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Original Research Article

Current state of awareness and safety practices for ionising radiation risks in orthopaedic doctors in Navi Mumbai: an online survey

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ABSTRACT

Background: Radiographic imaging in orthopaedic surgical centers is becoming more common, posing additional risks to the orthopaedic doctors, who become more exposed to ionising irradiation. As a result, orthopaedic surgeons must have a good understanding of radiation hazards. Despite these issues, many orthopaedic specialists do not get basic radiation safety training. A review of orthopaedic specialists' understanding, awareness, and routine radiation safety practices at an academic hospital in Navi Mumbai.
Methods: After institutional ethical approval, a panel of experts created an online survey comprising multiple-choice questions, which was utilized to perform a descriptive research. The questionnaire contained several aspects, each of which assessed orthopaedic understanding, awareness, and practices. The research cohort comprised orthopaedic doctors working through our tertiary medical center and medical college.
Results: According to our findings, only 82% of respondents were aware of the radiation dangers associated with fluoroscopy. The use of lead aprons, thyroid shields, goggles, and protective caps is 99%, 42%, 25%, and 25%, respectively. Despite the fact that 60% of respondents were aware of TLD badges. Only 23% of those who operate with inosing radiation use TLD badges. Approximately 61% of respondents were ignorant of intermittent fluoroscopy, and 85% utilized the C-arm tube while the device was active.
Conclusions: The vast majority of orthopaedic doctors utilise fluoroscopic imagery in the operating room on a daily basis, but they lack in-depth information and awareness about the radiation security hazards connected with this imaging modality. It is consequently advised that a radiation safety training curriculum be implemented.

Keywords: Radiation risk, Orthoapedic surgeons, Flouroscopy, X-ray exposure

INTRODUCTION

Advanced orthopaedic surgical techniques including less invasive procedures, as well as greater use of fluoroscopic visualisation, provide a possible increased danger to surgeons owing to ionising radiation exposure.[1] The indirect vision of anatomy by fluoroscopy allows numerous orthopaedic procedures to be performed with more ease, in less time, and with less traumatisation of patient tissues, minimising patient morbidity.[2]

Fluoroscopic usage in operating rooms is not without danger for the orthopaedic surgeon due to the biological consequences of ionising radiation. Ionising radiation impacts are classified into two types: deterministic and stochastic effects.[2,3] Deterministic effects, such as

cataracts, baldness, headaches, and thermal ulcerations, often develop above a certain dosage threshold. Stochastic effects include cancerous alterations in radiosensitive organs such as the breast, lung, thyroid, and bone marrow.[4]

According to the linear threshold model, the long-term malignancy potential is exactly proportional to the quantity of radiation a person is exposed to, regardless of time. As a result, it is critical for orthopaedic surgeons to be knowledgeable about radiation and its strategies for mitigating risk in an acceptable manner.[2]

India, being a developing country, has been at the forefront of advanced orthopaedic care management. However, there is a dearth of understanding and training concerning radiation danger and safety precautions among orthopaedic surgeons. As a result, we want to investigate orthopedists' awareness and working knowledge of ionising radiation danger in India.

METHODS

Study type

We did an online survey observational study.

Study place

We did this study by distributing the online link for the survey to orthopaedic doctors (trainee and consultants) in our tertiary health care institute (Dr. D. Y. Patil Medical college and Hospital, Navi Mumbai) and surrounding hospitals.

Study period

The study was carried out for 3 months from January 2023 to March 2023.

Selection criteria

Inclusion criteria for our study was orthopaedic doctors working in Navi Mumbai Medical Colleges. Female participants who were pregnant at the time of data collection were excluded. Seven surveys were incompletely completed and were thus eliminated from the study.

Procedure

The research location was in the Navi Mumbai region's medical colleges. We distributed the questionnaire using Google forms to all orthopaedic residents and consultants. The language of the survey was English only. The sample size was determined using the assumption that about 98% of orthopaedic surgeons will be exposed to ionising radiation while performing orthopaedic procedures. The sample size determined was 52 with a 95% confidence level and a 5% margin of error. Nonetheless, we received 72 answers.

