

Post-operative Radiographs for Degenerative Lumbar Spinal Fusions?

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Abstract

A retrospective review of 70 consecutive lumbar degenerative surgical cases in which intraoperative fluoroscopic imaging was compared with immediate postoperative radiographs using a novel vertebral grid-coordinate system. Same-hospitalization postoperative standing lumbar AP and lateral radiographs do not appear to be cost-effective or to provide additional clinically relevant information when intraoperative fluoroscopy is utilized.

Keywords: Lumbar; Spinal fusion; Postoperative radiograph; Instrumentation

Key Points

is more consistent accuracy and a potential for significant cost savings with the use of intraoperative fluoroscopic imaging as the baseline study for instrumented single-level lumbar degenerative fusion procedures.

The routine use of in-house postoperative radiographs does not appear to be of significant additional clinical benefit in patients who have an uncomplicated postoperative course.

Introduction

Many surgeons consider routine in-hospital postoperative imaging to be a care standard for spinal fusion patients. One study to-date has questioned the accuracy of postoperative spinal radiographs. Farber et al. [1] suggested that plain radiographs alone may not accurately reveal true pedicle screw placement. In this study, computed tomography showed 10 times as many screws violating the medial cortex as did the postoperative radiographs. The authors recommended thin-section computed tomographic scans to evaluate postoperative neurologic deficits in patients undergoing instrumented lumbar spine fusion with pedicle screws [1].

The utility and value of repetitive postoperative radiographs in uncomplicated patients has been evaluated in the orthopaedic total joint literature. Two separate studies have each found no need for early repetitive radiographs provided that the immediate postoperative total joint radiographs were of good quality [2,3]. In addition, the radiologist's reading of the total joint radiograph was demonstrated to provide no clinical benefit.

The additional clinical value of in-house postoperative radiographs in uncomplicated single-level instrumented lumbar fusion patients following the use of intraoperative imaging has never been demonstrated. Only one study currently exists in the spine surgery literature evaluating the routine use of radiographs during the first year after lumbar fusion [4]. This study also suggests that routine spinal radiographs are of little clinical value in asymptomatic patients during the first year after uncomplicated spinal fusion. The authors of this study do, however, recommend routine postoperative radiographs in the recovery room after surgery to document implant position [4].

Proper documentation of initial implant position and spinal segmental alignment is imperative after single-level spinal fusion. It is common protocol in many hospitals for spinal surgeons to obtain in-hospital postoperative radiographs. Immediate postoperative radiographs may provide valuable and clinically relevant information for those patients who experience a complicated postoperative course, or for those patients who have traumatic spinal injuries or deformity.

However, the clinical value of the routine use of immediate postoperative radiographs after instrumented single-level degenerative lumbar fusion surgery in uncomplicated patients remains unknown.

The purpose of this study is to evaluate the additional clinical yield and cost-effectiveness of in-hospital postoperative standing radiographs for patients undergoing instrumented single-level lumbar degenerative fusions in which intraoperative fluoroscopy is utilized. Are postoperative standing lumbar radiographs necessary prior to hospital discharge in patients who have an uneventful postoperative course?

Materials and Methods

We performed a retrospective review of 70 consecutive adult patients during a two-year period. Each had a degenerative lumbar spinal diagnosis and an instrumented single-level fusion performed by the same fellowship-trained, attending spine surgeon using intraoperative fluoroscopy. Single-level surgical procedures consisted of instrumented posterior spinal fusion (PSF) (47), and instrumented posterior lumbar interbody fusion (PLIF) using pedicle screws and a single cage (23). Forty-nine patients had surgery for spondylolisthesis.

Medical record reviews were performed to reveal the 70 consecutive patients who had a documented uneventful postoperative hospitalization without complication and without evidence of a new postoperative neurologic finding. Each of the 70 patients had digital imaging files consisting of both intraoperative anteroposterior (AP) and lateral fluoroscopic images and same-hospitalization standing AP and lateral radiographic images that were performed within 72 hours postoperatively. Intraoperative and postoperative images were evaluated by two independent orthopaedic surgeons using a novel vertebral grid coordinate-mapping system to locate screw position and to control for magnification differences between images (Figures 1a and 1b).

