Intraoperative Visualization with 3D Fluoroscopy for Posterior Pelvic Fixation Reduces Revision Rates and Radiation Exposure

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INTRODUCTION: Achieving optimal screw positioning in posterior pelvic ring (PR) fracture fixation is critical for fracture stability and safety. Formerly, our institution used intraoperative plain-film fluoroscopy followed by postoperative computed tomography (CT) to assess fracture reduction and screw placement. Introduction of the 3D mobile C-arm has improved intraoperative visualization without high radiation doses associated with conventional imaging. This study compared rates of revision surgery pre- and post-3D fluoroscopy (3DF) implementation and assessed radiation dosages of intraoperative 3DF, standard intraoperative plain-film fluoroscopy, and postoperative CT.

METHODS: A retrospective review was conducted on patients treated for posterior PR fractures at a level-1 trauma center between 2014-2022. Utilization of 3DF or plain-film fluoroscopy, and any intraoperative screw changes were documented. Rates and details of revision surgery were recorded. Radiation doses for 3DF, conventional plain-film fluoroscopy, and postoperative CT were extracted from radiology reports.

RESULTS: Among 250 patients (mean age 35.9, 52% male) undergoing fixation for posterior PR fractures, 92 (36.8%) had 3DF intraoperatively, while 158 (63.2%) had plain-film fluoroscopy. 27 patients (8 3DF, 19 plain-film, $p=0.413$) had screws changed intraoperatively, primarily to modify screw path (59.3%), to achieve better purchase/reduction (18.5%), and to modify screw size (11.1%). Mean follow-up was 192 days. Overall, 12.4% of patients required revision surgery, predominantly for removal of symptomatic implants (10.8%). There was a significantly higher rate of revision in the plain-film group compared to the 3DF group (6.5% vs 5.4%, $p=0.002$). Furthermore, mean radiation dose for the 3DF group was significantly lower than that for patients who had both conventional fluoroscopy and postoperative CT (176.3mGy vs 522.0mGy, $p<0.001$).

DISCUSSION AND CONCLUSION: Utilization of the 3D C-arm intraoperatively significantly lowered revision rates and radiation exposure compared to traditional fluoroscopy. Improved visualization with 3DF may have contributed to fewer revisions due to timely intraoperative screw changes, which may have been missed by fluoroscopy alone. These findings highlight the potential of 3DF to improve surgical precision and minimize radiation exposure.