Ethical approval

Ethical approval was taken from our institutional ethical board.

Statistics

For data collecting, we utilised Google forms. After analysing the data, we put it in Microsoft excel files with password security. Data analysis was done with the help of Microsoft excel software.

RESULTS

We had 79 responses from all over Navi Mumbai from orthopods. We filtered 7 out of them to be incomplete and discarded them. The questionnaire was completed by 72 orthopaedic trainees and specialists who are currently working in Navi Mumbai. The bulk of participants were orthopaedic registrars, followed by a few consultants.

Demographic information: In our survey, 72 orthopaedic doctors responded. There were five female orthopaedic surgeons. The majority of responses (94.6%) were orthopaedic trainees, with the remainder being orthopaedic consultants. The bulk of the doctors (65 in total) were aged 20 to 30. Four of the doctors were between the ages of 30 and 40. The remaining three consultants were between the ages of 40 and 50 as seen in Table 1.

Table 1: Demographic of the respondent doctors in our survey.

Variable	Frequency (%)
Gender	
Male	67
Female	5
Training level	
Trainees	69
Consultants	3
Age (years)	
20-30	65
30-40	4
40-50	3

Usage of lead protection gear for radiation exposure

Awareness of radiation risk from fluoroscopy

Figure 1 shows that around 82% of respondents were aware of the radiation dangers associated with fluoroscopy.

Protective gear usage

Despite the fact that 99% of respondents agreed to wear lead aprons during fluoroscopy, more than half (58%) did not use thyroid protectors during X-rays (Figures 2 and 3). Only 25% of responders wear a lead head protective hat.

0.15 mm lead equivalent goggles are used to protect against radiation that might cause long-term problems such as cataract (Figure 4). Figure 1 shows that just 25% of responders utilise such safety goggles. This demonstrates that, while lead aprons are generally utilised widely, additional protective equipment such as thyroid shields and lead protection caps are used seldom.

Awareness about radiation measurement while working with ionizing radiation

Awareness of TLDs

According to our poll, only around 60% of respondents are aware of thermoluminescent dosimeters (TLDs) as shown in Figure 5. Even more concerning, less than a quarter (23%) of respondents utilise thermoluminescent dosimeters (TLDs) when working with ionising radiation (Figure 1).

Sending TLDs to BARC

The Bhabha Atomic Research Centre (BARC) serves as a central location for measuring and monitoring the radiation levels of TLD batches. Yet, more than half (53%) of respondents' state that they do not send TLD batches to BARC on a regular basis (Figure 1).

Awareness of methods to minimize radiation risks

Intermittent fluoroscopy

A 3 second burst with a 'long off' pause is advised. It is best to avoid using continuous fluoroscopy. The majority of respondents (61%) were, however, unfamiliar with the intermittent fluoroscopy method. Only one-third of those questioned were familiar with this imaging technique (Figure 2).

