



3-26-2015

# Radiation Exposure to the Eye with Mini C-arm Use During Hand Surgery

Mark L. Wang, MD, PhD

*Rothman Institute at Thomas Jefferson University, [Mark.Wang@jefferson.edu](mailto:Mark.Wang@jefferson.edu)*

C. Edward Hoffer, MD, PhD

*Rothman Institute at Thomas Jefferson University*

Frederick E. Liss, MD

*Rothman Institute at Thomas Jefferson University*

Asif Ilyas, MD

*Rothman Institute at Thomas Jefferson University, [asif.ilyas@rothmaninstitute.com](mailto:asif.ilyas@rothmaninstitute.com)*

Charles Leinberry, MD

*Rothman Institute at Thomas Jefferson University, [Charles.Leinberry@rothmaninstitute.com](mailto:Charles.Leinberry@rothmaninstitute.com)*

*See next page for additional authors*

## [Let us know how access to this document benefits you](#)

Follow this and additional works at: <http://jdc.jefferson.edu/rothinsposters>

 Part of the [Orthopedics Commons](#)

### Recommended Citation

Wang, MD, PhD, Mark L.; Hoffer, MD, PhD, C. Edward; Liss, MD, Frederick E.; Ilyas, MD, Asif; Leinberry, MD, Charles; and Beredjiklian, MD, Pedro, "Radiation Exposure to the Eye with Mini C-arm Use During Hand Surgery" (2015). *Rothman Institute Conference Posters*. Paper 16.  
<http://jdc.jefferson.edu/rothinsposters/16>

This Article is brought to you for free and open access by the Jefferson Digital Commons. The Jefferson Digital Commons is a service of Thomas Jefferson University's [Center for Teaching and Learning \(CTL\)](#). The Commons is a showcase for Jefferson books and journals, peer-reviewed scholarly publications, unique historical collections from the University archives, and teaching tools. The Jefferson Digital Commons allows researchers and interested readers anywhere in the world to learn about and keep up to date with Jefferson scholarship. This article has been accepted for inclusion in Rothman Institute Conference Posters by an authorized administrator of the Jefferson Digital Commons. For more information, please contact: [JeffersonDigitalCommons@jefferson.edu](mailto:JeffersonDigitalCommons@jefferson.edu).

---

**Authors**

Mark L. Wang, MD, PhD; C. Edward Hoffer, MD, PhD; Frederick E. Liss, MD; Asif Ilyas, MD; Charles  
Leinberry, MD; and Pedro Beredjiklian, MD

# Radiation Exposure to the Eye with Mini C-arm Use During Hand Surgery

Mark L. Wang, MD. PhD, C. Edward Hoffler, MD, PhD, Frederick E. Liss, MD, Asif Ilyas, MD, Charles Leinberry, MD., and Pedro Beredjiklian, MD

Investigation performed at the Rothman Institute at Thomas Jefferson University, Philadelphia, PA.

## INTRODUCTION

Fluoroscopic radiation exposure is a potential occupational health risk to the Hand Surgeon, given operator proximity and the relative lack of eye shielding. The association of eye radiation exposure and the early development of cataracts have been previously reported. Mini C-arm fluoroscopy is commonly utilized during routine Hand Surgery. At present, the amount of radiation exposure to the eye, associated with the routine use of mini C-arm fluoroscopy, is unknown, thus warranting further investigation. The purpose of this study is to test the hypothesis that eye radiation exposure, sustained during routine mini C-arm use, does not exceed that of previously reported critical radiation dosages to the eye.



## MATERIALS AND METHODS

Over a four month period, eye radiation exposure was measured in four board-certified Hand Surgeons utilizing mini C-arm fluoroscopy (OrthoScan, Scottsdale, AZ) during routine surgical procedures. Eye dosimeters were secured to surgical loupes at the level of the orbit. Accumulated radiation dosage was analyzed and compared to control badges on a monthly basis, and background exposure was eliminated (Landauer, Glenwood, Illinois). For each procedure, mini C-arm radiation output was logged, including the dose rate, total accumulated dosage, and total exposure time.

