

Radiation in Spine Surgery: should we be concerned?

Selby Spine Meeting
Thursday, February 2, 2017
4:00-4:08 PM

Background: *Two Biological Effects of Ionizing Radiation*

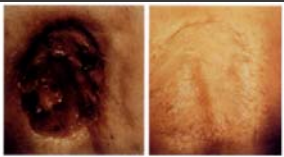
Stochastic Effects

- ⦿ Cancer
- ⦿ Intellectual Disability
- ⦿ Genetic Effects, especially 1st trimester

Deterministic Effects


- ⦿ Sterility
- ⦿ Cataracts
- ⦿ Bone Marrow Suppression
- ⦿ Skin Injury

Figure 2. (A) Photograph of the patient's back 6-8 weeks after multiple coronary angiography and angioplasty procedures. (B) Photograph of the injury approximately 10-21 weeks after the procedures. A small necrotic area is present. (C) Photograph of the injury approximately 18-21 months after the procedures. These necrosis is evident. (d) Close up photograph of the lesion shown in c. (E) Photograph of the patient's back after skin grafting.



Radiation-induced Skin Injuries from Fluoroscopy¹

1. Spine 2005;32:1093-1098




Increased cancer risk among surgeons in an orthopaedic hospital

Giuseppe Mastrangelo¹, Ugo Fedeli¹, Emanuela Fadda¹, Angelo Giovanazzi², Luca Scozzato¹ and Bruno Saia¹

- ⦿ Small orthopedic hospital outside of Bologna, Italy
- ⦿ Infrequent use of lead aprons with fluoroscopy (1976-1999)
- ⦿ 9/31 orthopedic surgeons with cancer
 - ⦿ 3 skin cancer, 2 lung cancer, 1 colon cancer
 - ⦿ Humerus chondrosarcoma & 2 Non-hodgkin lymphoma
 - ⦿ 360 & 685 mSv exposure in the Non Hodgkins lymphoma surgeons
- ⦿ High likelihood that the cancer was radiation induced; probability of causation estimated at 43 & 63%

Occupational Medicine 2005;55:498-500
doi:10.1093/occmed/kqi048




A 5-Year Retrospective Analysis of Exposure to Ionizing Radiation by Neurosurgery Residents in the Modern Era
 Hasan A. Zaidi¹, Andrew Montoure², Peter Nakaji³, Alden Bice⁴, Luis M. Tumlalán⁵

How much radiation do we receive?

- Barrow neurosurgery program in Phoenix studied 34 residents over training
- Endovascular and MIS spine cases
- During training 12.15 ± 13.50 mSv ≈ 6 HCT over 7 years
- Dose was measured on the outside of thyroid shield

WORLD NEUROSURGERY, [HTTP://DX.DOI.ORG/10.1016/J.WNEU.2015.09.059](http://dx.doi.org/10.1016/j.wneu.2015.09.059)




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Table 1. Typical Effective Dose of Radiation to Surgeon or Patient from a Single Exposure

Radiation Source	Effective Dose, mSv (mrem)
MIS TUIF*	0.02
Fluoroscopically guided pedicle screws*	0.1
Chest radiograph	0.1 (10)
Skull radiograph	0.1 (10)
Cervical radiograph	0.2 (20)
Lumbar radiograph	1.5 (150)
CT head	2.0 (200)
Barium enema	7.0 (700)
CT chest	7.0 (700)
CT abdomen/pelvis	10.0 (1,000)
Neurosurgical residency	12.15 (1,215)
Vertebroplasty	16.0 (1,600)
Coronary angiography	20.0 (20,000)

WORLD NEUROSURGERY, [HTTP://DX.DOI.ORG/10.1016/J.WNEU.2015.09.059](http://dx.doi.org/10.1016/j.wneu.2015.09.059)




Occupational Exposure Limits in the United States

Table 2. Recommendations from the National Council on Radiation Protection and Measurements on Radiation Exposure Limits

Suggested Peak Exposure Limit	Effective Dose, mSv (mrem)
Maximal annual	50 (5,000)
Maximal whole body	500 (50,000)
Maximal skin, hands, and feet	500 (50,000)
Maximal eyes	20 (2,000)
Maximal during pregnancy (during entire gestation)	5 (500)


WORLD NEUROSURGERY, [HTTP://DX.DOI.ORG/10.1016/J.WNEU.2015.09.059](http://dx.doi.org/10.1016/j.wneu.2015.09.059)



National Council of Radiation Protection and Management

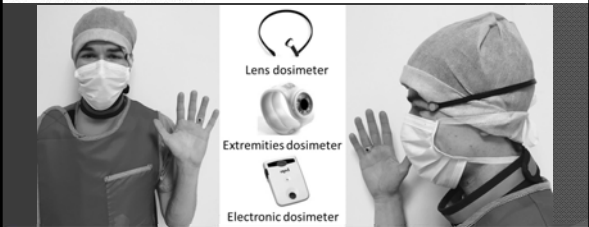
- ◉ National Council of Radiation Protection:
Acceptable Occupational Exposure Limit = 500 mSv annually¹
- ◉ Exposure to 1 mSv of radiation can be expected to increase the baseline risk of cancer by 0.004%²
- ◉ 2700 MIS-TLIFs required per year to exceed OEL³

¹Taher et al. Spine 38: 1386-92, 2013.
²Williams et al. J Nucl Cardiol. 2011.
³Taher et al. Spine 2013




Assessment of the Radiation Exposure of Surgeons and Patients During a Lumbar Microdiscectomy and a Cervical Microdiscectomy: A French Prospective Multicenter Study

Michael Grelat¹, Joël Greffier², Pascal Sabatier³, Cyril Dauzac⁴, Guillaume Lonjon⁵, Bertrand Debono⁶, Julien Le Roy⁷, Pascal Kouyoumdjian⁸, Nicolas Lonjon⁹



N=134	MLD (n=62)	ACDF or TDR (n=72)
Lens of Eye	>28,350/year	>48,293/year
Extremity, Hand	>53,792/year	>69,998/year
Chest	>34,246/year	>163,934/year

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ALARA

As Low As Reasonably Achievable

- ◉ Decrease the amount of fluoroscopy: spot fluoro vs. continuous, >75% less radiation
- ◉ Increase distance from exposure source:
 - 7.7 times less fluoro opposite from source
 - Sponge stick (5-10 cm) is 25% less to hand
 - 3-4 feet is safe but "6 feet" is the commonly given distance

Zaidi et al. World Neurosurgery 2016



Get the Lead Out!!!!

- 0.25 mm thickness blocks 90% of radiation¹
- 0.55 mm thickness blocks 99% of radiation¹
- >400 times less thyroid radiation with collar²
- Regular glasses 20% less¹
- Lead glasses 30-70% less¹
- Ceiling suspended shields and lead walls are shown to be effective in studies as well (6.59 mSv to 0.0017mSV)³

¹Singer. J Am Acad Orthop Surg 2005

²Muller et al. Injury 1998

³Chohan J Neurointerv Surg 2014



Conclusions

- Occupational ionizing radiation exposure represents a real risk to spine surgeons due to its stochastic effects.
- Always use lead aprons and thyroid shields, proper fluoroscopy and surgery techniques.
- With good clinical practice, the increased risk of cancer attributable to fluoroscopy should be <0.01%



Thank You!