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Hip resection arthroplasty for acute femoral neck fractures in the non-ambulator

Kevin Steelman, MD*, Nicholas Bolz, MD, Jennifer Fleming, NP, Rahul Vaidya, MD

Abstract

Objectives: Hemiarthroplasty (HA) is the current standard of care for displaced femoral neck fractures (FNFs) in non-ambulators. Despite excellent outcomes, arthroplasty-specific risks remain, including dislocation, implant failure, periprosthetic fracture and infection, and fat embolization syndrome. To eliminate the possibility of these complications, should non-ambulatory patients with acute, native hip FNFs be treated with simple hip resection arthroplasty (HRA) instead of HA?

Design: Retrospective case series.

Setting: Large, urban level-1 trauma center.

Patients/Participants: Five non-ambulatory patients (6 hips) with acute, native hip FNF underwent femoral head and neck resection. Also, the most recent 10 FNFs treated with HA were also identified for comparison purposes.

Intervention: HRA was performed via a Smith-Peterson approach with an oscillating saw or osteotome to complete the fracture or perform a fresh neck cut.

Main Outcome Measurements: Outcomes included postoperative vs preoperative VAS pain scores and narcotics usage, and return to baseline functional status (sit up in bed or a chair postoperatively). Procedure time for HRA was compared with the 10 most recent patients with FNF treated with HA.

Results: HRA resulted in decreased postoperative vs preoperative VAS pain scores (7.7 vs 3.3, $P = .002$), and decreased operative times (59.2 minutes for HRA, 111.8 minutes for HA, $P < .001$). All HRA patients had immediate return of baseline function.

Conclusion: HRA offers shorter operative times when compared with HA, decreased postoperative VAS pain scores, and immediate return to functional baseline status without possibility of arthroplasty-specific complications. HRA may be an acceptable treatment option for FNFs in the non-ambulator.

Level of evidence: IV

Keywords: femoral neck fracture, girdlestone, hip resection arthroplasty, non-ambulatory

1. Introduction

Femoral neck fractures are a common orthopaedic injury. Typically, these injuries are treated surgically, as nonoperative treatment can lead to a host of devastating complications including pneumonia, urinary tract infections, pressure sores, and venous thromboembolic events.[1] Displaced femoral neck fractures in the elderly are generally treated with either total (THA) or hemiarthroplasty (HA) depending on patient comorbidities and mental status. Relatively healthy, active patients often will receive THA, whereas patients with significant medical comorbidities, limited ambulation, or altered mental status will often receive HA.[2]

Despite its current standard of care, HA for femoral neck fractures in the non-ambulator is not without risk. These include: implant dislocation, implant failure due to lack of host bony ingrowth, or poor cementation technique, periprosthetic fracture due to the presence of stress risers at the bone/cement–implant interface, prosthetic joint infection (PJI), and fat embolization syndrome during insertion of pressurized cement in cemented HA.

To eliminate these risks, we present our initial case series of non-ambulatory patients with femoral neck fractures treated with femoral head and neck resection. Hip resection arthroplasty (HRA), often incorrectly referred to as the Girdlestone procedure, is a treatment that has traditionally been used for periprosthetic hip fractures in patients with significant medical comorbidities, or hips affected by chronic osteomyelitis. HRA as a treatment for hip fracture in the non-ambulator offers several advantages, including the impossibility of dislocation, implant failure, periprosthetic fracture, prosthetic joint infection, and reduced risk of fat embolization syndrome as the femoral canal is not

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Detroit Medical Center, Detroit, MI.

** Corresponding author. Address: 1198 E. Brockton Avenue, Madison Heights, MI 48071. Tel: +616 560 1457. E-mail address: Krsteelman1@gmail.com (K. Steelman).*

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violated. HRA also provides pain relief by removing incongruous bony edges at the fracture site, which is a pain generator.[3] It is a simple procedure that can be done quickly, as there is no broaching, no implant placement, and no waiting for cement to cure.

Our hypothesis was that performing HRA in non-ambulators with native hip FNFs would result in: Decreased postoperative vs preoperative VAS pain scores, decreased postoperative vs preoperative narcotic medication use, immediate postoperative return to baseline function (sitting up in bed or in a chair), and decreased operative time when compared with the current standard of care, hemiarthroplasty. A cohort of HA patients was also followed for the development of any arthroplasty-specific complications for 1 year after surgery.

