

Are Orthopaedic Residents Concerned about Radiation Protection?

Mamer S Rosario,
Venancio P Garduce Jr and
Joseph Keat T Sison

Department of Orthopaedics, East
Avenue Medical Center, Quezon City,
Philippines

Corresponding author: Mamer S Rosario

✉ mamerrosario@yahoo.com.ph

Department of Orthopaedics, East Avenue
Medical Center, Quezon City, Philippines

Tel: +639236863484

Citation: Rosario MS. Are Orthopaedic
Residents Concerned about Radiation
Protection? Arch Can Res. 2015.

Abstract

Background: A study in the United Kingdom (UK) has found that basic surgical trainees were lacking in the essential knowledge of ionizing radiation in orthopaedic trauma. The same scenario could be happening in the Philippines, on top of the observation that in most major tertiary hospitals, orthopaedic residents get much radiation exposure both intra- and extra-operatively as radiographic positioning of patients has been a major responsibility in the residency program.

Methods: One hundred fifty-six (156) orthopaedic residents from all the Metro Manila-based training institutions were asked to answer questions adapted from the pre-set questionnaire used by Khan et al. (Appendix A). in the UK study. Chi-square test was used to compare difference in proportions, and p-values less than or equal to 0.05 were considered statistically significant.

Results: Responses show 84 of 156 residents (54%) has never read any literature on radiation protection, and 141 (90%, p-value<0) do not know the ALARA principle. One hundred fifty-three (153) of 156 residents (98%, p-value<0) are aware of the thyroid shield, but only 56% of them (p-value<0.042) use it. Seventy-four of them (47%) do not consider pregnancy test use important, and 62% of them (p-value<0) do not order one among trauma patients of childbearing age. One hundred and ten of 156 residents (70%) do not know that severity between scattered and direct radiation is dissimilar.

Conclusion: Filipino orthopaedic residents, too, are lacking in the essential knowledge of ionizing radiation. Most of the residents are not adhering to radiation safety principles, and are not practicing safety measures.

Recommendations: Authors recommend that orthopaedic residents should have more robust training and information available in this context. They suggest it should be provided on local, regional, and national basis.

Keywords: Orthopaedic residents, Ionizing radiation, Trauma, Radiation safety

Received: November 15, 2015; **Accepted:** November 30, 2015; **Published:** December 06, 2015

Introduction

A study by Khan et al. [1], assessing the awareness and attitudes of basic surgical trainees from England and Wales regarding ionizing radiation in orthopaedic trauma surgery, showed that they were lacking in the essential knowledge of ionizing radiation in orthopaedic trauma surgery. Most of them had never read the literature about it. Most of the surgical trainees did not wear the thyroid shield, and some of them were even unaware of it. Most of the trainees did not know the difference between scattered

and direct radiation. One-third of trainees did not consider pregnancy test to be mandatory. Even worse, one-fourth of trainees did not even ask for a pregnancy test. Two-fifths of the trainees requested radiological studies without weighing the pros and cons. And majority did not know about the safety principle for radiation.

It can be observed that Filipino orthopaedic residents play a major role in most radiographic procedures in Philippine tertiary level hospitals, either as C-arm operators during surgery or as assists in radiographic positioning of patients. In some, if not in most

major tertiary hospitals in the Philippines, orthopaedic trainees get much radiation exposures during x-ray procedures both intra- and extra-operatively as radiographic positioning of patients up to the act of x-ray shooting has been a major responsibility, if not a primary task, in their orthopaedic residency program. And yet not to mention, the many C-arm- and fluoroscopy-guided surgeries that Filipino orthopaedic residents primarily do or assist in, and thereby get exposed to.

The same scenario could be happening in the Philippine orthopaedic residency program. It must be feared that this lack in the essential knowledge of ionizing radiation can spell a significant occupational danger to Filipino orthopaedic residents.

