, 467 cases were type III and 671 cases were type IV with an average age of  $74.9 \pm 8.8$  years (range, 59–96 years). These patients had common associated comorbidities summarized in Table 1.

Our department developed an ERAS treatment for THA and HA and implemented it for all the geriatric patients with femoral neck fractures in this study. The process consisted of health and rehabilitation education, prioritizing laboratory tests and examinations, comorbidity consultations, preventive measures for infection, multimode analgesia, plans for fluid therapy, spinal anesthesia, small standard incisions, blood-sparing strategies, no drains, compression bandages, deep venous thrombosis prophylaxis, incision management, and early postoperative mobilization.<sup>[5]</sup>

Age is a consideration when choosing a surgical approach. In this study, we preferred to perform THA (744 cases) with a posterolateral approach for patients <80 years old and performed bipolar HA (394 cases) with an anterolateral approach for patients >80 years old. Cementless acetabular cups and stems were used in 692 patients and cementless acetabular cups and cement stems were used in 52 patients, cement fixation was used in all patients with HA. For bearings of THA, ceramic-on-ceramic systems (n=706) and ceramic-on-polyethylene systems (n=38) were used. Partial weight bearing with crutches was encouraged on the first day postoperatively.

Time to surgery, the LOS in hospital after surgery, rate of blood transfusion, complications (superficial and deep infections, dislocation of the hip joint, aseptic loosening, periprosthetic fractures, deep vein thrombosis), and the rate of readmission were reviewed. Functional outcomes (Harris hip score [HHS]) were evaluated postoperatively (at 3 months, 1 year, and 2–3 years).

## 2.2. Statistical analysis

Follow-up was calculated from the date of the primary THA or HA to the date of either death or the last documented follow-up, whichever came first. All statistical analyses were performed using SPSS software, version 23.0 (IBM Corp., Armonk, NY). A *P*-value  $\leq .05$  was considered significant.

## 3. Results

This study included 1138 patients who underwent THA or HA for femoral neck fractures. The mean age of the patients was  $74.9 \pm 8.8$  years (range, 59–96 years); 265 patients (23.3%) were men and 873 patients (76.7%) were women. 36.7% patients had medical comorbidities, and 12.7% patients with serious comorbidities were not allowed to undergo surgery within 48 hours. The mean time to surgery and the length of hospital stay

after surgery was 2.4 days (range, 1–7 days) and 2.2 days (range, 2–7 days), respectively. Eight hundred and fifty-two patients (74.9%) underwent surgery within 48 hours of admission to our hospital and 1052 patients (92.4%) were discharged within 48 hours after surgery. The rate of transfusion of blood products was 9.7% (a transfusion trigger of 80 g/L was used), with an average transfusion of 2.3 units (range, 1.5–8 units) and no documented transfusion reactions. All patients were discharged home, there was no other social services in this rapid discharge.

The overall rate of complications was 1.4% (deaths after discharge were excluded). There were 2 intraoperative fractures during insertion of the implant, and 2 deaths within 72 hours of the operation. Of these, 1 died of an acute pulmonary embolism and 1 died of cardiac failure. After a mean follow-up of 21.2 months (range, 6 months–3 years), there were 127 deaths (2 deaths in hospital, 7 deaths at 3 months, and 72 deaths at 12 months, respectively). There were no periprosthetic fractures, deep infections, or prosthetic loosening within the follow-up period. Twelve patients (9 patients with THA and 3 patients with HA) had dislocations in the early postoperative period, which were managed with manual reduction (10 patients) and open reduction (2 patients). Since our hospital is only an orthopedic hospital and non-medical readmission was not documented, the rate of readmission was 1.05%.

The Harris hip score (HHS) was used to measure functional outcomes of the hip joint. Due to the retrospective nature of this study, preoperative HHS could not be measured, hence no preoperative to postoperative HHS comparisons could be made. The mean HHS score was  $92.7 \pm 7.6$  and 90.2% of the geriatric patients with femoral neck fractures treated with ERAS THA and HHA had a satisfactory HHS at the final follow-up.

## 4. Discussion

This retrospective study showed that geriatric patients benefit from THA and HA with ERAS for displaced femoral neck fractures. The aim of hip-fracture surgery in the elderly is to remove pain and provide the best functional results while minimizing complications and revision rates.<sup>[3]</sup> Therefore, it is widely accepted that arthroplasty, HA, and THA are the treatments of choice for most elderly individuals, who sustain a displaced femoral neck fracture. However, there remains uncertainty regarding the effect of a THA as compared with HA. Bhandari et al<sup>[6]</sup> reported that the incidence of secondary procedures did not differ significantly between patients with displaced femoral neck fractures who were randomly assigned THA and HA, and that THA provided a clinically unimportant improvement over HA in function and quality of life over 24 months. At the same time, Ravi et al<sup>[7]</sup> found that THA was associated with lower rates of revision and reduced health-care costs, relative to HA.

