



The utility of post-operative hip radiographs in patients treated with hip hemiarthroplasty for femoral neck fractures

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ARTICLE INFO

Article history:

Accepted 7 July 2019

Keywords:

Radiographs
Hemiarthroplasty
Trauma
Femoral neck
Fracture

ABSTRACT

Background: Patients treated with hip hemiarthroplasty for low energy femoral neck fractures routinely undergo hip radiographs at each postoperative clinic visit regardless of history and physical findings. No studies to date have evaluated the effectiveness of this accepted practice. The goal of this study was to identify the postoperative utility of both history and physical (H/P) and hip radiographs in the treatment course of patients treated with hip hemiarthroplasty for low energy femoral neck fractures.

Methods: A retrospective chart review was performed on consecutive patients treated with hip hemiarthroplasty for low energy femoral neck fractures. An abnormal H/P and hip radiographs as well as a change in treatment course were recorded at each clinic or emergency department visit.

Results: Five hundred and eighty-three patients met inclusion criteria, consisting of 1177 clinic and 50 emergency department (ED) visits. An abnormal radiograph in the presence of a normal H/P did not lead to a change in treatment course. An abnormal H/P alone changed treatment course in 28 (3%) clinic visits and 18 (36%) ED visits. An abnormal H/P and the presence of an abnormal hip radiograph changed the treatment course in 23 (2%) clinic visits and 18 (36%) ED visits. In only one case – 0.3% of abnormal radiographs or 0.08% of 1177 clinic visits - did an abnormal hip radiograph change treatment course in the setting of an abnormal H/P within 6 months from surgery. The average cost of a series of hip and pelvis radiographs was \$242.

Conclusions: Abnormal radiographs do not change treatment course in the presence of a normal H/P. Hip radiographs obtained in clinic within 6 months of surgery rarely lead to a change in treatment course and thereby are a source of excess cost and radiation exposure to the patient.

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Introduction

Femoral neck fractures in the elderly population are expected to grow in the United States as the number of residents older than 65 years of age increases. The American Academy of Orthopedic Surgeons states that each year 350,000 patients are hospitalized for hip fractures, a number expected to double by the year 2050 as both the mean age of the population and incidence of osteoporosis

increases. [1] The estimated healthcare cost of hip fracture treatment in the United States in 2010 was 17–20 billion dollars per year [2]. With the ongoing pressures of rising healthcare costs there is ongoing focus on the cost-effectiveness of prevention, diagnosis, and treatment of hip fracture care. However, few studies have narrowed their focus to eliminating repetitive studies and duplication of services of postoperative clinical care in this patient population.

To our knowledge, no study to date has investigated the utility of postoperative hip radiographs in patients treated with hip hemiarthroplasty for femoral neck fractures. In an attempt to reduce unnecessary studies in our hip fracture patients, the purpose of this study is to identify the postoperative utility of both history and physical (H/P) and hip radiographs in the treatment course of patients treated with hip hemiarthroplasty for low energy femoral neck fractures. We hypothesize that clinic hip

Abbreviations: ED, emergency Department; H/P, history and physical; HO, heterotopic ossification; THA, total hip arthroplasty; SSI, surgical site infections; TKA, total knee arthroplasty; ORIF, open reduction and internal fixation.

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radiographs taken within 1 year of surgery rarely affect treatment management and thereby are a source of excess cost and unnecessary radiation exposure to the patient.

