

# Westside Regional Medical Center PMSR-RRA

## Intraoperative Radiation Exposure to US Podiatric Medicine and Surgery Residents Annually: How Much Are We Really Getting?

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### INTRODUCTION

The National Council on Radiation Protection (NCRP) and United States Nuclear Regulatory Commission (U.S. NRC) currently recommend a maximum annual allowable shallow dose equivalent (SDE), deep dose equivalent (DDE), and lens of the eye dose equivalent (LDE) exposure of 50,000mrem(500mSv), 5,000mrem (50mSv), and 15,000mrem (150mSv) respectively, in combined occupational and non-occupational exposures (1-3). The impetus stems largely from the known risks of ionizing radiation (posterior sub-capsular cataracts, as well as thyroid, esophageal, and breast cancer) and hinges on the fact that radiation tracking with dosimeters and utilization of PPE (lead lined lenses, thyroid shields, and aprons) has been shown to significantly reduce exposure (4-8). Importantly, because the stochastic effects of radiation are cumulative, not well studied long-term, and relate both to the degree and duration of exposure; PPE provides an effective, simple means to reduce any long-term potential for risk (9). However, the occupational hazards to US podiatric medicine and surgery residents from ionizing radiation remains unknown (10.)

### AIM

The purpose of the present prospective observational study was to quantify and compare the SDE, DDE and LDE exposures for podiatric medicine and surgery residents at a single institution over 12 consecutive months (July 2018 to July 2019). We hypothesized that the annual exposures would be higher for the upper (senior) versus lower (intern) residents.

### METHODS

- Institutional Review Board (IRB) approval and written consents for participation were obtained.
- Inclusion criteria required: lead apron use during fluoroscopy cases, dosimeter compliance >85%, and maintenance of an ongoing surgical log.
- Resident were each issued 2 dosimeters labeled with their full name for simultaneous external and internal wear (Figure 1).

Figure 1: Dosimeters for simultaneous wear under (L) and over (R) lead aprons during fluoroscopy.



- At the end of each month, new dosimeters were distributed and residents completed their monthly logs
- The SDE, DDE and LDE exposures (mrem) were provided on printed summaries from Landauer.
- After 12 consecutive months, the SDE, DDE and LDE exposures were calculated and compared.
- Statistical analyses were performed using STATA software. Descriptive statistics were used to analyze continuous data. All analyses that generated p values were 2-tailed. Significance was set at p <0.05

### RESULTS

Five residents were excluded over the course of the study for dosimeter non-compliance (3), survey non-compliance (1), or pregnancy (1). Of the remaining 4 residents, 2 were PGY-3's and 2 were PGY-1's .

Overall, residents each logged an average of 19 operative cases per month and 222 per year. More than half cases (53%) required intraoperative fluoroscopy, for which mini C-arm was used in most cases.

The monthly SDE, DDE, and LDE exposures averaged 7.3, 9.3, and 7.0 mrem, respectively; while annual SDE, DDE, and LDE averaged 87.3, 112, and 84 mrem, respectively. No significant monthly (P = 1.0, P = 0.70, P= 0.74) or annual (P = 0.67, P = 0.67, P= 0.33) exposure differences were identified (Figures 2-4).