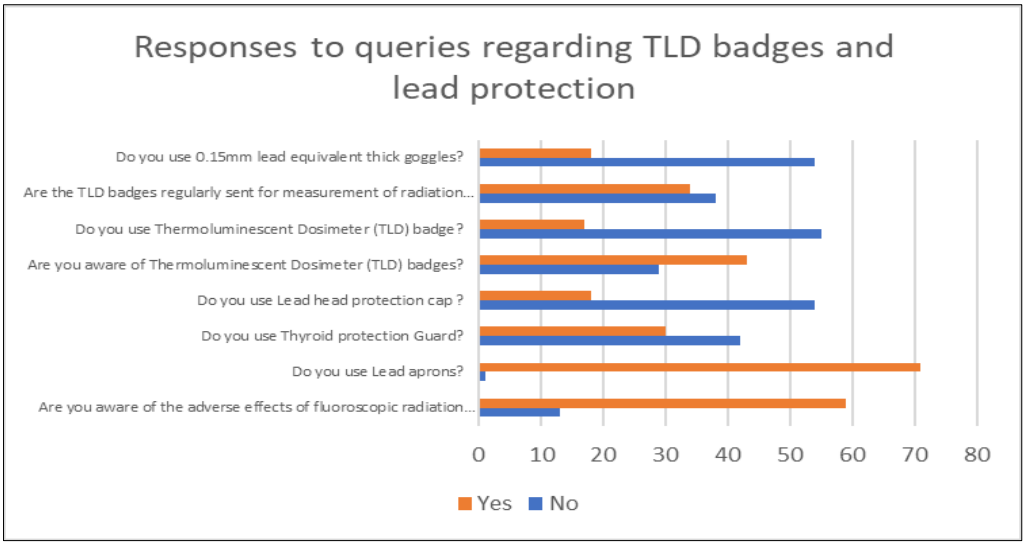

Figure 1: The proportion of doctors responding to various questions on TLD badges, lead protection gear.

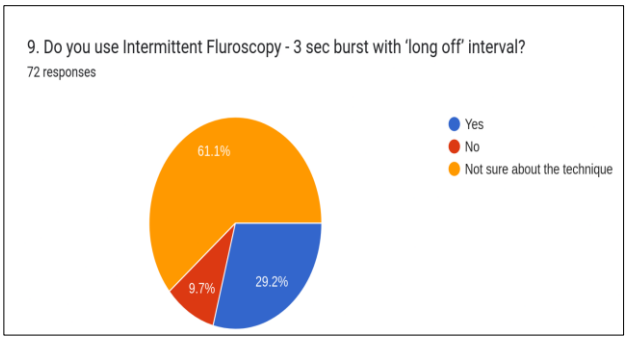

Figure 2: Awareness of intermittent fluoroscopy.

Handling of the C arm while in operation

Handling the C-arm tube while the machine is in use increases the risk of radiation exposure. The vast majority of respondents (85%) reported that they handle the C-arm tube while it is in use, suggesting a high radiation risk to those who do so (Figure 3).

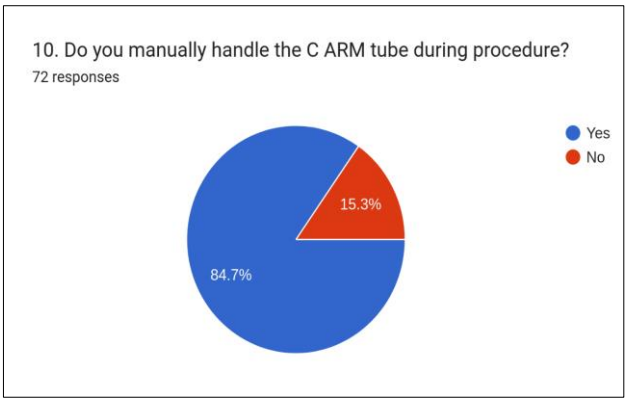

Figure 3: Percentage of respondents manually handling C-arm during the machine is active.

X-ray beam collimation

Collimation reduces the area of the beam while enhancing the contrast of the skiagram. It also lowers the radiation dose to the surgeon and staff. While 43% of respondents were unaware of collimation and 18% said they never collimated, the remaining 40% said they used to collimate X-rays to minimise radiation (Figure 4).

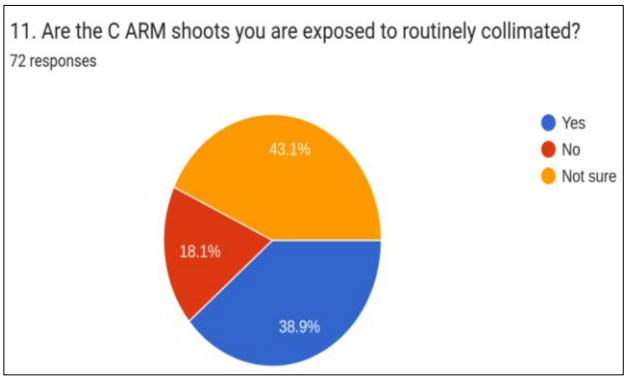

Figure 4: Percentage of respondents awareness about collimation.