Materials and methods

A retrospective chart review was performed on consecutive patients treated with hip hemiarthroplasty for low energy femoral neck fractures at our three affiliated institutions from 2004 to 2012. The study protocol was approved by our Institutional Review Board. Data charted from each postoperative visit were collected. All patients included in this study underwent one hip radiograph prior to discharge from the hospital and at least one hip radiograph during a postoperative visit. Abnormal radiographs were interpreted by a radiologist or an orthopaedic surgeon. Exclusion criteria included pathologic femoral neck fractures caused by neoplasm and visits without hip radiographs. The endpoints for data collection included the last clinic visit or a complication requiring a return to the operating room. The following data was recorded at each postoperative visit: history and physical (H/P); hip radiographs as interpreted by both the radiologist or treating orthopedic surgeon; and change in treatment course as dictated by the treating orthopedic surgeon. Abnormal physical exam conditions included an antalgic gait, decreased range of motion, decreased strength, abnormal neurological exam. Physical exams were performed by attending orthopedic surgeons, residents, and fellows. Femoral implants used were institution specific and included either a press-fit versus cemented Stryker Howmedica Hip Fracture Stem or a Depuy Summit Basic Stem. The approach (direct lateral or posterior), implant manufacturer, and use of either a cemented or press-fit femoral stem were dictated by the treating surgeon at each institution.

Statistical analysis was performed using SPSS software (version 19.0, SPSS Inc./IBM, Chicago, IL). Kappa coefficients were used to assess agreement between the effect of abnormal H/P and hip radiographs on change in treatment course and the z-test was used to compare proportions. Two-tailed values of $p < 0.05$ were considered statistically significant. Power analysis indicated that the sample size provided over 80% power to detect differences between abnormal H/P and hip radiographs on change in treatment course at each time point using the z-test (version 7.0, nQuery Advisor, Statistical Solutions, Saugus, MA). To provide precision of estimates regarding complications and need for additional treatment, 95% confidence intervals are calculated.

Results

Patient demographics

We identified 736 consecutive patients treated with hip hemiarthroplasty for low energy femoral neck fractures from 2004 to 2012. Of those, 583 patients were included in the study according to inclusion and exclusion criteria. Inclusion criteria included one hip radiograph prior to discharge from the hospital and at least one hip radiograph during postoperative ED or clinic visit. Exclusion criteria included pathological fractures caused by neoplasm and visits without hip radiographs. The mean age of our study population was at the time of surgery 81.81 ± 9.08 (range 35–101 years). The mean time of follow-up was 10 months (range, 2 weeks to 86 months). There were 441 (76%) female cases and 142 (24%) male cases. At time of presentation, 450 (77%) cases were community ambulators, 133 (23%) household ambulators. There were 365 (63%) cemented and 218 (37%) press-fit femoral stems. A direct lateral or posterior approach to the hip was utilized in 555 (95%) and 28 (5%) cases, respectively.

Visit demographics

Data was collected from 1177 clinic visits and 50 ED postoperative visits. Mean number of clinic visits and hip radiographs per patient was 2.01 (range, 1–6 visits). Clinic visits occurred within 3 months of the index procedure in 475 (40%) patients, 3–6 months in 364 (31%), 6–12 months in 199 (17%), 12–24 months in 98 (8%), and greater than 24 months in 41 (3%). ED visits occurred within 3 months of the index procedure in 24 (48%) patients, 3–6 months in 2 (4%), 6–12 months in 4 (8%), 12–24 months in 10 (20%), and greater than 24 months in 10 (20%).

Abnormal H/P and hip radiographs per clinic and ED visits

A change in treatment course was observed only in patients with an abnormal H/P with or without an abnormal radiographic finding. An abnormal radiograph alone did not change the treatment course in any clinic patients or ED patients. An abnormal H/P with a normal radiograph, however, did change the treatment course for 28 (2%) of clinic patients and 18 (36%) of ED patients. An abnormal H/P was identified in 93 (8%) clinic visits and in all 50 ED visits. An abnormal hip radiograph was identified in 309 (26%) clinic visits and 27 (54%) ED visits ($p < 0.0002$). A normal radiograph in the setting of an abnormal H/P changed treatment for 20 (2%) clinic patients and 18 (36%) of ED patients. A change in treatment course was observed in 51 (4%) clinic visits and 36 (72%) ED visits ($p < 0.0002$). Full details of these data are summarized in the appendix Tables 1 and 2.

