

BACKGROUND

Occupational radiation exposure amongst interventional pain medicine physicians is an essential topic in the discussion of workplace safety and career longevity. Many opinions from across all medical specialties exist for the varying types of dosimeters to accurately estimate exposure during radiation producing procedures. Some argue that hand dosimeters worn on the finger are superior due to proximity of the hands to the working field and source of radiation. Others note the variability in physician technique affecting the accuracy of hand dosimeters as well as their perceived effect on dexterity and discomfort while performing procedures.

This study's aim was to compare radiation exposure recordings between the commonly worn chest dosimeter and hand dosimeters to elucidate any potential discrepancies that may lead to more impactful safety measures. A secondary aim was to examine any differences in broken glove events or breeches of sterility during procedures.

METHODS

- Ten subjects were randomly divided into two equal numbered cohorts consisting of a control group (n=5) that was assigned to wear the standard chest dosimeter only and an experimental group (n=5) that wore both chest and hand dosimeters. Dosimeter wearing compliance and radiation exposure measurements were collected for each of the subjects' dosimeter(s).
- Comparison between the chest dosimeters of the control and experimental groups was done to assess baseline radiation exposure of the experimental group.
- Due to the differing OSHA safety thresholds for chest and extremity radiation (2500 mrem vs. 37500 mrem), to compare radiation recordings between the chest and hand dosimeters, absolute radiation exposure recordings were interpreted as a percentage of the allowable six-month maximum.