Materials and Methods

One hundred fifty-six orthopaedic residents from all the 11 Metro Manila-based orthopaedic training institutions (East Avenue Medical Center, Armed Forces of the Philippines Medical Center, Veterans' Memorial Medical Center, University of Santo Tomas Hospital, Philippine General Hospital, De La Salle University Medical Center, Philippine Orthopedic Center, The Medical City, St. Luke's Medical Center, Jose R. Reyes Memorial Medical Center, and Makati Medical Center) were asked to complete a questionnaire (**Appendix B**) adapted from the one formulated by Khan et al. in their UK study. All the questions are evidence-based (1), and covered the following topics: 1) knowledge of the area of the body most exposed to radiation in orthopaedic trauma surgery; 2) hand dominance and its effects on radiation exposure; 3) knowledge of any literature about radiation safety; 4) knowledge of the thyroid shield and its usage; 5) grade of surgeon and risk of radiation exposure; 6) pregnancy test in female patients of childbearing age; 7) gonadal shield in children; 8) multiple radiological studies for critically ill patients and their impact on deciding the number of radiological studies (cumulative radiation dose effect); 9) knowledge of ALARA principle; and 10) monitoring of radiation exposure. Chi-square test was used to compare difference in proportions, and p-values less than or equal to 0.05 were considered statistically significant.

Results

One hundred fifty-six orthopaedic residents were involved in the study. Their responses to the 13 questions are tabulated in **Table 1**. Only questionnaire items 4 (hand dominance significance), 5 (literature reading), and 8 (pregnancy test in trauma patients) yielded response percentage differences that are statistically insignificant (p -value >0.05).

Discussion

There are plenty of studies done on radiation exposure in orthopaedic trauma surgery (1-15), but only 46% of the residents from our study had read any literature about it. Hand exposure to radiation was reported to be a limiting factor in orthopaedic trauma surgery, which differs from previous studies done on cardiologists and radiologists in whom the limiting factor is the dose to the eye lens [2]. Forty percent of the resident participants in our study answered item 1 correctly, and the percentage differences among the responses to item 1 are seen statistically

significant. In a study by Jones et al., orthopaedic surgeons are being advised to use dose reduction gloves especially for high-risk procedures [3].

There is no correlation between a surgeon's hand dominance and hand radiation exposure [4]. In our study, 55% of the residents thought that hand dominance does affect radiation exposure.

A study by Bahari et al., [5] showed significant reduction in radiation exposure with use of the thyroid shield. Muller et al., [6] also showed that the average ionizing dose without the thyroid shield was 70 times higher compared to that from a shielded group. Despite 98% of the residents in our study being aware of the thyroid shield, only 56% use it. Studies have actually recommended thyroid shield use for protection, especially within the 2-meter zone [7,8].

Tasbas et al., observed that the senior surgeon always stands at a safe distance (>90 cm) whenever an assistant surgeon keeps the patient in position for intraoperative imaging. Their study reported significantly higher radiation doses among the assistant surgeons [9]. In our study, 10% of the residents thought that senior surgeons received higher levels of radiation exposure.

Fifteen percent of the resident participants do not know the difference between scattered and direct radiation, and 55% consider scattered radiation to be as harmful as direct radiation. Alonso et al., [7] showed that scattered radiation doses received were consistently low when beyond 2 meters from the radiation source, and high whenever within operating distance. Surgeons are advised to stay as far possible from the x-ray beam to reduce radiation risks [8].