The 20 abnormal H/Ps leading to change in course in the setting of normal radiographs included 2 deep infections requiring a return to the operating room, 4 superficial infections treated with oral antibiotics, one postoperative hematoma requiring incision and drainage in the operating room, 8 trochanteric bursitis requiring a steroid injection, and 5 visits with abnormal groin or thigh pain in the setting of normal radiographs. A radiographic abnormality in the setting of an abnormal H/P lead to a change in treatment course in 23 of 309 (7.4%) clinic visits and 17 of 27 (63%) of ED visits ($p < 0.0002$). Using the calculated Kappa coefficients, the level of agreement between the effect of abnormal H/Ps and hip radiographs on treatment course in the clinic was 0.628 ($p < 0.0001$) and ED was 0.359 ($p < 0.002$).

Fig. 1 illustrates the effect of abnormal H/P and hip radiographs on treatment course as a function of time. The rate of abnormal radiographs leading to a change in treatment course in the setting of an abnormal H/P steadily increased from 0% within 3 months from surgery to as high as 40% in patients presenting to clinic greater than 2 years from surgery. Only 1 of 309 (0.3%) abnormal radiographs lead to a change in treatment course within the first 6 months from the time of surgery. The rate of abnormal H/Ps changing treatment course also steadily increased with time with the exception of the first 3 months where all 6 abnormal H/Ps lead to a change in treatment.

At our institution, the cost of a standard 2–3 view series of the hip with pelvis is \$242.00 for CPT 73502, resulting in a mean total cost of \$ 283,582.86 for the 583 patients included in our study.

Abnormal hip radiograph type per clinic and ED visits

A total of 309 (26%) and 27 (54%) abnormal hip radiographs were identified in the clinic and ED, respectively. Twenty-three of 309 (7%) and 17 of 27 (63%) abnormal clinic and ED radiographs, respectively, led to a change in treatment course in the presence of an abnormal H/P ($p < 0.002$). Again, all radiographic abnormalities leading to a change in treatment course occurred in the setting of an abnormal H/P. In the clinic, the most common radiographic abnormality leading to a change in treatment course was

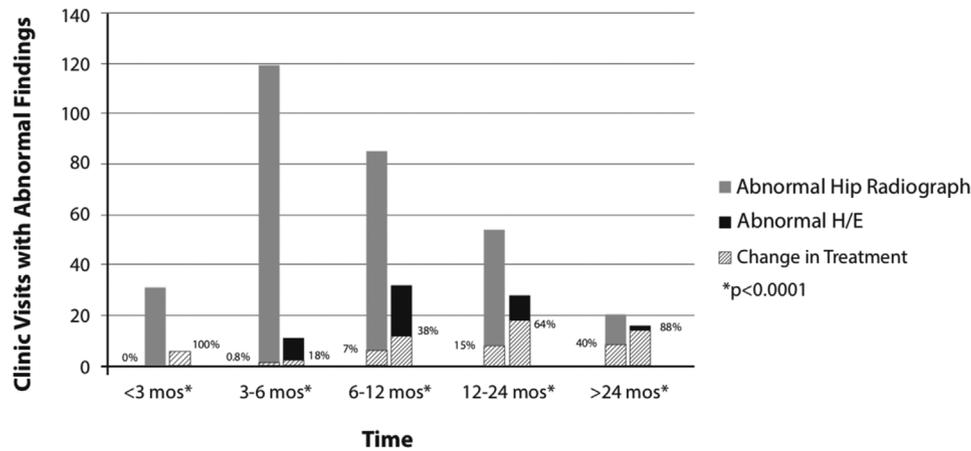


Fig. 1. Effect of Clinic Exam and Hip Radiographs on Treatment Course as a Function of Time.

acetabular arthritis in 9 of 21 (43%), femoral prosthesis radiolucency in 8 of 28 (28%), and heterotopic ossification (HO) in 4 of 249 (1.6%). No Vancouver A1 periprosthetic fractures changed treatment course. In the ED, there were no cases of HO or femoral prosthesis radiolucency and the one case of acetabular arthritis in the ED did not lead to a treatment change. Full details of these data are summarized in the appendix Table 3.

