

MAN KI BAAT

ORTHOPAEDIC SURGEON: SHIELD THYSELF!!



Introduction

Radiation has revolutionized diagnostic and interventional procedures in modern medicine, particularly in orthopaedics. From X-rays and CT scans to intraoperative fluoroscopy and image-guided surgeries, radiation has become an indispensable tool. However, with its benefits come substantial risks. Orthopaedic surgeons and operating room (OR) staff are regularly exposed to ionizing radiation, often in high doses over long careers. The cumulative exposure, if inadequately managed, may lead to deterministic effects such as skin injuries and cataracts, and stochastic effects like carcinogenesis and genetic mutations. Despite the widespread use of fluoroscopy in procedures like fracture fixation and spinal surgeries, awareness and consistent application of safety measures remain inconsistent.

Sources of Radiation in Orthopaedics

The primary source of radiation to orthopaedists is ionizing radiation, particularly from fluoroscopic devices such as C-arms, intraoperative CT scans and navigation systems. Minimally invasive spine surgeries, closed intramedullary nailing, percutaneous pinning and screw placement are among a host of surgeries where the surgical team, especially the lead surgeon face considerable radiation exposure, both due to proximity of exposure and duration of use.

Orthopaedic surgeons, especially trainees, may underestimate these risks. Studies have reported increased radiation exposure among orthopaedic residents compared to consultants due to lack of training and inconsistent use of protection.

Radiation is emitted in two primary ways:

1. Direct beam exposure - Which should never occur to a surgeon or staff
2. Scatter radiation - Which arises when the primary beam hits the patient's body and deflects, exposing nearby personnel

Risk factors influencing exposure include:

- Duration of the procedure
- Type of procedure (e.g., spinal procedures use more imaging)
- Distance from the source
- Inadequate shielding
- Positioning (surgeons closer to the image intensifier receive less scatter)

Health Hazards of Radiation Exposure

Radiation exposure carries both deterministic and stochastic health risks.

DETERMINISTIC EFFECTS

These have a threshold dose and increase in severity with dose:

- **Skin damage:** Prolonged fluoroscopy may lead to radiation dermatitis
- **Cataracts:** The eye lens is particularly sensitive, and even moderate doses can cause posterior subcapsular cataracts
- **Infertility:** High doses to the pelvic region can impair reproductive function

STOCHASTIC EFFECTS

These have no threshold and increase in probability with dose:

- **Cancer:** Prolonged low-dose exposure increases the risk of leukemia, thyroid cancer, and other malignancies
- **Genetic mutations:** Exposure can affect germ cells, increasing the risk of hereditary disorders

PREGNANCY

Exposure to ionizing radiation during pregnancy can harm the developing fetus, especially during organogenesis (2-15 weeks gestation). Risks include:

- Miscarriage
- Congenital malformations
- Growth retardation
- Childhood cancer

The International Commission on Radiological Protection (ICRP) recommends a maximum occupational dose of 20 mSv per year averaged over five years, with no more than 50 mSv in any single year. These thresholds are frequently approached or exceeded in busy orthopaedic units without proper controls.

Radiation Protection Strategies

A core radiation safety concept is **ALARA (As Low As Reasonably Achievable)** which focuses on minimizing exposure through time, distance, and shielding.

- **Time:** Reduce the time spent using fluoroscopy
- **Distance:** Standing farther from the source significantly reduces exposure. Inverse square law dictates exposure falls with the square of distance
- **Shielding:** Use of lead aprons (0.5 mm lead equivalent), thyroid collars, leaded glasses, and mobile lead screens

Radiation Protection Measures

1. Personal Protective Equipment (PPE)

- **Lead aprons:** Should be routinely worn by all staff during fluoroscopic procedures
- **Thyroid shields:** The thyroid is highly radiosensitive. Consistent use reduces cancer risk
- **Lead glasses:** Protect the eyes from scatter radiation and prevent cataracts

- **Gloves:** Lead gloves offer limited protection but are useful in high-dose settings

2. Distance

Distancing oneself from the radiation source is one of the most effective and easily implemented strategies for reducing radiation exposure during fluoroscopy in orthopaedic procedures. During fluoroscopy, the primary source of exposure to the surgical team is scatter radiation from the patient. Standing farther from the patient – particularly on the image intensifier side – reduces scatter exposure. Increasing the distance from 0.5 meters to 1 meter reduces exposure by a factor of four. Ideally, staff not directly involved in imaging should remain at least 2 meters away or behind protective barriers. When proximity is unavoidable, using tools with extended handles or remote foot pedals allows necessary actions while maximizing distance.