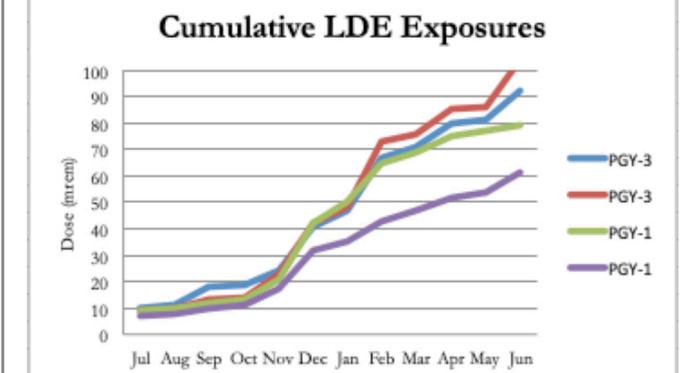
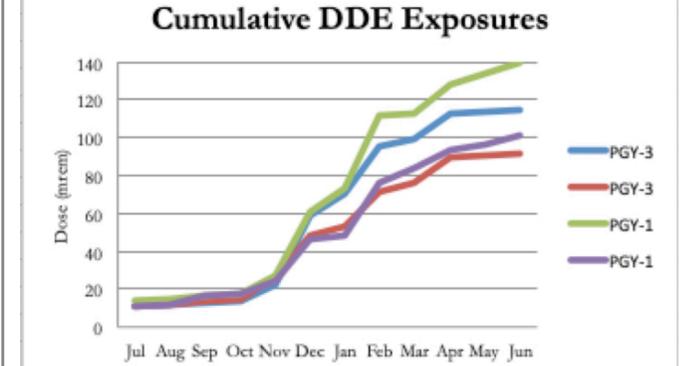
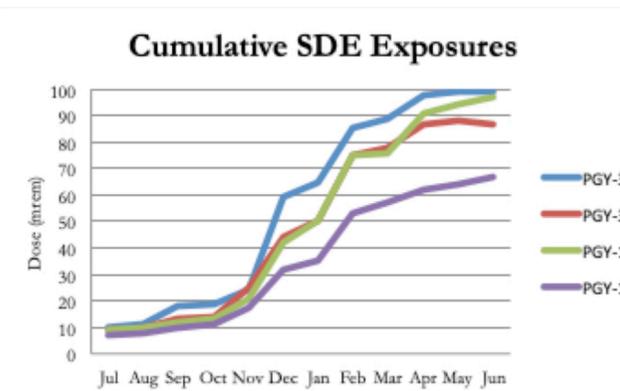
Resident	Total Cases	Total Fluoroscopy Cases	Compliance (%)	Days Off	SDE/DDE/LDE (mrem)
PGY-3	189	118	97%	25	99, 115, 104
PGY-3	180	124	92%	20	87, 92, 92
PGY-1	267	116	85%	0	97, 140, 79
PGY-1	248	83	96%	3	66, 101, 61

	Overall				PGY-1				PGY-3				P-Value*			
	Mean	(SD)	Min, Max	Median	Mean	(SD)	Min, Max	Median	Mean	(SD)	Min, Max	Median				
Monthly DDE	9.3	(9.97)	1.39	6.0	(11.0)	10.0	(10.44)	1.39	6.0	(8.8)	8.6	(9.23)	1.37	56.25	(11.5)	0.70
Monthly LDE	7.0	(7.13)	1.34	5.5	(7.75)	5.8	(5.14)	1.17	3.75	(7.0)	8.2	(8.88)	1.34	6.0	(8.5)	0.74
Monthly SDE	7.3	(7.49)	1.34	5.25	(7.57)	6.8	(6.75)	1.25	4.0	(6.8)	7.8	(8.45)	1.34	5.5	(8.3)	1.0
Annual DDE	112.0	(20.93)	92, 140	108.0	(31.0)	120.5	(27.58)	101, 140	120.5	(39.0)	103.5	(16.26)	92, 115	103.5	(23.0)	0.67
Annual LDE	84.0	(18.42)	61, 104	85.5	(28.0)	70.0	(12.73)	61, 79	70.0	(18.0)	98.0	(8.49)	92, 104	98.0	(12.0)	0.33
Annual SDE	87.3	(15.11)	66, 99	92.0	(21.5)	81.5	(21.92)	66, 97	81.5	(31.0)	93.0	(8.49)	87, 99	93.0	(12.0)	0.67

\*Results from Wilcoxon Sum of Ranks test

Table 3

1. Preferentially use mini versus large c-arm fluoroscopy
2. Reduce the total number of images obtained and time on "live" or "mag"
3. Wear PPE (ie. lead lined lenses, thyroid shields, lead aprons)
4. Increase the distance between radiation source and self (ie. inverse square law)
5. Aim the source tube away from self during imaging
6. Collimate the source tube



### CONCLUSIONS

The annual SDE, DDE and LDE for residents at a single PMSR-RRA was well below the recommended dose limits of 50,000 mrem/year (SDE), 5,000 mrem/year (DDE), and 15,000 mrem/yer (LDE) set by the NRCP.

### BIBLIOGRAPHY

1. References. lum exer adipstrud doloree tuerat lorpera esenibh eu faccum eum iusclli quamcommy nit lorerillut ullam quat lore verostrud ming et, si tie facilisque modolorin volore
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