Radiation Protection in Fluoroscopy
Introduction

Physicians performing fluoroscopic guided procedures should be aware of the potential for serious radiation-induced skin injury to the patient. Occasionally this is an unavoidable consequence of the time required to perform complex procedures. Some of this exposure, however, can be minimized through a better understanding of how the equipment works and how some operational procedures affect the total skin dose.

Good radiation protection procedures and personnel skills are essential for reducing both staff and patient exposure.

All personnel involved in the radiologic examination have a role in making sure all patients’ procedures are performed in a safe manner.
Major Points:

- Factors affecting staff doses
- Factors affecting both staff and patient doses
- Factors affecting patient doses
- Protection tools
- Radiation protection rules
- Image Wisely and Image Gently
Radiation Protection in Fluoroscopy

Factors affecting staff doses
Factors affecting staff doses

- The main source of radiation for the staff in a fluoroscopy room is the patient (scattered radiation).
- The scattered radiation is not uniform around the patient.
- The level of dose rate around the patient is a complex function of a great number of factors.
Factors affecting staff doses

Scattered dose rate is higher near the area into which the X-ray beam enters the patient.

- Scatter dose rate: 0.03 rem/h, 0.06 rem/h, 0.09 rem/h
- 100 kV: 1 mA
- 11x11 cm
- 1 m patient distance
- Patient thickness: 18 cm
Factors affecting staff doses

FIELD SIZE DEPENDENCE

Scattered dose rate is higher when field size increases.
Factors affecting staff doses

Scattered dose rate is lower when there is more distance from the patient.
Factors affecting staff doses

X-ray Tube Position
Image Intensifier

- Position the X-ray tube under the patient not above the patient.
- The largest amount of scatter radiation is produced where the X-ray beam enters the patient.
- By positioning the X-ray tube below the patient, you decrease the amount of scatter radiation that reaches your upper body.
Radiation Protection in Fluoroscopy

Factors affecting staff and patient doses
Factors affecting staff and patient doses

Collimation

Collimating tightly to the area of interest:

- Reduces the patient’s total focal skin exposure.
- Improves image contrast.
- Scatter radiation to the operator and staff will also decrease.
Factors affecting staff and patient doses

CHANGING FROM NORMAL FLUOROSCOPY MODE TO THE BOOST HIGH DOSE RATE MODE INCREASES DOSE RATE
Factors affecting staff and patient doses

OVERUSE OF MAGNEFICATION MODE  

INCREASES DOSE RATE
Factors affecting staff and patient doses

IF PATIENT SIZE INCREASES

PATIENT SKIN DOSE AND THE LEVEL OF SCATTERED RADIATION INCREASE SUBSTANTIALLY
Radiation Protection in Fluoroscopy
Factors affecting patient doses
Factors affecting patient doses

CHANGING FROM HIGH TO LOW NOISE MODE (FOR CINE AND DSA - Digital Subtraction Angiography) Increases dose per image
Factors affecting patient doses

THE USE OF THE GRID

INCREASES PATIENT SKIN ENTRANCE DOSE
Factors affecting patient doses

- Changing to a smaller image intensifier field can increase patient entrance dose.
Factors affecting patient doses

CHANGING FROM CONVENTIONAL FLUOROSCOPY TO DIGITAL MODE CAN DECREASE DOSE RATE
Factors affecting patient doses

USING PULSED FLUORO INSTEAD OF CONTINUOUS FLUORO

1 pps: 5% of dose
2 pps: 10% of dose
4 pps: 20% of dose
Radiation Protection in Fluoroscopy

Protection tools
Protection tools

- Time
  Decrease the time

- Distance
  Inverse Square Law
  Double the distance receive 1/4 the dose

- Shielding
  Aprons: 0.25 mm Pb equivalent
  Thyroid collar, Pb gloves, rollaway shields
  Patient shielding

- Dosimeter Badge
  Collar and waist badges,
  ring badges, dosimeter storage, control badges
Protection tools