2. Methods

After obtaining IRB approval, we retrospectively reviewed the electronic medical record for all patients undergoing resection arthroplasty for acute native hip femoral neck fractures over a 3-year period at our institution, an urban level-1 trauma center. Inclusion criteria were non-ambulatory patients with acute, native hip, femoral neck fractures who underwent resection arthroplasty. Non-ambulatory status was defined as bedridden, or wheelchair bound with the ability to stand only for transfers. Patients were excluded if they had presence of orthopaedic implants in the fractured hip from any prior treatments for any reason, if they were non-ambulatory secondary to cerebral palsy or spinal cord injury (SCI), or if they had an actively septic joint in the fractured hip. For comparison of patients treated with HRA to the current standard of care we reviewed the most recent 10 consecutive patients who underwent HA for displaced femoral neck fractures at our institution.

HRA procedures were performed by one of several trauma-fellowship-trained orthopaedic surgeons. Each patient underwent a standard anterior (Smith-Peterson) approach to the hip joint with resection of the femoral head and neck. Incomplete or irregular fractures were completed or planed with either an oscillating saw or osteotome at the level of the fracture. No further resection was performed (Fig. 1). HA procedures were performed by the same group of surgeons and both the anterolateral (Watson-Jones) and posterior approaches were utilized according to surgeon preference.

Primary outcomes measured included pain control, subjective pain scores, operative time, and the ability to sit up in bed or a chair postoperatively. Pain control was quantified through pre- and postoperative morphine equivalents given per hour per day. Pre- and postoperative subjective pain scores were measured as the average visual analog scale (VAS) pain scores per day while hospitalized. Operative time was recorded from "in room time" to "surgery end time," corresponding to the time the patient's stretcher was brought into the operating room and the time the surgical dressings were in place. Secondary outcomes studied were the development of arthroplasty-specific complications in the HA group. These included dislocation, implant failure for any reason, PJI, periprosthetic fracture, and the development of fat embolization syndrome intraoperatively or postoperatively. Descriptive statistics were utilized to evaluate for significance using an alpha factor of 0.05. Continuous variables were compared using a Student two-tailed t test. All statistical analysis was performed using Microsoft Excel (Redmond, Washington). All investigations involving human subjects and the use of patient data for research purposes were approved by the committee on research ethics at our institution in accordance with the Declaration of the World Medical Association. Informed consent from human subjects was obtained as required.

3. Results

A total of 6 native hip femoral neck fractures in 5 non-ambulatory patients were identified and included in the study (Table 1). Each patient was non-ambulatory prior to injury due to severe medical comorbidities that did not include cerebral palsy or spinal cord injury. All fractures were sustained secondary to mechanical falls during transfers. Average pre- and postoperative morphine equivalent averages per hour were 0.93 and 0.52 mg, respectively (Fig. 2, $P = .12$) for patients undergoing HRA. Average pre- and postoperative VAS pain scores were 7.7 and 3.3 on a scale of 0 to 10 (Fig. 3, $P = 0.002$). All patients (5) after all procedures (6) had the ability to sit up in bed or in a chair immediately postoperatively. Length of surgery in HRA and HA patients was 59.2 and 111.8 minutes, respectively (Fig. 4, $P < .001$). All patients in both the HRA and HA cohorts were followed for at least 1 year. No patients in the HA cohort suffered a hip dislocation, implant failure, periprosthetic fracture, or fat embolization syndrome at 1 year postoperatively. One patient (1/10) did develop a PJI that required a return trip to the OR for prosthesis explantation, irrigation and debridement, and placement of an antibiotic cement spacer.

Figure 1. AP pelvis of right-sided subcapital femoral neck fracture taken in the resuscitation bay. Black lines outline jagged bone edges at fracture site (A). AP pelvis immediately postop after hip resection arthroplasty (HRA). Black line shows new smooth bone edge after new femoral neck cut was made with an oscillating saw (B). AP pelvis 1-year postop showing minimal vertical displacement of proximal femur (C).

