ΔAssessing the Oncogenic Risk to Patients From Fluoroscopy During Trauma Surgery

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Purpose: Recent increased concern about radiation exposure during surgery has focused primarily on exposure to the surgeon. However, the patient is more directly exposed to radiation and, in surgery about the pelvis and hip, cannot be shielded. The purpose of this study was to prospectively evaluate patients' exposure to radiation during fracture surgery of the acetabulum, pelvic ring, and femur for calculation of future cancer incidence (CI) based on previously validated models.

Methods: After IRB approval, 63 patients with acetabulum, pelvic ring, and femur fractures were prospectively identified for inclusion through routine trauma workup at a Level I trauma center. Patients were treated by a fellowship-trained orthopaedic trauma surgeon through standard of care treatment as dictated by their injuries. After obtaining informed consent, dosimeters were placed on the patient in locations determined for each surgery by a certified radiation health physicist. The age, sex, injury pattern, weight, height, surgeon, operation performed, operative time, total fluoroscopy time, fixation construct, and average emission energy of the x-ray tube were recorded for each patient. Study dosimeters were processed with a control dosimeter to account for radiation exposure during travel and storage. Total effective dose equivalent (TEDE), or whole body dose, and specific organ doses were determined using custom mapping through commercially available software. Lifetime CI calculations were based on validated BEIR VII models for a 30-year-old patient (National Research Council, 2006).

Results: 41% of patients were female and the average body mass index was 27.2 ± 6.6 kg/m^2. 18 patients were treated for acetabular fractures, 30 for femoral shaft or intertrochanteric femur fractures, and 15 for pelvic ring injuries. Patients with acetabular injuries received the highest TEDE at 1.970 ± 0.147 mGy and 1.650 ± 0.062 mGy for women and men, respectively. The lifetime CI, for any cancer type, associated with these doses is 0.021% for females and 0.011% for males. The greatest mean single-organ dose to the ovaries (8.100 ± 0.617 mGy) occurred during acetabular fracture surgery and correlated to an increased ovarian cancer risk of 0.003%. The greatest mean single-organ dose to the prostate (8.48 ± 5.180 mGy) occurred during pelvis fracture surgery and was correlated to an increased prostate cancer risk of 0.003%.

Conclusion: While fracture surgeries around the pelvis and femur are some of the most fluoroscopic-dependent orthopaedic procedures performed, the radiation exposure incurred presents a relatively small increased risk to the average patient of future cancer development.

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See pages 99 - 147 for financial disclosure information.

	Female		Male	
	TEDE*	Ovarian Dose*	TEDE*	Prostate Dose*
Acetabulum	1.970 ± 0.147	8.100 ± 0.617	1.650 ± 0.062	7.750 ± 0.261
Femur	0.193 ± 0.117	0.088 ± 0.070	0.282 ± 0.185	0.582 ± 0.518
Pelvic ring	0.563 ± 0.324	2.730 ± 1.570	1.120 ± 0.717	8.480 ± 5.180
	Overall CI	Ovarian CI	Overall CI	Prostate CI
Acetabulum	0.021%	0.003%	0.011%	0.003%
Femur	0.002%	<0.001%	0.002%	<0.001%
Pelvic ring	0.006%	0.001%	0.008%	0.003%

*All values in milligray (mGy)

• 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.