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RESEARCH ARTICLE

ORTHOPEDIC SURGEONS AND RADIATION EXPOSURE: A SURVEY ANALYSIS ABOUT MYTHS AND FACTS

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ABSTRACT

Introduction: Orthopedic surgery has a particularly hazardous work environment in which surgeons are at increased risk for exposure to infections, radiations, smoke, chemicals, excessive noise, musculoskeletal injuries, as well as emotional and psychological disturbances. Here we are only going to focus on the exposure to radiation while operating and what precautions to be taken. The purpose of this study is to evaluate the knowledge levels of orthopedic surgeons about exposure dose and possible risks of fluoroscopy. ***Materials and Methods:*** A questionnaire form with a total of 10 questions was taken to orthopedic surgeons working in GMC Jammu. The participants were requested to answer the given questions. The questionnaire evaluated participant's knowledge about the exposure dose and possible risks of fluoroscopy and the preventive measures they take. Effects on patients were not assessed in this study. ***Results:*** A lead apron was the most commonly used protection from the harmful effects of radiation (100%) but without thyroid gland shield and glasses. Fluoroscopy shots were performed with the help of operating room personnel (86%). No Surgeon used any personal radiation monitoring device. Almost every surgeon was found to be anxious that as an orthopedic surgeon we receive very high doses of radiations and about the possible deleterious side effects. ***Conclusion:*** According to the survey results, the need for fluoroscopy was very high in orthopedic surgery but it doesn't exceed all other interventionalists. However, orthopedic surgeons have inadequate knowledge about the exposure dose and possible level of risks of fluoroscopy. Therefore, we believe that training on this topic should be provided to all orthopedic surgeons. Myths related to radiation exposure in orthopedics surgery must be addressed.

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INTRODUCTION

Requirement of imaging intra operatively is much higher in orthopaedic surgery in comparison to most of the other interventionalists and hence Orthopedicians are at higher risk. Also orthopedic surgeons while operating remain near the x-ray beam and cannot distance themselves to reduce their radiation exposure (Singer, 2005). Radiations have 2 types of effects on our body i.e. Stochastic and non stochastic. Severity of Stochastic effect is unrelated to dosage of radiations and is the result of chromosome damage. In somatic cells, they typically manifest as cancer; in germ cells, as genetic defects in off springs (Hendee, 1993; Balter, 1999; Herscovici and Sanders, 2000). However probability of occurrence is dose dependent. Non stochastic effects require a threshold dose (Dose dependent). Non stochastic effects present themselves within hours or days as Erythema, burns, sterility, radiation sickness, and even death (Very high dose) (Little, 1992). If threshold is not reached the damage is repairable (Little, 1992). As recommended by the International Commission on Radiological Protection (ICRP) that most countries tend to adopt. Currently the safe radiation exposure level is 20 mSv/ year (actually 100 mSv in5 years-not to exceed 50mSv in any one year). Surgeons are exposed to scattered radiations and not primary ones which minimize their effect. However maximum radiation exposure for the gonads does not differ from that for the torso (Sheiner *et al*., 2003). Orthopedic surgery has a particularly hazardous work environment in which surgeons are at increased risk for exposure to infections, radiations, smoke, chemicals, excessive noise, musculoskeletal injuries, as well as emotional and psychological disturbances. Here we are only going to focus on the exposure to radiation while operating and what precautions to be taken. The purpose of this study is to evaluate the knowledge levels of orthopedic surgeons about exposure dose and possible risks of fluoroscopy. To evaluate the knowledge levels of orthopedic surgeons about exposure dose and possible risks of fluoroscopy and to answer some most frequently asked questions by almost every orthopedic surgeon regarding radiation exposure and their safety.

MATERIALS AND METHODS

In this Survey Analysis a questionnaire form with a total of 10 questions was taken to 108 orthopedic surgeons including residents working in different hospitals of Jammu and Kashmir. The participants were requested to answer the given questions and

the mere answering of given questions was considered as their consent for the participation in this study. The questionnaire evaluated knowledge of participants about the exposure dose and possible risks of fluoroscopy and the preventive measures they take. The effects on patients were not assessed in this study. The answered questionnaire forms were assessed and final results were drawn from them and presented as results in this study. Our form also contained a blank column for any queries of the participants and then answered in light of appropriate references.

RESULTS

- Lead apron was used by all the surgeons (100%) but without thyroid gland shield and glasses except two (1.85%).
- Fluoroscopy shots were performed with the help of operating room personnel.
- No Surgeon used any personal radiation monitoring device.
- Almost every surgeon was found to be anxious that as an orthopedic surgeon we receive very high doses of radiations and about the possible deleterious side effects.

Queries of orthopedic surgeons

- How much radiation is safe for me?
- Is the dose to orthopedic surgeons much higher than other interventionalists?
- Is there a risk of cataract after several years of work in an orthopedic operating room?
- Can I work my full professional life with radiation in the operating room and have no radiation effects?
- What is the typical radiation dose associated with orthopedic procedures?