TIME

- Take foot off fluoro pedal if physician is not viewing the image monitor
- Use last image hold (freeze frame)
- Five-minute timer
- Use pulsed fluoro instead of continuous fluoro
  - 1 pps: 5% dose with respect to continuous fluoro
  - 2 pps: 10%  
  - 4 pps: 20%
- Low-Dose mode: 40% dose of normal fluoro
- Pulsed Low-Dose provides further reduction with respect to Normal Dose continuous mode:
  - 1 pps = 2% of dose;  
  - 2 pps = 4%;  
  - 4 pps = 8%;  
  - 8 pps = 15%
- Record fluoro time and calculate rads delivered—report if more than 300
Protection tools

- DISTANCE
  - One step back from tablesde: cuts exposure by factor of 4
  - Move image intensifier close to patient: less patient skin exposure less scatter and sharper image
Protection tools

- **SHIELDING**
  - Pb (or Pb equivalent) aprons: can cut exposure by factor of 20
  - Thyroid collars, Pb gloves, eye glasses, wrap around aprons
  - Properly used rollaway shields
  - Use shielded rooms
  - Patient shielding: thyroid, eyes, gonads
Protection tools

**DOSIMETER BADGES**

- Always wear your collar dosimeter outside the Pb apron

- Be sure to turn in your dosimeter on time for a proper exposure reading—results may not be accurate and a late fee will be assessed
Protection tools

**DRAPED**

- **D-** Distance
  - Inverse square law, primarily for the operator
- **R-** Receptor
  - Keep image receptor close to patient and collimate
- **A-** Angles
  - Avoid steep angles
- **P-** Pedal
  - Keep foot off pedal except when looking at the monitor
- **E-** Extremities
  - Keep patient and operator extremities out of the beam
- **D-** Dose
  - Avoid cine, adjust frame rate, wear personal dosimeter
Radiation Protection in Fluoroscopy

Radiation protection rules
Radiation protection rules

- Minimize cine & high-dose fluoro

- A licensed radiological technologist or credentialed professional practitioner are the only personnel who may operate (turn on) a fluoroscopy machine, position a patient, or select the technique

- Patient’s exposure documentation
  - document skin areas irradiated
  - document fluoro time in patient record
  - calculate and document patient exposure
Radiation protection rules

- **Standard Operating Procedures**
  - each clinical protocol / procedure
  - modes of operation, image recording
  - emphasis on minimizing duration
  - risk / benefit on a case-by-case basis

- **Equipment Quality Control**
  - preventative maintenance
  - calibrations
  - radiation output values
  - check and document Pb aprons, shields, gloves annually
Radiation Protection in Fluoroscopy

Image Wisely

&

Image Gently
The American College of Radiology and the Radiological Society of North America formed the Joint Task Force on Adult Radiation Protection to address concerns about the surge of public exposure to ionizing radiation from medical imaging. The Joint Task Force collaborated with the American Association of Physicists in Medicine and the American Society of Radiologic Technologists to create the Image Wisely campaign with the objective of lowering the amount of radiation used in medically necessary imaging studies and eliminating unnecessary procedures.

Image Wisely offers resources and information to radiologists, medical physicists, other imaging practitioners, and patients.

www.imagewisely.org
The Image Gently Alliance is a coalition of health care organizations dedicated to providing safe, high quality pediatric imaging worldwide. The primary objective of the Alliance is to raise awareness in the imaging community of the need to adjust radiation dose when imaging children. The ultimate goal of the Alliance is to change practice.

The Image Gently Alliance began as a committee within the Society for Pediatric Radiology in late 2006. In 2007, The SPR leadership reached out to friends and colleagues in sister societies representing the key members of the imaging team, ACR, ASRT and AAPM, to form "the Writers Group." These organizations developed the concept of the Alliance and their representatives developed the campaign in the summer of 2007.

www.imagegently.org
Radiation Protection in Fluoroscopy

Summary
Summary

- Many physical factors may significantly affect patient and staff dose while working with fluoroscopy equipment: beam angle, distance from the source, image intensifier diameter, and type of fluoroscopy system.

- Do not overuse magnification modes
Summary

- Wear protective aprons and dosimeters
- Know where scatter is highest
- Keep your distance, as far as is practical

Click here to complete the required Physician Fluoroscopy Quiz