Table 1

List of 6 cases of hip resection arthroplasty (HRA) in 5 different patients and the reasons for patient non-ambulatory status

Patients	Reason for non-ambulatory status
Patient 1R	Dementia
Patient 1L	Dementia
Patient 2	Dementia
Patient 3	Chronic PJI in knee, severe rheumatoid arthritis
Patient 4	Congestive heart failure, severe hip AVN
Patient 5	Weakness due to multiple strokes

1R, Patient 1 right hip; 1L, Patient 1 left hip.

4. Discussion

Gathorne Robert Girdlestone [4] first published his eponymous technique in 1928 as a treatment for tuberculosis of the hip.[5] The first reported femoral head and neck resection, however, was actually first described by Anthony White in 1818 in a child with septic hip pseudarthrosis.[6] The technique described by Girdlestone included a transverse incision with the center of the incision over the greater trochanter, and consisted of resection of a large portion of the gluteal muscles, the entire greater trochanter, the femoral head and neck, and all of the acetabular cartilage. If needed, the procedure even included resection of the hip adductors and the pectineus muscle, with release of the femoral neurovascular structures.[5] Current techniques for hip resection arthroplasty are obviously much less invasive, but the eponym has often remained (incorrectly), regardless of the level of resection. When performed today, HRA is a simple procedure that yields a mobile, painless, and stable hip. It has rarely been indicated as a primary procedure for a fractured hip, especially with the advent of modern orthopaedic techniques and implants.[6]

There is a paucity of literature regarding HRA in the context of native hip femoral neck fractures in patients without cerebral palsy. To the knowledge of the authors, the only case series describing the use of HRA for native hip fractures is a study by Sawadogo et al[6] in 2017. In that study, 24 patients between 2011 and 2015 underwent HRA for neglected (not acute) femoral neck fractures. Fourteen patients were available for follow-up study. At an average of 5 years of follow-up, none of these patients were taking regular pain medication, and all could walk short distances and ambulate in the home without the use of walking aids. They had an average femoral shortening of 3.5 cm, and an average hip flexion of 102°, however, a case series by Lowry in 1985 at the University of Iowa stated there is no relationship between the importance of femoral shortening and functional abilities in patients who undergo HRA.[7] The mortality rate in the Sawadogo et al study was 20%, which is similar to other rates in the literature in patients undergoing HRA for PJI, periprosthetic fractures, and hip fractures in the setting of CP.[7–10]

Hip fractures today in the non-ambulator or in patients with senile dementia are generally treated with HA. In the past, the decision for nonoperative treatment was often made as senile patients do not always complain of pain and are often minimal ambulators. These patients were given narcotic pain medication, and they would form a "functional Girdlestone." This resulted in a painful, nonfunctional hip, and was associated with increased rates of pneumonia, urinary tract infections, pressure sores, and venous thromboembolic events.[1] Today, there is no reason to think that senile patients are in any less pain than nonsenile patients, and studies have shown that HA is appropriate in these patients and results in overall good outcomes and adequate pain control.[11]

When HA is pursued for hip fractures in non-ambulators, or minimally ambulatory senile patients, despite its success with return to baseline function and pain control, there are still small but present risks for arthroplasty-specific complications, particularly dislocation and infection.[12] A recent study showed that although HA has a lower risk of dislocation than THA, dementia, and insufficient posterior wall angle were associated with higher