All cases of acetabular arthritis and femoral prosthesis radiolucencies leading to a change of treatment course occurred greater than 6 months postoperatively. A change in course was observed in only one visit (0.9%) with HO less than 6 months postoperatively. In the ED, femoral component dislocations and Vancouver B1 periprosthetic fractures lead to a change in treatment course in all cases. Only 1 of 4 Vancouver A1 fractures was treated with ORIF in a patient who also had a dislocation. Vancouver A1 periprosthetic fractures were most frequently observed 3 to 12 months postoperatively, whereas Vancouver B1 fractures greater than 12 months. Fifty percent of all dislocation occurred within the first 3 months from surgery. All cases of protrusio lead to a change in treatment course, namely conversion to total hip arthroplasty (THA), at a time greater than 6 months from surgery.

Complications per patient

An intraoperative complication was reported in 12 (2.1%) cases, including 9 (1.5%) greater trochanteric (GT) fractures treated with plate or cerclage fixation, 2 (0.34%) calcar fractures treated with cerclage fixation, and 1 (0.17%) patient with anterior instability. At least one postoperative complication was observed in 104 (18%) of cases, of which 46 (44%) required a return to the operating room. A change in treatment course was observed in 45 patients. Six patients were observed to have a change in treatment course in more than once clinic visit, accounting for the discrepancy in the total number of changes in treatment course per patient (45) versus per clinic visit (51). Fifty-nine complications were identified by either H/P or radiographs in clinic and 44 in the ED. Patients diagnosed and treated in clinic returned to the operating in 14 of 59 (24%) of patients, and in the ED 33 of 35 (94%). The majority of complications diagnosed in the ED include surgical site infections (SSI), dislocations and periprosthetic fractures, whereas the majority of those diagnosed in clinic included acetabular arthritis, trochanteric bursitis, and femoral component radiolucency. The most frequent complications identified by abnormal H/P alone were SSI and trochanteric bursitis requiring steroid injections. The utility of radiographs in the diagnosis of infection and trochanteric bursitis was minimal. In only one case was femoral component radiolucency associated

with a diagnosis of infection. There was no association between trochanteric bursitis and the radiographic finding of HO, fractures or femoral component radiolucency.

Discussion

In the present study, we found that a change in treatment course was observed only in patients with an abnormal H/P with or without an abnormal radiographic finding in both ED and clinic visits. We did not observe an abnormal radiograph change treatment course in the setting of a normal H/P in any cases. Patients who presented to the ED were significantly more likely to have both an abnormal H/P and abnormal hip radiographs. Abnormal H/P and hip radiographs during ED visits were also significantly more likely to change treatment course as compared to those in clinic visits.

There are a few reports in the literature evaluating the utility of routine postoperative radiographs in orthopedic patients, none of which detail outcomes in hip hemiarthroplasty. In surgery of the spine, multiple studies have shown that the routine use of postoperative radiographs of the lumbar and cervical spine have limited utility and are not recommended. [3–8] For example, in 451 pediatric patients who underwent surgery for scoliosis and were asymptomatic, Shau et al. found that caregiver complaints, comorbidities, and clinical suspicion ought to be considered over routine radiographs which provided low utility in guiding treatment course [3]. In 383 adults with cervical spine fusions and subsequent normal history and physical exam presentations, routine postoperative radiographs changed management 0.57% of the time [5]. In total hip (THA) and knee (TKA) arthroplasty patients have also been well-studied [9–15]. Ververeli et al found that review of routine postoperative radiographs did not affect treatment course in 124 total knee arthroplasties and 98 total hip arthroplasties [10]. Niskanen showed that early, repetitive routine radiographs had no effect on treatment course in 200 cemented TKA and THA [13]. Ghattas et al evaluated the utility of the first postoperative xray in 171 patients treated with open reduction and internal fixation (ORIF) for fractures [14]. In their study, abnormal xrays did not change treatment course in any patients, whereas an abnormal H/P lead to a change in patient management in 3 (1.5%) patients. Stone et al. found no statistical difference in radiographic measures in 268 patients at 2- or 6-weeks follow-up. They only found 3 (1%) of their patients had an unexpected change in their treatment. [16] Similar data have been reported for the utility of post-operative radiographs in ankle fracture fixation [17] and radial shaft fractures [18]. To date, no study has evaluated the postoperative utility of both H/P and hip radiographs in the

treatment course of patients treated with hip hemiarthroplasty for low energy femoral neck fractures.