3. Procedural Strategies

- **Pre-procedural planning:** Minimize fluoroscopy time by rehearsing surgical steps and using preoperative imaging effectively
- **Collimation:** Narrowing the X-ray beam to the area of interest reduces scatter
- **Positioning:** Keeping the image intensifier close to the patient and the X-ray source farther reduces exposure
- **Low-dose settings:** Use pulsed or low-dose modes on fluoroscopy machines

4. Training and Education

Education remains the most crucial component. Incorporating a culture of safety and accountability within orthopaedic teams ensures consistent protection practices.

- Orthopaedic training programs should:
- Include formal modules on radiation safety
- Encourage the use of real-time dosimeters
- Promote audits and feedback mechanisms

5. Technological Advances

- Modern C-arms come with features like pulse fluoroscopy, last image hold, and dose monitoring, which reduce unnecessary exposure
- Navigation systems and robotics reduce dependence on fluoroscopy
- Augmented reality and 3D imaging offer safer alternatives for complex procedures
- Digital radiography with lower doses is replacing traditional film-based methods

Radiation Dose Monitoring

Dose monitoring is essential for occupational safety. Personnel should wear dosimeters – typically badge-type devices – on their chest, thyroid level, or under the lead apron to track exposure.

In some countries, regulations mandate:

- Routine machine calibration and maintenance.
- Training and certification for fluoroscopy use.
- Institutional audits and exposure logs.

Despite availability, underutilization of dosimeters and underreporting of high exposure incidents remain problems globally, especially in resource-limited settings.

Conclusion

Radiation plays a pivotal role in advancing orthopaedic care, enabling accurate diagnosis and precision in surgical procedures. However, its use carries significant risks, especially for healthcare workers exposed to cumulative doses over years of practice. Understanding the sources of radiation, recognizing the biological effects of exposure, and adhering to principles of radiation safety are vital.

Despite established guidelines, many orthopaedic practitioners continue to operate with inadequate protection, often due to lack of training or

awareness. Emphasizing protective strategies - including PPE use, proper fluoroscopy techniques, dose monitoring, and continuing education - is essential. Institutions must prioritize radiation safety through policy enforcement, technological upgrades, and fostering a culture of accountability.

By integrating safety with surgical practice, orthopaedic teams can ensure that the benefits of radiation are fully realized while minimizing harm to both patients and healthcare professionals.

References

- 1. International Commission on Radiological Protection (ICRP) guidelines.
- 2. UK Health and Safety Executive (HSE) - Ionising Radiations Regulations 2017.
- 3. NCRP Report No. 168: Radiation Dose Management.
- 4. Singer G. Occupational radiation exposure to the surgeon. J Am Acad Orthop Surg. 2005.
- 5. Mehlman CT, DiPasquale TG. Radiation exposure to the orthopaedic surgical team during fluoroscopy. J Bone Joint Surg Am. 1997.

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BOS NEWS

From the President's Desk...

DR. GAUTAM ZAVERI



BOS EVENTS HELD IN JULY 2025

JULY 6 L. N. VORA MASTER CARES & MASTER SHARES SERIES

Venue: **Saifee Hospital**

Conveners: **Dr. Sangeet Gawhale, Dr. Vikas Agashe**

Delegates: 100

Topic: **Failed Fracture Fixation - Upper Limb**

Sponsor: **Aareen Healthcare**

JULY 12 BOS WORLDWIDE WEBINAR

Venue: **Online**

Collaborating Association: **World Association Against Infections in Orthopaedic Trauma**

Conveners: **Dr. Vikas Agashe, Dr. Carlo Romani**

Faculty: **Dr. Aditya Menon, Dr. Carlo Romano, Dr. Mohamed Fadel, Dr. Thami Benzakour, Dr. Chingiz Alizadeh, Dr. Heinz Winkler**

Attendance: 500

Program: **7 cases of MSK infections** where unusual solutions led to. Good results were discussed.