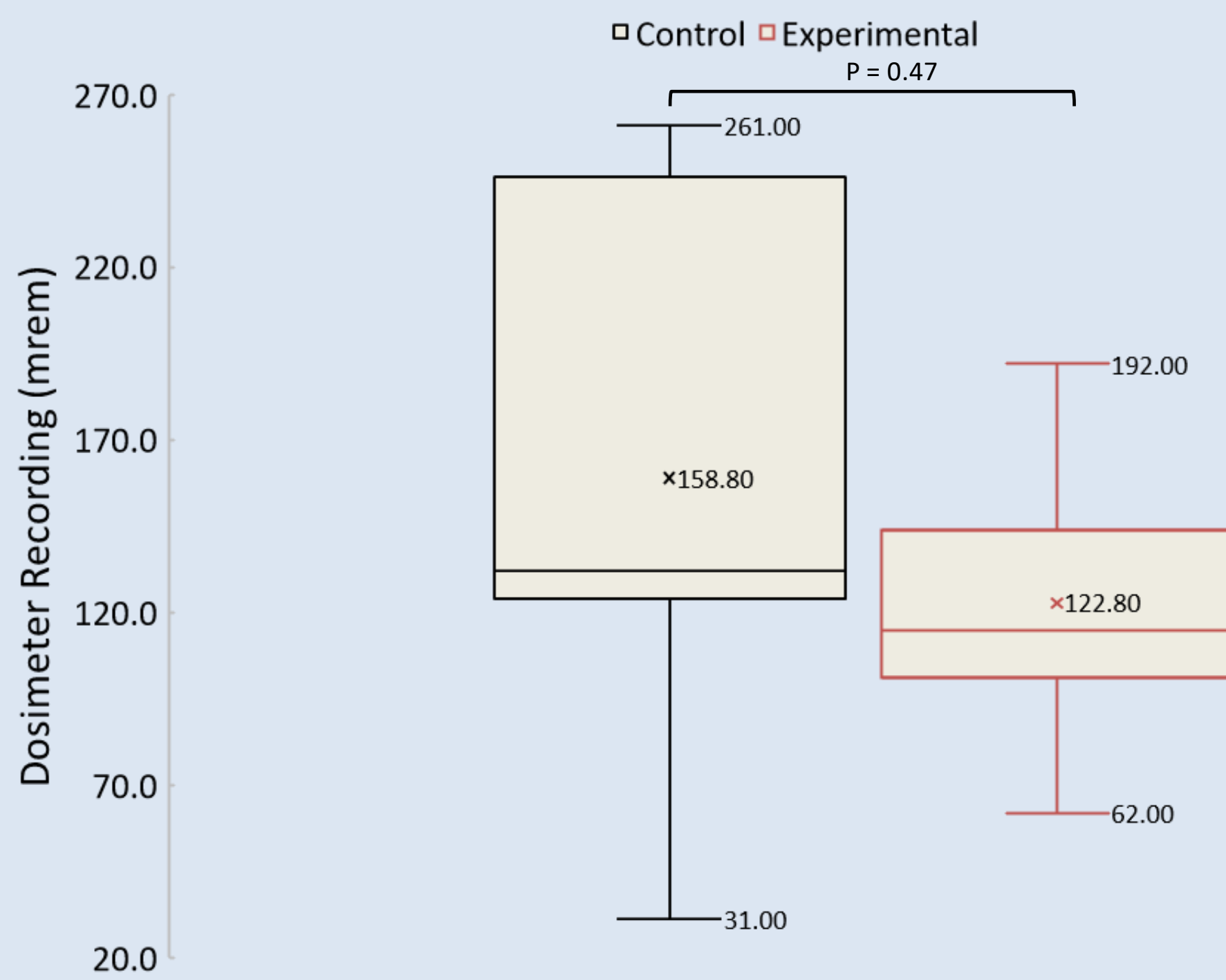
Hand and Chest Dosimeters



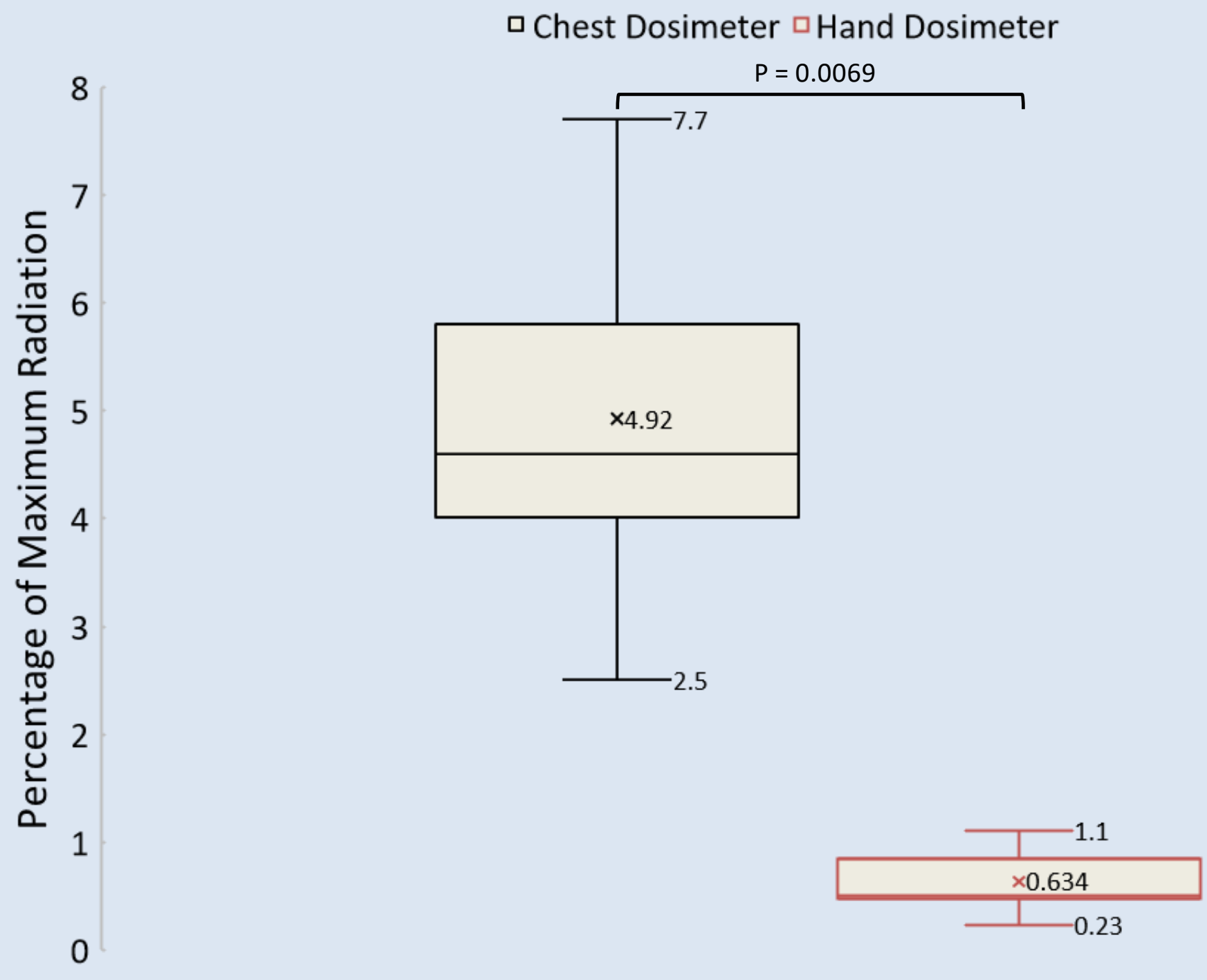
RESULTS

Physician	1	2	3	4	5	6	7	8	9	10
Chest Dosimeter 6mo Exposure (mrem)	62	115	144	101	192	132	261	124	246	31
Hand Dosimeter 6mo Exposure (mrem)	87	192	*407	319	180	-	-	-	-	-
Percent of allowable 6mo Max (Chest)	2.48	4.6	5.76	4.04	7.68	-	-	-	-	-
Percent of allowable 6mo Max (Hand)	0.232	0.512	1.085	0.851	0.48	-	-	-	-	-
Use Compliance of Chest Dosimeter (%)	98	93	98	100	98	93	98	100	96	100
Use Compliance of Hand Dosimeter (%)	90	97	*98	100	95	-	-	-	-	-

Six Month Chest Dosimeter Recording Comparison between Control and Experimental Groups



Percentage Allowable Six Month Maximum Dosimeter Recording within Experimental Group



* Due to discomfort with hand dosimeter, subject required replacement dosimeter partway through study and did not meet use compliance threshold of 90%. Hand dosimeter data was extrapolated to match compliance rate of chest dosimeter in the same subject.

CONCLUSIONS

- There was no significant difference in average six-month radiation exposure per individual between the control and experimental groups detected by chest dosimeters (158.8 mrem vs. 122.8 mrem P = 0.473). This indicates a similar overall exposure within the time period between the two groups.
- The average percentage of six-month maximum radiation exposure was significantly higher on the chest dosimeter compared to the hand dosimeter (4.9% vs. 0.63% P = 0.0069)
- The chest dosimeter recorded nearly nine times the acceptable percentage maximum compared to the hand dosimeter. However, both dosimeter recordings were well within acceptable safe standards.
- Given this data, the chest dosimeters may be the safer, more conservative option for monitoring occupational exposure compared to hand dosimeters.