Pregnancy test should be mandatory for all female trauma patients of childbearing age [10,11]. Trauma was reported to affect up to 8% of pregnancies, and is considered a leading cause of mortality among pregnant women in the United States. In our study, only 53% of the respondents thought pregnancy testing among female trauma patients is required. Bochicchio et al., [11] believe a pregnant patient whose pregnancy status is unknown to the trauma team is routinely exposed to doses of radiation exceeding recommendations set by the American College of Obstetrics and Gynecologists. Roughly eleven percent of the 3,976 women of reproductive age included in their study were found to be pregnant, and fetal mortality was found to be significantly higher. Only 38% of the resident participants in our study ask for a pregnancy test in female trauma patients of childbearing age, and the response differences to the question are statistically significant. Mann et al., [12] recommend that trauma surgeons should balance risks and benefits of a certain radiographic procedure on pregnant trauma patients, and know the range and likelihood of its negative effects on pregnancy.

Gul et al., [13] believe that strict adherence to guidelines, especially the use of gonadal shields, is required to decrease radiation exposures among children. Herscovici et al., [8] gave a similar recommendation. Majority of the respondents (85%, p -value <0) in our study believes gonadal shield use among children is a must.

In our study, majority of the respondents (76%) said they

weighed the pros and cons of radiation whenever requesting multiple radiological studies in critically ill patients. The response differences to this item were found to be statistically significant. In an urban level 1 trauma center [14], mean cumulative effective dose of radiation was found to be 30 times higher among trauma patients staying in the surgical intensive care unit, when compared to the average yearly radiation dose.

Both Bahari et al., [5], and Oddy and Aldam [15] emphasized adherence of all orthopaedic surgeons to the ALARA (As Low As Reasonably Achievable) principle. Unfortunately, most (90%, p -value<0) of the residents in our study are unaware of such principle.

Routine monitoring of radiation exposure is essential to prevention of radiation-related disease [5]. Sanders et al., recommend regular extremity dosimetry among orthopaedic surgeons [4], while Herscovici's group advise regular periodic calibration of dosimeters by the orthopaedic trauma staff [8]. In our study, almost all (97%, p -value<0) of the resident participants

thought routine monitoring of radiation is essential.

Conclusion

The results of this study show that Filipino orthopaedic residents are lacking in the essential knowledge of ionizing radiation in orthopaedic trauma surgery. Majority of them had never read any literature about it. Almost half of the residents do not wear the thyroid shield, despite almost all of them being aware of it. More than two-thirds of the orthopaedic residents do not know the difference between scattered and direct radiation. Almost half of the residents do not consider pregnancy test to be mandatory among female trauma patients of childbearing age, and almost two-thirds do not ask for a pregnancy test. One-fourth of the residents request radiological studies without weighing the pros and cons. Majority do not know about the ALARA principle.

Based on the above facts, the authors recommend that all orthopaedic residents should have more information and knowledge about ionizing radiation. Courses should be arranged at the local as well as the regional and national levels. They trust this set of courses can be included in the induction as well as evaluation of all active orthopaedic residents. This shall not only

Table 1 Tabulation of responses by the 156 participants from the 11 Metro Manila-based orthopaedic training institutions.

QUESTIONS	CATEGORIES	COUNT (%)	P-VALUE
Most affected area	Hand	63 (40)	<0.000
	Head	47 (30)	
	Eyes	25 (16)	
	Trunk	20 (13)	
	Foot	1 (1)	
Severity between scattered and direct similar?	Yes	86 (55)	<0.000
	No	46 (29)	
	Don't know	24 (15)	
More exposed: senior or junior?	Senior	16 (10)	<0.000
	Junior	140 (90)	
Hand dominance significant?	Yes	86 (55)	0.070
	No	70 (45)	
Literature reading	Yes	72 (46)	0.174
	No	84 (54)	
Awareness of thyroid shield	Yes	153 (98)	<0.000
	No	3 (2)	
Use of thyroid shield	Yes	87 (56)	0.042
	No	69 (44)	
Pregnancy test in trauma patients	Yes	82 (53)	0.258
	No	74 (47)	
Pregnancy test use	Yes	59 (38)	0.000
	No	97 (62)	
Gonadal sheet use in children	Yes	132 (85)	<0.000
	No	24 (15)	
Pros and cons weighed?	Yes	118 (76)	<0.000
	No	38 (24)	
Awareness of ALARA principle	Yes	15 (10)	<0.000
	No	141 (90)	
Monitoring of radiation exposure	Yes	152 (97)	<0.000
	No	4 (3)	

help in the professional competence of Filipino orthopaedic residents, but shall make them safe doctors as well.

