

The Effect of Metallic Hardware on Patient and Surgical Team Scatter Radiation Exposure Utilizing Mini-C Arm in a Simulated Forearm Fracture Fixation Model

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INTRODUCTION:

The Mini-C arm is commonly used orthopaedic surgery and is generally perceived as safe. To our knowledge no studies have compared the effect of absence or presence of orthopaedic hardware in the fluoroscopy field with respect to changes in the intensity and direction of scatter radiation exposure. The goal of this study was to determine if the presence of hardware increases scatter exposure to the patient and surgical team.

METHODS: Four trials were conducted using a lamb limb specimen and a standard Mini-C arm to simulate a forearm/wrist fracture fixation scenario. Trials 1 and 2 tested scatter with no hardware on the field. Trials 3 and 4 tested scatter radiation with a 3.5 mm LCDCP plate attached to the specimen with cortical screws and a self-retaining retractor. Keithley electrometer was used to measure scatter radiation directed at the eyes, thyroid, chest, hands (surgeon only), and gonads of the patient and surgical staff. Comparisons were made using scatter percentage (scatter/direct beam x 100).

RESULTS:

The surgeon and first assistant were the only team members exposed to measurable scatter radiation. The presence of orthopaedic hardware in the fluoroscopy field produced a substantial 181-fold increase in scatter radiation to first assistant's eyes (0.016% vs. 2.893%), 66-fold increase to the surgeon's right hand (0.025%/min vs. 1.653%/min), and 9-fold increase to the left hand (0.182%/min vs. 1.653%/min) in the horizontal Mini-C arm position trials.

DISCUSSION AND CONCLUSION:

Hardware in the fluoroscopy field increases radiation scatter exposure to a degree that may place the first assistant's yearly eye exposure in excess of the current International Commission on Radiological Protection (ICRP) limit. The presence of orthopaedic hardware in the operative field during the use of mini c-arm fluoroscopy increases occupational radiation exposure to the surgical team to an unsafe level. Surgeons and their assistants should wear lead aprons, thyroid shields, and leaded glasses when in close proximity to the operative field.