## TABLE 1

Procedure	Number of procedures	Average Number of Images Taken	Average Time (sec)	Accumulated Dosage (mGy)
ORIF Distal Radius Fracture, 3-part, Intra-articular	14	26.8	93.6	51.7
ORIF Metacarpal/Phalangeal Fracture	9	24.8	52.3	22.5
Basilar Thumb Arthritis Surgery	7	24.4	79.6	17.1
Removal of Hardware	5	19.2	118.0	58.8
ORIF Elbow Fracture	2	28.0	105.5	39.9
ORIF Scaphoid Fracture	2	28.0	74.5	32.7
Tendon Rupture Repair	2	18.0	35.0	15.6
Ligament Rupture Repair	2	6.0	35.0	6.0
ORIF Triquetrial Fracture	1	24.0	66.0	36.3
Open Treatment Scapholunate Instability	1	2.0	53.0	16.3
Excision of Bone Lesion	1	8.0	199.0	3.5

TABLE 1. Compilation of most common hand surgery procedures and their associated accumulated dosage in mGy.

## RESULTS

Average monthly eye dosimetry values included the following: dose rate was  $0.50 \pm 0.03$  mGy/sec, total accumulated dosage was  $32.16 \pm 7.88$  mGy, and total exposure time was  $75.72 \pm 16.36$  sec. Average monthly eye radiation exposure values were less than 30 mrem (previously reported maximum eye dosage is 1,250 mrem per month). A total of 46 procedures were performed over the collection period. The most commonly performed procedures included ORIF distal radius fractures (14), metacarpal and phalangeal surgery (9), and basilar thumb arthritis surgery (7). ORIF of the distal radius fracture was associated with higher average exposure time (93.57 sec) and average accumulated dosage (51.73 mGy).

## DISCUSSION

Cataract is the most prevalent eye disease in the world and is ranked as one of the top eye diseases by the World Health Organization (WHO). The current concept, on the pathogenesis of radiation-induced cataract formation, suggests that oxidative stress, generated by radiation exposure, results in the accumulation of reactive oxygen species, contributing to DNA damage to the lens epithelium. This cumulative DNA damage to the eye can result in the cataractous lens.

## DISCUSSION CONT.

Radiation exposure is a well-recognized occupational risk to the orthopedic hand surgeon. Previous studies have investigated the increased risk of radiation exposure to orthopedic surgeons, given the proximity to the radiation source and the relative lack of shielding to critical body parts.

These studies have generally focused on large C-arm, with the use of live fluoroscopy, as potential radiation sources. The use of mini C-arm fluoroscopy by the orthopedic hand surgeon, for fracture and arthritis treatment, is rising. The association of early onset cataracts with the increased radiation exposure of the eye lens has been well-documented. At present, the effect of mini C-arm fluoroscopy use on the critical dosage to the eye is relatively unexplored, and warrants further investigation.

Our study suggests that eye radiation exposure, from routine mini C-arm fluoroscopy use, on an average monthly basis, does not approach previously reported critical eye radiation loads associated with cataracts.

## SUMMARY POINTS

- The association of early onset cataracts with increased radiation exposure has been previously reported, and the contribution of routine mini C-arm fluoroscopy use towards the critical eye dosage is unknown.
- ORIF of distal radius fractures was associated with higher average exposure time and accumulated dosage compared to that of other commonly performed procedures.
- Our study suggests that eye radiation exposure, from routine mini C-arm fluoroscopy use, on an average monthly basis, does not approach previously reported critical eye radiation loads associated with cataracts.

## REFERENCES

- Riley SA. Radiation exposure from fluoroscopy during orthopedic surgical procedures. Clin Orthop Relat Res. 1989;(248):257–260.
- Singer G. Radiation Exposure to the Hands From Mini C-Arm Fluoroscopy. J Hand Surg. 2005;30(4):795–797. doi:10.1016/j.jhsa.2005.01.007.
- Smith GL, Briggs TW, Lavy CB, Nordeen H. Ionising radiation: are orthopaedic surgeons at risk? Ann R Coll Surg Engl. 1992;74(5):326–328.