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INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/13273

DOI URL: <http://dx.doi.org/10.21474/IJAR01/13273>



RESEARCH ARTICLE

AWARENESS OF RADIATION HAZARD IN ORTHOPAEDIC RESIDENTS SURGEON IN A CENTRAL INDIA

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Manuscript Info

Manuscript History

Received: 10 June 2021

Final Accepted: 14 July 2021

Published: August 2021

Abstract

One of the effective techniques which has evolved in contemporary orthopaedic practice is C-arm fluoroscopy in intra-operative orthopaedic procedures. Such techniques improve the competence of the surgeon while reducing the jejuneness and duration of the patient's stay at hospital. Although having awareness about reported benefits of the device, there is increasing worry over the surgical team's elevated radiation exposure. The current research was undertaken on orthopaedic surgeons working in the region of Central India to assess the amount of radiation exposure if they follow the normal precautionary steps as well as to raise awareness and encouraging them to use the image intensifier safety in daily practice. In addition, to raise concerns of radiation safety and the befitting use of radiation in the operating room. *Materials and Method:* This is an observational review of data gathered by residents performing common orthopedic surgical operations in emergency and routine OT during one-year residency at a medical college hospital. We calculated the mean radiation exposure on each resident (orthopedic resident postgraduate-3yr) with and without lead apron protection, and compared it with the ICRP limit for radiation to body per year between 1st January 2020 and 31st December 2021. *Result:* Total radiation levels accumulated by one resident without lead apron over 1 year was calculated (35.88 milliSv). which was greater to ICRP limit for radiation to body per year (20milliSv). Total radiation levels accumulated by one resident with lead apron over 1 year was calculated (2.04 mSv). which was less than ICRP limit for radiation to body per year (20mSv). *Conclusion:* Orthopedic resident surgeons are not listed as Radiation personnel. Radiation toxicity, in addition to the risks of other surgical industries, is therefore an additional occupational danger. As a result, orthopedic resident surgeons should be concerned. During surgeries, junior orthopaedic residents vastly underestimate their level of radiation. They should adhere to the guidelines outlined above. The conventional assertion that radiation exposures during c arm use are negligible and should be disregarded, as the long-term adverse biological effects of continuous low-dose radiation exposure are uncertain at this time. There's a chance of cancer, as well as genetic variations and fertility complications.

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Introduction:-

In today's orthopedics operative theater, the use of fluoroscopy devices is on the rise. The image intensifier has enabled orthopedic surgeons to better envision the anatomy of the bone and conduct different procedures with greater ease, resulting in a smaller incision region, less time in the operating room, and less tissue damage, resulting in lower morbidity.¹ However, some surgeons overuse it, ignoring the concept of radiation safety, while others underuse it due to irrational concerns.¹ Ionizing radiation has two biological effects: a dose-dependent deterministic effect and a dose-independent stochastic effect. The deterministic effect, which may involve cataracts, alopecia, headache, dermal ulceration, and infertility, is unlikely to appear within a certain dose level, while the stochastic effect has no such threshold dose and may include activation of malignancy in radiosensitive organs such as the breast, lungs, thyroid, and red bone marrow.² Since ionizing radiation is invisible and intangible, it is difficult to keep away from in an orthopedic operating room, particularly for residents and consultants who operate close to the fluoroscopy machine. In addition, the absence of necessary radio-protective equipment increases the risk of long-term complications. The use of a dosimeter to measure dose is not regularly practiced, since residents in emergency action theaters are in a rush to complete an event, and even the lead aprons we wore are improperly held, and bad habits such as holding hands in direct x-ray are normal. In everyday use, thyroid gland shield special gloves are seldom used.³

In general, orthopedic surgeons, mostly residents, are unaware of their radiation exposure. As a result, the aim of this research is to quantify the annual radiation exposure of residents employed in a medical college (tertiary care hospital) and equate it to international standards. Thus raising awareness among resident doctors is important. Orthopaedic Surgery and Radiation Risk.