References

- 1 Khan F, Ul-Abadin Z, Rauf S, Javed A (2010) Awareness and attitudes amongst basic surgical trainees regarding radiation in orthopaedic trauma surgery. *Biomed Imaging Interv J* 6: e25.
- 2 Smith GL, Briggs TW, Lavy CB, Nordeen H (1992) Ionising radiation: are orthopaedic surgeons at risk? *Ann R Coll Surg Engl* 74: 326-328.
- 3 Jones DG, Stoddart J (1998) Radiation use in the orthopaedic theatre: a prospective audit. *Aust N Z J Surg* 68: 782-784.
- 4 Sanders R, Koval KJ, DiPasquale T, Schmelling G, Stenzler S, et al. (1993) Exposure of the orthopaedic surgeon to radiation. *J Bone Joint Surg Am* 75: 326-330.
- 5 Bahari S, Morris S, Broe D, Taylor C, Lenehan B, et al. (2006) Radiation exposure of the hands and thyroid gland during percutaneous wiring of wrist and hand procedures. *Acta Orthop Belg* 72: 194-198.
- 6 Müller LP, Suffner J, Mohr W, Degreif J, Rommens PM (1997) [Effectiveness of lead thyroid shield for reducing roentgen ray exposure in trauma surgery interventions of the lower leg]. *Unfallchirurgie* 23: 246-251.
- 7 Alonso JA, Shaw DL, Maxwell A, McGill GP, Hart GC (2001) Scattered radiation during fixation of hip fractures. Is distance alone enough protection? *J Bone Joint Surg Br* 83: 815-818.
- 8 Herscovici D Jr, Sanders RW (2000) The effects, risks, and guidelines for radiation use in orthopaedic surgery. *Clin Orthop Relat Res*: 126-132.
- 9 Tasbas BA, Yagmurlu MF, Bayrakci K, Ucaner A, Heybeli M (2003) Which one is at risk in intraoperative fluoroscopy? Assistant surgeon or orthopaedic surgeon? *Arch Orthop Trauma Surg* 123: 242-244.
- 10 Flik K, Kloen P, Toro JB, Urmey W, Nijhuis JG, et al. (2006) Orthopaedic trauma in the pregnant patient. *J Am Acad Orthop Surg* 14: 175-182.
- 11 Bochicchio GV, Napolitano LM, Haan J, Champion H, Scalea T (2001) Incidental pregnancy in trauma patients. *J Am Coll Surg* 192: 566-569.
- 12 Mann FA, Nathens A, Langer SG, Goldman SM, Blackmore CC (2000) Communicating with the family: the risks of medical radiation to conceptuses in victims of major blunt-force torso trauma. *J Trauma* 48: 354-357.
- 13 Gul A, Zafar M, Maffulli N (2005) Gonadal shields in pelvic radiographs in pediatric patients. *Bull Hosp Jt Dis* 63: 13-14.
- 14 Kim PK, Gracias VH, Maidment AD, O'Shea M, Reilly PM, et al. (2004) Cumulative radiation dose caused by radiologic studies in critically ill trauma patients. *J Trauma* 57: 510-514.
- 15 Oddy MJ, Aldam CH (2006) Ionising radiation exposure to orthopaedic trainees: the effect of sub-specialty training. *Ann R Coll Surg Engl* 88: 297-301.

This article is part of the Special Issue entitled – **Cancer development from a basic science**, edited by **Dr. Nabil Mohie Abdel-Hamid**, (Kafrelsheikh University, Egypt) and belongs to Volume S1 of **Archives in Cancer Research**.