

Dynamic Stress Fluoroscopy (DSF) for Evaluation of the Femoral Neck After Intramedullary Nails: Faster, Cheaper, and Equally Effective as Intraoperative AP Pelvis Radiograph

David M. Joyce, MD; Jason M. Evans, MD; Hassan R. Mir, MD, MBA;
Vanderbilt University, Nashville, Tennessee, USA

Background/Purpose: Femoral neck fractures are often encountered in high-energy injuries to the ipsilateral femoral shaft. Several protocols have been proposed in the literature to prevent a patient from leaving the operating room (OR) with a missed femoral neck fracture, with the most recent being a combination of preoperative radiographs and CT scan, and intraoperative static fluoroscopy (SF) and an AP pelvis radiograph prior to waking the patient. No prior study has looked at intraoperative dynamic stress fluoroscopy (DSF) to identify ipsilateral femoral neck fractures after intramedullary nailing (IMN). We sought to compare a protocol utilizing intraoperative DSF as an alternative to AP pelvis radiographs to identify femoral neck fractures associated with ipsilateral femoral shaft fractures.

Methods: Following IRB approval, all adult femoral shaft fractures treated at our institution from 2011-2013 were retrospectively collected (N = 737). Exclusion criteria were pathologic fractures, nonunion cases, malunion cases, flexible nails, and plates, leaving 671 acute adult femoral shaft fractures treated with IMN. All patients underwent identical preoperative workup including femur and pelvic radiographs and pelvic CT scans. Patients were divided into 2 groups based on intraoperative testing determined by attending surgeon preference: (1) Group 1 (N = 159) underwent DSF examination at the conclusion of the IMN (2 attending surgeons); (2) Group 2 (N = 512) had an intraoperative AP pelvis radiograph at the conclusion of the IMN (4 attending surgeons). The electronic medical record was used to identify femoral neck fractures found prior to OR, in the OR, and after leaving the OR (missed). Imaging was reviewed to verify the operative reports. Performance statistics for diagnostic tests were utilized.

Results: There were 33 femoral neck fractures ($33/671 = 4.9\%$), with 20 of those identified prior to OR. In Group 1 (DSF), 9 fractures were identified prior to OR, 1 was identified in the OR (with DSF), and 1 was missed. In Group 2 (AP), 11 fractures were identified prior to OR, 9 in the OR (6 with SF, 3 with AP pelvis radiograph), and 2 were missed. Utilizing the protocol for Group 1 (DSF), the following performance measures were obtained: sensitivity = 90.9%, specificity = 100%, positive predictive value (PPV) = 100%, and negative predictive value (NPV) = 99.3%. Utilizing the protocol for Group 2 (AP), the following performance measures were obtained: sensitivity = 90.9%, specificity = 100%, PPV = 100%, and NPV = 99.6%. There was no statistical difference when comparing the 2 protocols ($P = 1.000$).

Conclusion: A protocol using DSF was found to be equally clinically effective to one using intraoperative AP pelvic radiographs in detecting femoral neck fractures associated with ipsilateral femoral shaft fractures treated with IMN. Obtaining an intraoperative AP pelvis radiograph can be time-consuming and costly when considering the film itself (~\$100) and the additional OR time required (~\$62/minute). Surgeons may proceed with confidence utilizing a protocol with dynamic stress fluoroscopy (DSF) as it saves time and money with no detriment to patient care in comparison to a protocol with intraoperative AP pelvis radiographs.

- The FDA has not cleared this drug and/or medical device for the use described in this presentation (i.e., the drug or medical device is being discussed for an "off label" use). For full information, refer to page 600.