The Orthopaedic surgeons are vulnerable to both direct (primary) and scattered (secondary) radiation during surgical procedures. Direct (primary) radiation is delineated as the radiation that travels between the X-ray generator and receiver tape whereas scatter can be described as when the radiation is released as the primary beam collides with artifacts in its path, such as the patient, operating table, and instruments. Such type of radiation exposure is vulnerable to both surgeon and circulating staff.³ As per the Inverse square theorem, the intensity of X-rays (which can be defined as photons per unit area) is inversely proportional to the square of the distance from the source due to which the impact of direct fluoroscopy beam exposure at 2 meters is relatively small, but scattered radiation remains a possibility. (Dewey et al 2005). Therefore, it becomes important for all the team members including surgeons, assistants, and scrub team are aware of the risks of radiation and hence take precautionary measures to limit their exposure. The radiation or dose absorbed by the operating room personnel's body parts such as eyes, forehead, neck, thyroid, and hands is arduous to monitor and record as the dose distribution is heterogeneous in case of scattered radiation. Personal protective equipment (PPE) is effective in limiting the radiation exposure. It is observed that the surgeons who did not wear lead thyroid shielding were exposed to radiations 415 times higher (33.2–0.08mSv) than the surgeons who wore the lead thyroid shield. Also, when the fluoroscopy tube was placed over the eyes, the vulnerability to the upper extremities, eyes, and thyroid rose by 4-5 times.⁴

A cadaveric analysis was performed with the help of dosimeters at various distances which revealed that the exposure or dose of radiation obtained at 15 centimeters from the beam was 100 times greater than the dose received at 30 centimeters,⁵ which clearly shows that orthopedic surgeon trainees' dearth in dispensable knowledge of ionizing radiation and did not follow radiation safety principles. Several studies were conducted that revealed medical physics is not regularly taught in orthopedic educational programs which resulted in an awareness gap among orthopaedic surgeons considering, the fact, that hospital administrators are responsible for radiation safety for their employees.⁵ According to ICRP, the safe limit for dose-based impact occupationally exposed people is 20mSv for body, 150 mSv for Thyroid and 500 mSv for hands.