Study parameters included implant position on true AP and lateral images, segmental sagittal plane alignment, interbody graft position, spondylolisthesis grade, and hospital charges for patient imaging and interpretation. A review of each patient's electronic medical record was performed up to one year after the surgical procedure (Figure 2a-d).

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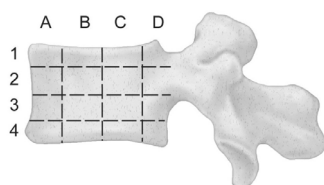


Figure 1a: Lateral - Vertebral Grid Coordinate-mapping System used to locate screw tip position.

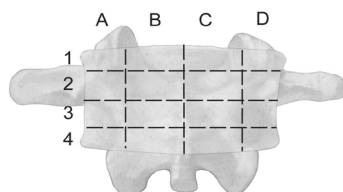


Figure 1b: AP - Vertebral Grid Coordinate-mapping System used to locate screw tip position.

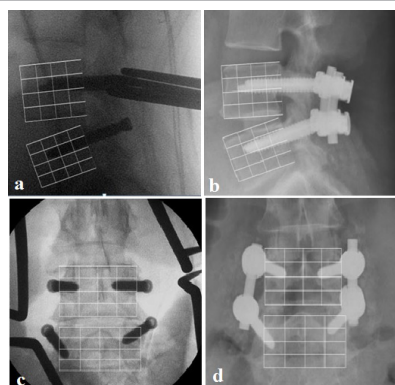


Figure 2: Lateral (a, b) and AP (c, d) images in 2 patients demonstrating a fluoroscopic and postoperative radiograph grid-coordinate match.

Results

In a direct comparison between the intraoperative AP and lateral fluoroscopic images and the in-hospital postoperative standing AP and lateral radiographs using the novel grid coordinate system, early instrumentation failure and/or screw position change was not observed by either independent evaluator in any of the 70 patients (0%). Seventy-four patients (74%) demonstrated grid-coordinate match for all screw positions on both the fluoroscopic images and the true AP and lateral radiographs.

Malrotation precluding comparison with the fluoroscopic image was next most frequently observed with the in-house AP postoperative radiographs of the lumbar spine for degenerative pathologies 9/70 (12.9%). Segmental sagittal alignment for the operative segment on each image was measured using digital Cobb measurement technology. Segmental sagittal alignment difference between intraoperative fluoroscopic and postoperative radiographic sagittal images for all 70 cases averaged only 1.2° (range 0–9°). This difference was not statistically significant (paired student *t*-test, $p > 0.05$).

There was no significant difference noted by either observer between intraoperative and immediate postoperative interbody graft position. Additionally, no difference was demonstrated in spondylolisthesis grade between the intraoperative fluoroscopic image and postoperative images in any of the 49 patients who had preoperative degenerative or isthmic spondylolisthesis.

Patient hospital billing charges for postoperative AP and lateral postoperative in-house radiographic imaging with interpretation averaged \$600. Additionally, electronic medical record review revealed that none of the 70 consecutive patients in the study underwent revision surgery at the instrumented level during the first year after the index procedure.

Discussion

While the literature is replete with articles defining the outcomes of degenerative lumbar spinal fusions, little exists to support the clinical value of the routine postoperative radiographs that are typically obtained after lumbar surgery [5,6]. Many spinal surgeons consider routine standing AP and lateral in-house radiographs to be an absolute care standard after instrumented lumbar fusion surgery.

The authors of this study are of the opinion that routine standing spinal radiographs may be of significant clinical benefit in fusion cases that are performed for fracture, instability, or neoplasm diagnoses as these diagnoses have a greater propensity for postoperative instability. However, the routine use of these radiographs after single-level degenerative lumbar fusions remains a subject for considerable debate at this time.

The results of our study demonstrate that intraoperative fluoroscopic imaging provides an accurate initial baseline study for the documentation of implant position, segmental sagittal alignment, interbody graft position, and spondylolisthesis grade after single-level instrumentation for degenerative lumbar pathologies. Discrepancies in these parameters were not demonstrated by either observer in any of the study patients. Additional clinically relevant information was not identified on the in-hospital postoperative radiographs in any of the 70 study patients who each had an uncomplicated postoperative hospitalization and with no documented intervention based on the results of the in-house radiographs.