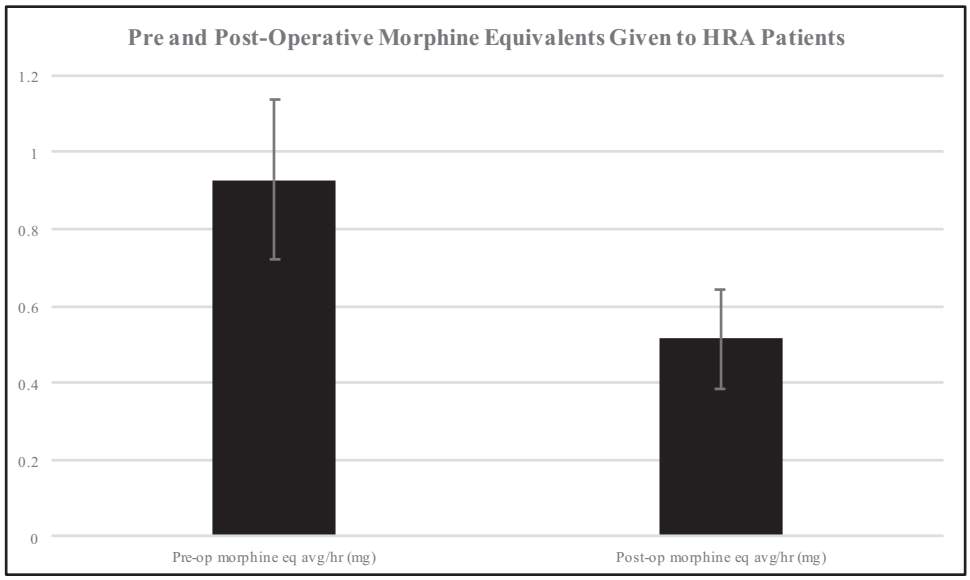

Figure 2. Pre- and postoperative average hourly morphine equivalents given to patients who underwent hip resection arthroplasty (HRA). Error bars represent standard error. $P = .12$.

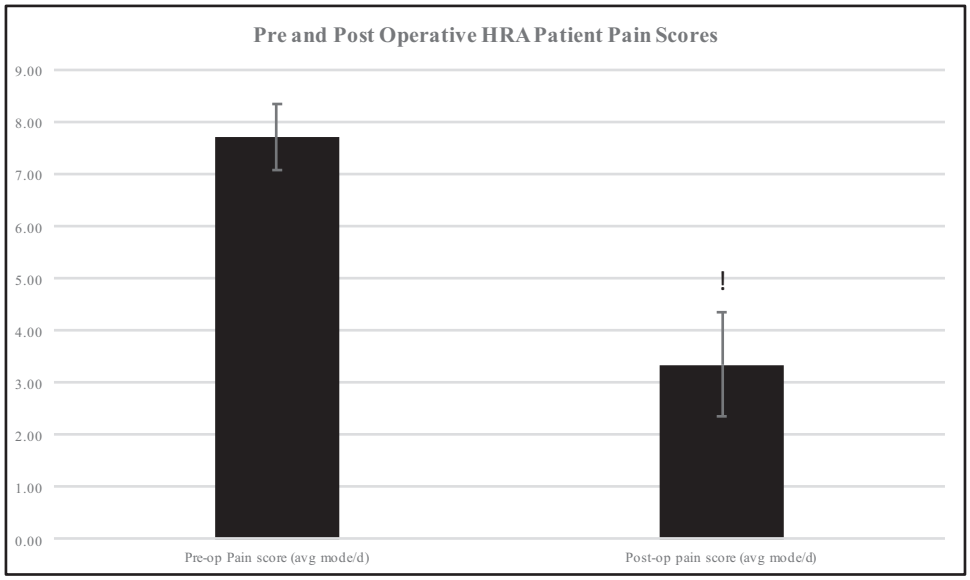

Figure 3. Pre- and postoperative average patient VAS pain scores on a scale from 0 to 10 as reported to nursing staff in patients who underwent hip resection arthroplasty (HRA). Error bars represent standard error. *$P = .002$.

risks of dislocation in bipolar HA.[13] Another study showed that the risk for early PJI in elderly patients is increased with longer surgical times, higher BMI, and chronic glucocorticoid use.[14] Lower risk complications include aseptic revision for implant failure, which in a recent meta-analysis of 12,491 patients was found to be more common in uncemented fixation vs cemented fixation (3.0% vs 1.3%).[15] Of the 10 patients treated with HA in this study, only 1 patient suffered an arthroplasty-specific complication (PJI) at 1 year postop. Obviously, no patient in the HRA cohort suffered any complication associated with a hip prosthesis at 1 year postop.

Hip fractures in patients that are non-ambulatory secondary to SCI present another unique challenge to the orthopaedic surgeon. Although none of the patients in this study had SCI, it is worth noting that these patients have their own specific set of complications with operative or nonoperative treatment of hip fractures. A study by Bishop et al[16] showed that nonoperative treatment of hip fractures in SCI patients resulted in a higher incidence of pressure ulcers (20%) when compared with operative treatment (7%). SCI can also lead to significant heterotopic ossification (HO) around the hip joint. This alters sitting mechanics and can lead to pressure ulcers and