Daily cumulative X-ray exposure

Around 25% of responders said their total period of radiation exposure was longer than 15 minutes. In addition, over one-third of those polled were ignorant of their total cumulative radiation exposure period (Figure 5).

Later on Figure 6, elaborates on various queries about techniques of radiation protection and maintenance of lead protection gear. as mentioned below.

18-inch safety distance

To reduce the deleterious consequences of direct beam irradiation, the orthopaedic surgeon and his assistance must maintain an 18-inch buffer from the primary beam zone. However, only half of the responders used the safe distance strategy while shooting an X-ray.

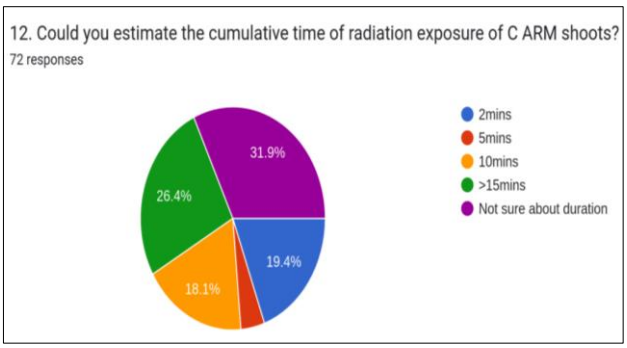

Figure 5: Cumulative time of radiation exposure by using C-arm.

Setting the exposure time alarm

Approximately 57% of respondents stated that they fail to set the exposure time alarm in the C-arm before commencing the operation of the C-arm. This makes determining the real radiation dosage exposure to the C-arm operators difficult.

Mini C-arm unit awareness

Mini C-arm units help to reduce radiation dose when compared to traditional C-arm units. The majority of responders (67%%) were ignorant of the mini C-arm.

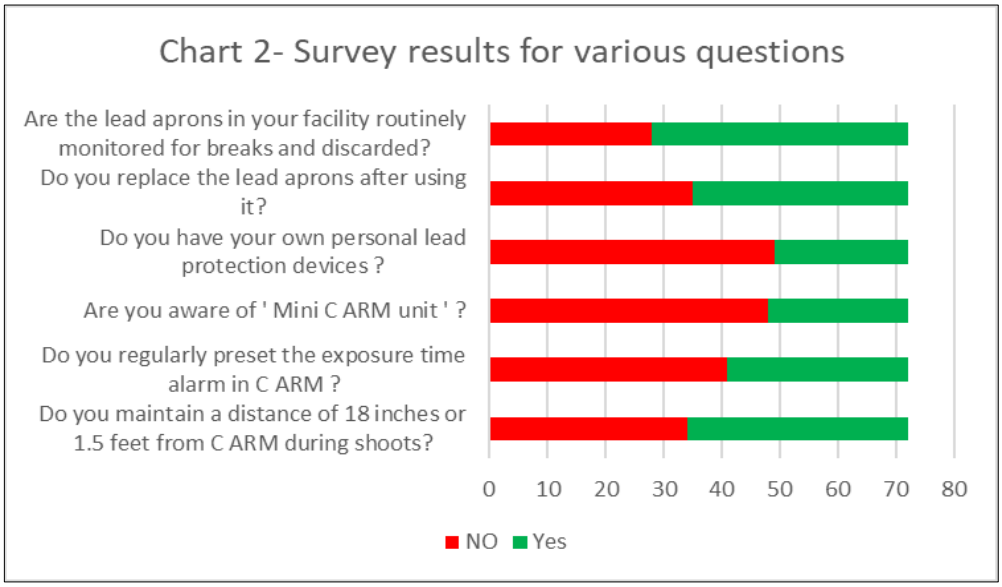

Figure 6: The proportion of doctors responding to various questions on maintenance of lead protection gear and radiation protection.