Sponsor: **Torrent Pharma**

JULY 12 - 18 BASIC ARTHROPLASTY COURSE

Venue: **Sion Hospital**

Conveners: **Dr. Abhijit Kale, Dr. Gaurav Kanade, Dr. Ashish Phadnis**

Delegates: 36

Program: **7-day arthroplasty feast** which included lectures, case discussions, saw bone workshops, Cadaver workshops and visits to OT to witness live surgery.

JULY 12 - 18 **BASIC ARTHROSCOPY COURSE**

Venue: **BPT Hospital**

Conveners: **Dr. Sandeep Biraris, Dr. Pradip Nemade**

Delegates: **26**

Program: **7-day arthroscopy feast** which included lectures, case discussions, saw bone workshops, Cadaver workshops and visits to OT to witness live surgery.

JULY 19 & 20 **BOS OUTREACH PROGRAM**

Venue: **Chhattisgarh**

Collaborating Association: **Chhattisgarh Orthopaedic Association**

Convener: **Dr. Gautam Zaveri** | Local Convener: **Dr. Alok Agarwal**

Faculty: **Dr. Sachin Bhonsle, Dr. Satish Mutha, Dr. Rohan Habbu, Dr. Anoop Dhamagaonkar**

Attendance: **Day 1 - 90 | Day 2 - 40**

Program:

Day 1 - PG Teaching Program

Day 2 - CME on Upper Limb Trauma

Sponsor: **Intas Pharma Aquila division**

JULY 26 & 27 **MONSOON PICNIC**

Venue: **Radisson Blu, Karjat**

Attendance: **35**

A BOS Picnic after almost 40 years saw 35 enthusiasts travel to Karjat. Idyllic settings - lush green foliage, mountains, fog, waterfalls and rains made for great backdrop.

Games, singing, music and camraderie made this event one of the highlights of the year.

UPCOMING BOS EVENTS IN

AUGUST 2025

AUGUST 3 **DR. K. V. CHAUBAL CLINICAL MEETING**

Venue: **Sion Hospital**

Convener: **Dr. A. B. Goregaonkar**

Sponsor: **INTAS INARA**

AUGUST 7 & 8 BOS SESSIONS AT TRAUMACON

Conveners: **Dr. Sushrut Babhulkar, Dr. Gautam Zaveri**

Session: **Periprosthetic fractures**

Moderator: **Dr. Girish Dewnany**

Session: **Open fractures**

Moderator: **Dr. Aditya Menon**

Session: **Challenging Trauma Cases**

Moderator: **Dr. Satish Mutha**

AUGUST 9 & 10 BOS OUTREACH PROGRAM

Venue: **Bhubaneswar**

Topic: **Musculoskeletal Infections**

Conveners: **Dr. Gautam Zaveri, Dr. Satya Ranjan Patra**

Faculty: **Dr. Vikas Agashe, Dr. S. S. Mohanty, Dr. Rujuta Mehta,
Dr. Rajendra Chandak, Dr. Aditya Menon, Dr. Mala Kaneria**

Sponsor: **Intas Aquila**

AUGUST 10 BOS WORLDWIDE WEBINAR

Collaborating Association: **Singapore Hand Society**

Convener: **Dr. Parag Lad**

Faculty: **Dr. Parag Lad, Dr. Rohan Habbu, Dr. Prashant Kamble, Dr. Pankaj Ahire**

Sponsor: **Torrent Pharma**

AUGUST 23 & 24 BOS OUTREACH PROGRAM

Venue: **Nanded**

Topic: **Upper & Lower limb Trauma**

Conveners: **Dr. Gautam Zaveri & Dr. Kagane**

Faculty: **Dr. Sangeet Gawhale, Dr. Harshad Argekar, Dr. Abhijit Kale,
Dr. Sachin Kale, Dr. Prashant Kamble**

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