Our observations are consistent with the belief that patients will present to the ED, and not the clinic, when they experience symptoms secondary to a significant complication requiring a change in treatment course, such as a return to the operating room. The level of agreement between the effect of abnormal H/P and hip radiographs on treatment course in both the ED and clinic as measured by the Kappa coefficient was moderate and fair, respectively. The relatively low level of agreement despite the high sample volume is secondary to our finding that a significant number of patients with abnormal H/Ps experience a change in treatment course despite having normal hip radiographs.

The analysis of the effect of abnormal H/P and hip radiographs on treatment course as a function of time shows that abnormal hip radiographs in the setting of an abnormal H/P rarely contribute to a change in treatment course during clinic visits within 6 months from surgery. In only one case (0.3% of abnormal radiographs or 0.08% of 1177 clinic visits) did an abnormal hip radiograph change treatment course in the setting of an abnormal H/P within 6 months from surgery. As expected, the effect of abnormal radiographs on treatment course increased as a function of time. We therefore conclude that routine hip radiographs taken during the first 6 months from surgery provide limited clinical utility and thereby serve as a source of excess cost and radiation exposure to the patient.

Potential radiographic complications of hip hemiarthroplasty include periprosthetic fractures, femoral component radiolucency, hip dislocation, HO, acetabular arthritis, and protrusion of the prosthesis. All of these complications were observed in either the ED or clinic. In the clinic, the majority of postoperative complications identified by abnormal hip radiographs were slow, progressive ‘chronic’ pathologies, including HO, acetabular arthritis, and femoral prosthesis radiolucency. Vancouver A1 periprosthetic fractures were the only ‘acute’ complications identified by clinic radiographs. All Vancouver A1 fractures were treated conservatively and without precautions. No cases identified in clinic required a return to the operating room for either ORIF or conversion to THA with ORIF, suggesting that this treatment method is appropriate. Although 5 Vancouver A1 periprosthetic fractures, representing 1.6% of abnormal radiographs or 0.4% of clinic visits, were identified by radiographs within 6 months of surgery, none of these patients underwent a change in treatment course based on this radiographic finding. This data supports our conclusion that complications identified in clinic rarely lead to a change in treatment course with 6 months from surgery and should therefore not drive the routine use of hip radiographs within this time period. In the ED, by contrast, the majority of postoperative complications identified by abnormal hip radiographs were ‘acute’ pathologies, including hip dislocations and periprosthetic fractures. The majority of these diagnoses required a change in treatment course – that is, a return to the OR – with the exception of stable pelvic ring fractures and Vancouver A1 periprosthetic fractures.

This study had several limitations. Given the retrospective design, the determination of an abnormal H/P was inferred in the majority of cases based upon the available information in each clinic note. Retrospective chart reviews have several inherent limitations such as potential misclassification bias or abstractor bias. [19] Additionally, a formal cost-effectiveness analysis was not performed given limited data availability and multi-hospital nature of the patient population. There was also no control group in our study design, which would strengthen conclusion and

increase internal validity. Finally, follow-up data was not available for 5 years from time of surgery.

Conclusions

We conclude that abnormal radiographs do not change treatment course in the presence of a normal H/P. Hip radiographs obtained in clinic within 6 months of surgery rarely lead to a change in treatment course regardless of H/P and thereby are a source of excess cost and radiation exposure to the patient. The majority of chronic postoperative complications are diagnosed in clinic, whereas acute complications present to the ED. Future research should be directed towards a prospective, cost-effectiveness analysis of the postoperative utility of hip radiographs in hip hemiarthroplasty patients.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:<https://doi.org/10.1016/j.injury.2019.07.005>.

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