Personal protective equipment

Many hospitals do not have proper protective lead gear. As a result, it is preferable for hospital workers who frequently operate in different hospital settings to have their own personal lead safety gear such as lead aprons, thyroid shields, and goggles. However, our data suggest that just one-third of respondents own protective lead devices.

Hospital lead aprons care

Monitoring malfunctioning lead aprons and changing them on a regular basis helps to minimise the unnoticed health risk of radiation exposure. Only half of those polled said the lead aprons were replaced after use. Around 40% of those asked said their hospital conducts frequent monitoring of lead aprons and replaces damaged ones on a regular basis.

DISCUSSION

According to our findings, there is a substantial lack of understanding regarding ionising radiation safety measures among orthopaedic surgeons in India. It also demonstrates that TLD badges, which should be worn by all employees exposed to radiation on a regular basis, are not worn in 76% of cases. Despite nearly total use of lead aprons, the study found that utilisation of lead goggles, thyroid shield, and lead protective cap is 41%, 25%, and 25%, respectively.

Papendorp et al in his study of orthopedist showed that 91% of doctors don't wear TLD batches and 73% mention that they have not got formal radiation safety training.[2]

Pires et al in his survey of brazilian orthopedic surgeons showed that only 5.8% of respondents use basic radiation protective gear and 47% use the dosimeter. However, only 2.7% of doctors reached their annual maximum permissible radiation dose.[5]

Sukhla et al in their study showed that there is significant protection achieved by usage of lead aprons in orthopaedic resident doctors. A resident doctor not wearing lead apron has a total radiation dose of 35.88 milliSV over a period of 1 year compared to one using lead apron (2.04 milliSV). The IRCP safe upper limit of cumulative 1 year radiation exposure is 20 milliSV.[6]

Snowden et al showed that in Scotland, 100% of orthopaedic surgeons wear lead aprons/gowns. However, only 46% of them wear thyroid shields and only 55% percent of respondents have completed radiation safety course.[6,7]

Our study is the first study about awareness of ionising radiation hazard in Navi Mumbai orthopaedic population. Similar study was done in the Mumbai region by Seth et al. It showed that, 15% of those polled didn't know the dangers of radiation exposure during routine orthopaedic surgery, 82% didn't know the recommended yearly allowance for each person, 30% didn't know the right way to position the C-arm, 44% didn't know how far away they should keep from the C-arm, 27% didn't know the advantages of pulsed fluoroscopy, 45% didn't know how thick the lead apron should be, and 11% didn't know they should wear.[8]

Our research has a few limitations. Our research is a questionnaire-based survey with a limited sample size of 72 participants. A multi-center Pan-India survey would shed additional light on orthopaedic experts' awareness and understanding of radiation danger.

We'd like to provide a few ideas to assist raise radiation awareness and encourage orthopedists to utilize proper protective equipment and follow safety rules.

There should be a mandatory radiation safety education, akin to biomedical research courses for medical professionals who frequently use ionizing radiation.

TLD batches should be made mandatory for all doctors and submitted to BARC on a yearly basis.

NABH should include provisions for proper lead protective gear, such as goggles, thyroid shields, and lead aprons, for all medical personnel who operate near ionising radiation.

CONCLUSION

Orthopaedic doctors should comprehend the fundamentals and rationale for radiation exposure limitations, as well as the research on the incidence of tumors, dermatitis, cancer risk, and cataracts, as well as the current intraoperative fluoroscopy safety guidelines. Because the harmful effects of radiation exposure on the human body have been established from the first reports on the use of radiography, an emphasis on radiation safety and protection should be uniformly included into graduate medical training.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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