Conclusion

Noordeen *et al*. (1993) calculated yearly exposure to the hands of 4740 mrem (approximately 10% of the yearly maximum dose for the hands) during studied orthopedic trauma procedures. Radiation exposure was approximately 10 times higher during spinal surgeries than during other musculo-skeletal. Rampersaud *et al*. (2000) found that hand exposure rate was 58.2 mrem/min during pedicle screw fixation. Mroz *et al*. (2008) found 5.7 minutes of exposure time for a single-level kyphoplasty. Exposure rates were highest when the C-arm was placed in the lateral position and was significantly reduced when the primary beam entered the patient opposite the surgeon, minimizing surgeon exposure to scattered radiation. Singer, 2005 found that, though the exposure rate of the mini C-arm is approximately 10% of that of a standard C-arm, surgeons tended to stand closer to the beam, which resulted in higher exposure than expected. Still, there is an estimated 1- to 2-fold reduction in radiation to the surgeon with mini C-arm, compared with standard C-arm, despite the mean increased number of exposures (Singer, 2005). Noordeen *et al*. (1993) also found that when the surgeon (vs. the technician) controls the C-arm foot pedal, there is a significant reduction in radiation exposure.

Queries answered

How much radiation is safe for me? There are radiation dose limits for staff recommended by the International Commission on Radiological Protection (ICRP) that most countries tend to adopt. Currently the level is 20 mSv/year (actually 100 mSv in 5 years - not to exceed 50 mSv in any one year). Most orthopedic surgeons using radiation protection devices and tools will have a radiation dose below typically 2 mSv/year.

Is the dose to orthopedic surgeons much higher than other intervention lists? No, the radiation dose to orthopedic and a trauma surgeon in most routine procedures is much smaller than interventional radiologists and those performing cardiac interventions (Bor *et al*., 2004; Ciraj-bjelac *et al*., 2010).

Is there a risk of cataract after several years of work in an orthopedic operating room? Very unlikely, Proper use of radiation protection tools and techniques can prevent deterministic effects such as cataract and can avoid any significant increase in probability of cancer risk for many years to cover the full professional life . To date, there have been no reports of radiation induced cataract among orthopedic surgeons; however such reports do exist for interventional radiologists and cardiologists (Ciraj-bjelac *et al*., 2010; Vano *et al*., 2010).

Can i work my full professional life with radiation in the operating room and have no radiation effects?
Yes it is possible, under optimized conditions when

- The equipment is periodically tested and it is operating properly;
- Personal protective devices (lead apron of suitable lead equivalence of 0.25 to 0.5 mm and wrap around type, protective eye wear or protective shields are used for the head/face and leg regions);
- Use of personnel monitoring devices is implemented to estimate radiation exposure

It is possible to achieve a smaller risk of radiation effects for a full professional life using the ALARA (as low as reasonably achievable) principle.

What is the typical radiation dose associated with orthopedic procedures?

- Minimally invasive trauma surgery in comparison to open operations requires high radiation exposure.
- Sports-related surgery, arthroplasty, and hand surgeries need less fluoroscopic images than trauma and reconstruction surgeons.
- Intraarticular and metaphyseal fracture operations carry more risk than diaphysis fractures for radiation exposure.

Radiation Shielding Methods (Bushberg *et al.,* 1994; Forrest, 1961; Gordon *et al.,* 1995)

Protective Gear	% Radiation Attenuation
Leaded gowns	90 (0.25 mm), 99 (0.5 mm)
Glasses	30-70 (leaded), 20 (ordinary)
Thyroid gland shield	90
Radio protective shield	7-50

According to the survey results, the need for fluoroscopy was very high in orthopedic surgery but it doesn't exceed all other intervention list. However, orthopedic surgeons have inadequate knowledge about the exposure dose and possible level of risks of fluoroscopy. Therefore, we believe that training on this topic should be provided to all orthopedic surgeons. Myths related to radiation exposure in orthopedics surgery must be addressed.

[QUESTIONNARE FORM]
RADIATION EXPOSURE IN ORTHOPEDIC SURGERY (MYTHS AND FACTS)

QUESTION 1: How often do you operate?

☐Once per week☐Twice per week☐>twice per week

QUESTION 2: How often do you use C-arm?

☐Never☐Sometimes☐Always

QUESTION 3: Do you think radiations have any effect on our body?

☐Yes☐No

QUESTION 4: Do you think as an Orthopedician you are exposed to more radiation dose while operating than any other intervention list?

☐Yes☐No

QUESTION 5: Do you know how much radiation is safe for a human being as per ICRP?

☐Yes☐No

QUESTION 6: Do you know how to operate a C-arm?

☐Yes☐No

QUESTION 7: What protective measures you take while operating to prevent radiation exposure?

☐Leaded gowns ☐Glasses ☐Thyroid gland shield

QUESTION 8: Do you use any Personal radiation exposure monitoring device?

☐Yes☐No

QUESTION 9: Do you Feel Safe while Operating under C-arm?

☐Yes☐No

QUESTION 10: Do you have any questions regarding radiation Exposure while operating?

_____

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THANK YOU **SIGNATURE**

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