Material and Methods:-

Type of Study – Observational study

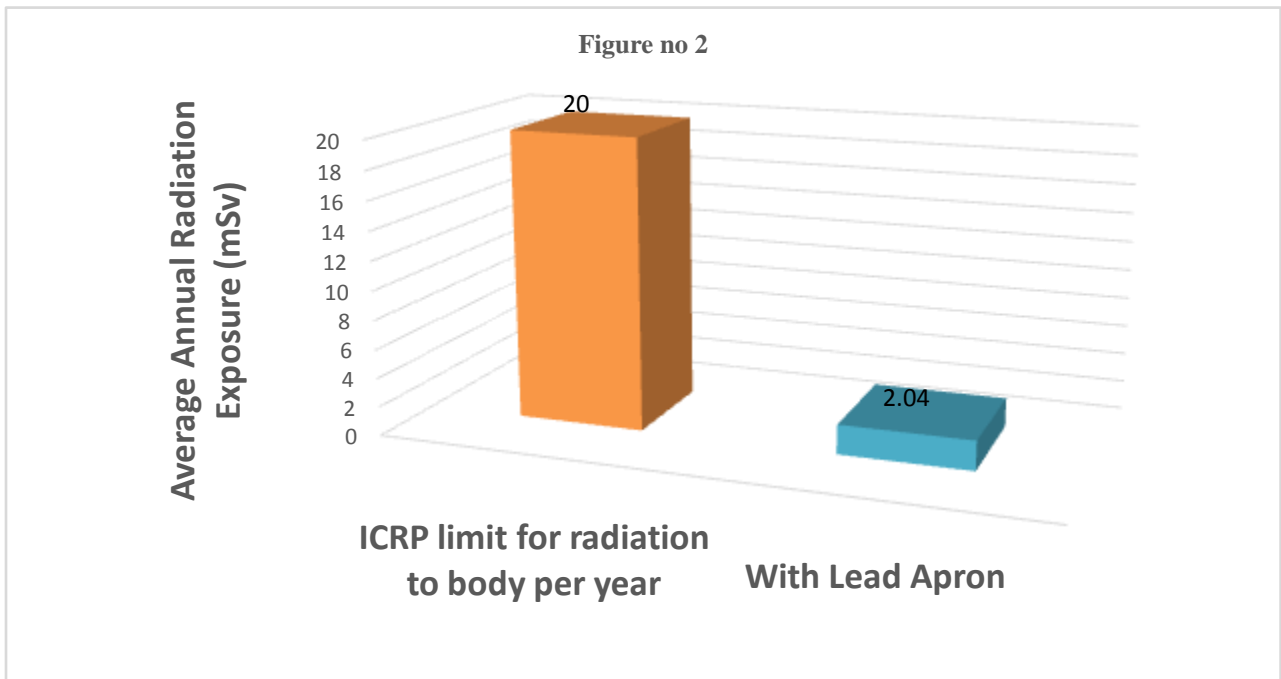
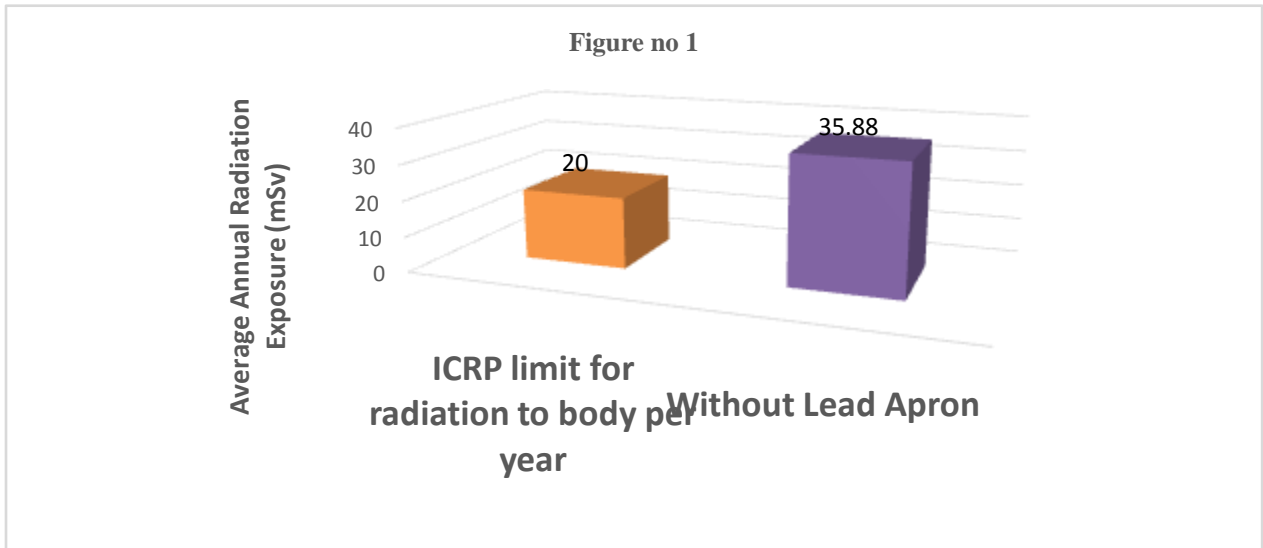
Time – January 2020 To January 2021

This is an observational review of data gathered by residents performing common orthopedic surgical operations in emergency and routine OT (under supervision) during one-year residency at a medical college hospital. We determined mean radiation dose by orthopaedic post-graduate 3rd year resident, under the supervision of faculty

surgeon, in a community teaching hospital for the period January 01, 2020 to December 31, 2021 by recording the average number of shoots taken in each operation. We calculated the mean radiation exposure on each resident with and without lead apron protection, and compared it with the ICRP limit for radiation to body per year (assuming residents were involved equally in cases). The Portable C-Arm fluoroscopy with image intensifier used for the procedure was Allegers HF59R and no TLD badges were used.

Result:-

There were 6 post-graduate, 3rd year residents, at any given time during our research, and a total of 1079 cases were ascertained over the course of the study. Total radiation levels accumulated by one residents without lead apron over 1 year was calculated (35.88 milliSv).which was compared to ICRP limit for radiation to body per year (20milliSv). The inference is that without lead safety, the dosage limit of 20milliSv a year to the body was surpassed.



Total radiation levels accumulated by one resident with lead apron over 1 year was calculated (2.04 mSv). Which was compared to ICRP limit for radiation to body per year (20mSv). The implication is that lead safety should not exceed the dosage level of 20milliSv a year to the body.