- This data also indicates that the use of a hand dosimeter alone may underestimate radiation to other parts of the body and physicians must consider their procedural practices when monitoring radiation exposure.
- There were no glove breaks recorded for any subjects in either group. One subject noted discomfort with the hand dosimeter that affected their ability to perform procedures, which emphasizes previously sighted concerns for this method of monitoring.

REFERENCES

- Occupational Safety and Health Administration, (n.d.), Ionizing Radiation Standards, United States Department of Labor, <https://www.osha.gov/ionizing-radiation/standards>
- Provenzano DA, Fiorentino SA, Kilgore JS, De Andres J, Sitzman BT, Brancolini S, Lamer TJ, Buvaendran A, Carrino JA, Deer TR, Narouze S. Radiation safety and knowledge: an international survey of 708 interventional pain physicians. Reg Anesth Pain Med. 2021 Jun;46(6):469-476. doi: 10.1136/rapm-2020-102002. Epub 2021 Mar 9. PMID: 33688038.
- Yamashita K, Ikuma H, Tokashiki T, Maehara T, Nagamachi A, Takata Y, Sakai T, Higashino K, Sairoy K. Radiation Exposure to the Hand of a Spinal Interventionalist during Fluoroscopically Guided Procedures. Asian Spine J. 2017 Feb;11(1):75-81. doi: 10.4184/asj.2017.11.1.75. Epub 2017 Feb 17. PMID: 28243373; PMCID: PMC5326736.
- Whitby M, Martin CJ. A study of the distribution of dose across the hands of interventional radiologists and cardiologists. Br J Radiol. Mar 2005;78(927):219-29. doi:10.1259/bjr/12209589
- Martin CJ. A review of radiology staff doses and dose monitoring requirements. Radiat Prot Dosimetry. 2009 Sep;136(3):140-57. doi: 10.1093/rpd/ncp168. Epub 2009 Sep 16. PMID: 19759087.
- van Rappard JRM, de Jong T, Hummel WA, Ritt MJPF, Mouës CM. Radiation Exposure to Surgeon and Assistant During Flat Panel Mini C-Arm Fluoroscopy in Hand and Wrist Surgical Procedures. J Hand Surg Am. 2019 Jan;44(1):68.e1-68.e5. doi: 10.1016/j.jhsa.2018.05.010. Epub 2018 Jun 20. PMID: 29934087.