Our study also demonstrated poor quality imaging in a large number of the in-hospital postoperative lumbar radiographs. Many study patients had in-hospital postoperative radiographs with malrotation of at least one of the images that precluded the observer's ability to compare the image to a true lateral or AP intraoperative fluoroscopic image. Poor-quality immediate postoperative imaging has been previously described in the orthopaedic total joint literature. Glaser and Lotke questioned the value of postoperative radiographs after uncomplicated, primary total knee arthroplasty [2]. Among 192 patients, the radiographs did not alter the postoperative management in any case. In examining overall quality of the radiographs, only 36% were of sufficient quality to provide an accurate baseline for further studies. Additionally, there were no instances in which radiographs taken before discharge were needed to aid in further management or legal defense. The authors concluded that the practice of obtaining routine, immediate postoperative knee radiographs in the absence of a specific clinical indication does not provide any additional clinical information and does not appear to benefit patient care.

A review of the literature reveals only one study investigating the need for radiographs in the immediate postoperative period after lumbar spinal fusion. Romero et al. performed a retrospective chart review of 670 clinic notes from 202 patients who underwent posterior instrumented lumbar spinal fusions over a 9-year period by a single surgeon [4]. The study's objective was to investigate the utility of routine radiographs in the first year after lumbar fusion to determine if they affect decision-making. Each patient's history and physical examination and the surgeon's interpretation of radiographs were graded as normal

or abnormal for all postoperative visits in the first year after surgery. Further action taken not felt to be routine was also recorded. No action was taken 100% of the time when history and examination was normal and either a normal radiograph or no radiograph was taken. If the patient history and examination were normal and radiographs were abnormal, further action was taken in only one instance. This occurred in a patient with asymptomatic implant dissociation who elected to undergo revision. In patients with abnormal histories or exams, further action was taken 72% of the time even in the presence of normal radiographs and 89% of the time when they also had abnormal radiographs. The authors concluded that routine radiographs seem to have limited utility in the early postoperative period after instrumented lumbar fusion and may place patients with normal postoperative courses at an increased risk of undergoing unnecessary diagnostic studies. Patients with postoperative complications were more likely to undergo more extensive testing leading to additional treatment being prescribed regardless of the interpretation of the radiographs.

The average patient charge for the standing postoperative AP and lateral in-house imaging with radiologist interpretation was \$600 at our institution. Our data does not demonstrate the cost-effectiveness of in-house spinal radiographs for uncomplicated single-level degenerative fusion cases. Electronic medical records review, to include the one-year follow-up period, revealed that none of the patients in our study had an additional intervention as a result of the radiologist's interpretation of the postoperative radiographs. Similarly, Niskanen reviewed in-hospital and outpatient postoperative radiographs for 200 cemented hip and knee arthroplasties [4]. The aim of this study was to assess the value of routine repetitive radiographic examinations and the value of a reading of the images by a radiologist. The results suggest the following: If post-operative radiographs are of good quality, there seems to be no need for early repetitive radiographs. Neither is a radiologist reading of the radiographs after joint arthroplasty of any benefit.

Our study has several limitations to include a relatively small sample size and the inclusion of only single-level lumbar fusions for degenerative pathology. The utility of postoperative radiographs for multilevel degenerative lumbar fusions and for lumbar fusions for spinal pathologies other than degenerative was not evaluated in our study.

Ultimately, the decision to perform postoperative radiographs should remain under the jurisdiction of the operative surgeon according to clinical judgement.

Our data suggest that the intraoperative fluoroscopic images are more cost-effective and consistent in establishing the baseline study after instrumented single-level lumbar fusion for degenerative spinal pathology. The intraoperative fluoroscopic image provided the more accurate baseline study in a much higher percentage of our patients. We believe that the accuracy of the intraoperative fluoroscopic images can be increased with greater surgeon attention to performing true AP and lateral intraoperative image after completion of the instrumentation.

Conclusion

In this patient population with degenerative lumbar pathology, routine use of postoperative standing AP and lateral radiographs may not be necessary. The use of in-house postoperative lumbar radiographs does not appear to be of significant additional clinical benefit in patients who have an uncomplicated postoperative course.

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