Age is a consideration when choosing a treatment, HA has been established as an effective management option resulting in excellent pain relief, early mobilization in the sedentary elderly, and for patients living longer with healthier and active lives.<sup>[8]</sup> THA has been gaining popularity as an appropriate treatment option. This is consistent with our choice, we prefer to perform THA for patients <80 years old and bipolar HA for patients >80 years of age.

A femoral neck fracture is a debilitating condition and associated comorbidities may increase the length of the hospital stay and significantly influence the prognosis after surgery.<sup>[9]</sup> In

our cohort, 36.7% patients had medical comorbidities, and 12.7% patients with serious comorbidities (e.g., uncontrolled diabetes and hypertension, rapid atrial fibrillation, pneumonia, long-term use of anticoagulant drugs, etc) were not allowed to undergo surgery within 48 hours. In a study by Bekerom et al,<sup>[10]</sup> 26% patients with femoral neck fractures, who had preoperative comorbidities, underwent surgery after 2 days. Their results were similar to the results in our study. Due to the urgent nature of patients with femoral neck fractures, various examinations and consultations for medical comorbidities increased the waiting time to surgery. In our department, as part of the ERAS process, preoperative examinations (e.g., cardiac ultrasound, lower extremity venous ultrasound, ECG, pulmonary computed tomography, bilateral hip x-rays, etc) need to be completed within 12 hours of admission, which shortens the hospital stay before surgery.

The ERAS program also referred to fast-track surgery (FTS), which was pioneered by Henrik Kehlet in the mid-1990s and has been developed rapidly in total knee arthroplasty and THA in the recent years.<sup>[5]</sup> Combining various techniques of the ERAS programs (e.g., improved non-opioid analgesic techniques, together with an improved understanding of early loss of muscle function, orthostatic intolerance, perioperative blood management, mechanisms of postoperative delirium and cognitive dysfunction, and the need for thromboembolic prophylaxis) could result in decreasing the postoperative hospital stay to 1 to 2 days.<sup>[11]</sup> However, a short duration of hospitalization with a high re-admission rate (the non-medical readmission was not documented in our hospital) is of no value. Glassou et al<sup>[12]</sup> compared the risks of re-admission, reoperation, and mortality within 90 days of surgery in orthopedic departments with well-documented FTS arthroplasty programs with those in all other orthopedic departments in Denmark, and found that FTS optimized the program without any rise in readmission, reoperation, and mortality. Is this benefit available in geriatric patients with femoral neck fractures treated with ERAS THA and HA? There were limited reports, to the best of our knowledge. This retrospective study shows that geriatric patients benefit from ERAS THA and HA for displaced femoral neck fractures.

The most common complications of ERAS in THA and HA after femoral neck fractures in our study were dislocations. Nine patients with THA and 3 patients with HA experienced dislocations, and were readmitted to hospital for reduction. This was the most crucial contributory factor to the risk of readmission. The results were similar to those from several previous studies.<sup>[13,14]</sup> It was accepted that the rate of prosthetic dislocation after THA for femoral neck fractures was relatively higher, compared with those with THA for femoral head necrosis and osteoarthritis of the hip.<sup>[14]</sup>

Infection is also a common cause for readmission; however, there was no infection during the follow-up in our study. In a British study, 16,496 patients underwent HA or THA, hospital mortality was 8.4% and 5.8%, respectively.<sup>[15]</sup> However, Khan et al<sup>[16]</sup> reported that in comparisons of mortality risk, the 90-day risk of mortality declined from 0.8% to 0.2% after implementation of an ERAS program. The hospital mortality in our study decreased to 0.2%, and was consistent with this previous finding.

In our department, all patients were discharged home instead of sending them to other rehabilitation facilities. The total LOS in hospital was days in our cohort, which benefited from optimizing the treatment process with ERAS. Patient satisfaction was

positively associated with a short hospitalization and decreased cost of treatment.

There were a number of limitations in our study. Firstly, this was a retrospective study with the inherent difficulties associated with this type of study design. Ideally, a randomized control study of patients receiving an ERAS and a traditional program should have been undertaken. Secondly, there was no control group (traditional program group) for direct comparison, and all the results were not evaluated between the THA and HA groups. Thirdly, since our hospital is only an orthopedic hospital, the medical readmission was not documented and analyzed. Finally, a mean 21.2 months of follow-up was relatively short, and a long-term clinical result needs further evaluation.

In conclusion, an ERAS program of the THA and HA is patient-oriented, it optimizes the interventional measures during the perioperative period for geriatric patients with femoral neck fractures, and can improve short-term clinical results without any rise in rates of orthopedic readmission, reoperation, and mortality.

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## Author contributions

**Data curation:** Junhui Zhang.

**Methodology:** Zhenglin Di.

**Software:** Junhui Zhang.

**Writing – original draft:** Zheyu Huang.

**Writing – review & editing:** Zhimin zeng.

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