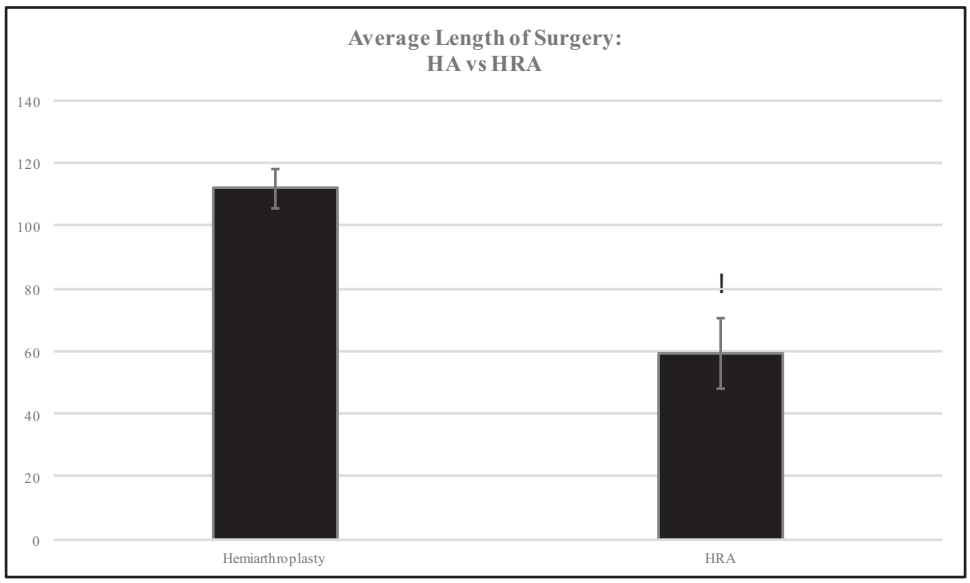

Figure 4. Average length of surgery for patients with native acute femoral neck fractures treated with either hemiarthroplasty (HA) or hip resection arthroplasty (HRA). Surgical time measured from "patient in-time" until "surgery end time" which was from the time the patient entered the operating room until the dressings were placed. Error bars represent standard error. * P value $< .001$.

subsequent osteomyelitis of the hip.[17] HRA and even the more invasive "modified Girdlestone procedure" has been described as a treatment option for these patients with HO and chronic pressure ulcers.[18,19] A 15 year follow-up study by Rubayi et al[20] showed that 11.1% had recurrence of HO, and 43.6% of patients had recurrence of pressure ulcers requiring surgery. SCI patients with hip fractures, HO, chronic pressure ulcers, or osteomyelitis, deserve special attention during operative planning; however, a full discussion of this scenario is beyond the scope of this study.

Our study examined non-ambulatory patients (without CP or SCI) with native hip femoral neck fractures. While HA can provide immediate return of baseline function, minimal complications, and adequate pain control in this patient population, we have shown that when treated with HRA, these patients receive the same return of function without any risk of arthroplasty-specific complications. While a head-to-head comparison of pain control between HRA and HA patients is beyond the scope of this study, we did find that patients treated with HRA did have significantly reduced postoperative VAS pain scores compared with their preoperative state (7.7 vs 3.3, $P = .002$). In addition, HRA results in faster OR times when compared with HA (59.2 vs 111.8 minutes, $P < .001$), which may prove beneficial in patients with significant medical comorbidities that are at higher risk for complication with longer times under anesthesia. Finally, a limited anterior approach was used for all HRA procedures. This provided excellent exposure to the hip joint with a small incision that is not under pressure as the patient lies in bed or sits in a chair.

There are a few notable weaknesses associated with this study. First, non-ambulatory patients without CP or spinal cord injury with an acute native hip femoral neck fracture are a very small and specific patient population, so we were only able to present 6 hips in 5 patients. Second, due to the numerous medical and psychiatric comorbidities often associated with this patient population, VAS pain scores are often inconsistent, and may not necessarily reflect how the patient is feeling. Third, this was a retrospective study with limited numbers of a complicated patient cohort. It is underpowered, and head-to-head comparisons of patient outcomes are difficult to isolate to any operative intervention (HRA or HA).

5. Conclusion

This is the first study that describes hip resection arthroplasty for acute native hip femoral neck fractures in the non-ambulator. HRA results in immediate return to baseline functional status without risk of arthroplasty-specific complications. It provides significant postoperative pain relief, as well as results in shorter OR times when compared with HA. HRA is a viable treatment option for hip fractures in the non-ambulator.

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