S. No.		
1	ICRP limit for radiation to body per year	20.00
2	With Lead Apron	2.04

Discussion:-

Owing to their proximity to exposure region, orthopaedic surgeons and assistants face the highest radiation risk of all OT workers. The aim of this research was to look at the radiation doses obtained by orthopedic resident surgeons in a central Indian medical college. In addition, efforts are being made to raise radiation safety sensitivity and the healthy use of radiation in operating rooms. The annual radiation dosage of resident surgeons without the use of a

lead apron was found to be higher than the ICRP maximum for body radiation exposure each year (shown in table no1). Many authors have indicated that orthopedic surgeons have a considerably higher chance of cancer due to high radiation exposure. We observed annual radiation exposure of resident surgeons per year with the use of lead apron was less than the ICRP limit for radiation to body per year (shown in table no 2).although it is well within the ICRP limit but the effectiveness of lead apron is disputable and it only signifies reduction of non-stochastic effects but nothing conclusive can be said about the stochastic or non dose dependent effects and chance effects like cancers. There was a significant decrease in annual radiation exposure of resident surgeons per year when a lead apron was worn by a resident as compared to annual radiation exposure of resident surgeons per year when a lead apron was not worn.

The amount of radiation obtained, on the other hand, cannot be rendered zero, but it can be reduced by applying the ALARA (As low as reasonably achievable) principles.

Earlier researches have proposed that the caliber of radiation doses by orthopaedic surgeons could be associated with an elevated incidence of congenital abnormalities and in some cases childhood cancers in their off springs.

While existing radiation protocols tend to be appropriate based on low dose radiation, there are also questions about the preventive procedures used by orthopedic personnel to keep radiation doses as low as reasonably achievable (ALARA). The resident doctors must take the following precautionary measures

Preoperatively

1. In order to help residents, develop fundamental surgical skills through perennial practice away from actual patient treatment it is necessary to make surgical skill simulation as a mandate part of instructions.⁶
2. Proper use of dosimeter/TLD badges (thermo luminescent dosimeter) to monitor routine radiation dose.
3. Orientation program towards radiation protection to resident doctors and OT staff as well.
4. Procedure should be planned well in advance to increase technical proficiency.
5. Always try to recollect the ALARA principle for everyone in the operating room, and not just the patient.

Intraoperative measures

1. All personal protective gear like a lead apron, thyroid shield is a must.
2. A minimum safe distance of 18 inches must be maintained by the team along with the surgeon from the region of primary beam in order to prevent from the delirious effects direct beam radiation.¹
3. Adequately trained c arm operator to avoid unnecessary shoots.
4. C arm scatter maximum radiation in horizontal fluoroscopy than usual poster anterior imaging.
5. While doing the operation always avoid overt touching of X-ray tube and keep direct radiation to the hand to a minimum.
6. Exposure time alarm which would warn surgeon after a specific number of shoots.
7. The image intensifier should be placed as close as possible to the patient.
8. Always use a collimator in order to reduce the size and intensity of the x-ray beam.

Other related measures

1. Protective shields must not be folded as it will break the lead present in it and therefore, should be held in a safe place. They must be examined on a regular basis, with defective parts either fixed or discarded.
2. Lead Boxes can be helpful in keeping and storing TLD badges which are used for surveillance purposes.
3. Increased exposure equilibrate for the C-Arm unit's decreased performance in order to achieve comparable imaging light and contrast. During a 1-year interval, the level of radiation delivered varies by more than 100 percent in more than 30 percent of the machines. As a result, it is preferable to provide a semi-annual quality assurance in terms of radiation output and system resolution for all units.¹
4. The known radiation risks will get emphasized if regular audits and trainings are being conducted in the hospitals.

Conclusion:-

Orthopedic resident surgeons are not listed as Radiation personnel. Radiation toxicity, in addition to the risks of other surgical industries, is therefore an additional occupational danger. As a result, orthopedic resident surgeons should be concerned. During surgeries, junior orthopaedic residents vastly underestimate their level of radiation. They should adhere to the guidelines outlined above. The conventional assertion that radiation exposures during c arm use are negligible and should be disregarded, as the long-term adverse biological effects of continuous low-dose radiation exposure are uncertain at this time. There's a chance of cancer, as well as genetic variations and fertility complications.

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