Ask EuroSafe Imaging
Tips & Tricks

IR Working Group

Eye protection for interventionalists

Roberto Sánchez (Hospital Clínico San Carlos and Universidad Complutense de Madrid, Spain)
G. Bartal (Meir MC and Tel Aviv University, Israel)
Barry Hallinan (Beaumont Hospital, Dublin, Ireland)
Background

• The eye lens is one of the most radiosensitive organs.

• ICRP has alerted that there may not be a threshold dose for eye lens opacities [1].

• European regulation has reduced the dose limit for the eye lens of workers from 150 mSv / year to 100 mSv / 5 years (i.e. 20 mSv/year) [2].

• Interventionalists are among professionals with the highest risk.
Efficacy of protection tools: Protection screens

- Ceiling suspended screens are the most effective dose reduction tool for the eye lens.

- Usually 0.5 mm Pb equivalent. Absorbs 95-97% of radiation.

- CIRSE and SIR recommend: Ceiling-suspended shields can provide significant additional dose reduction, especially to unprotected areas of your head and neck. Leaded eyewear is recommended if ceiling-suspended shields cannot be used continuously during the entire procedure [3].

- Dose reduction factors (factor dividing dose) reported from different authors ranged from 3 to 33 [5] (depending on its position relative to the operator).

- It is essential to position the screen appropriately to get effective protection.
1. The operator has a radiation dosimeter close to his face to measure scatter radiation. Without protective screen the operator’s dose rate was 1,2mSv/h.

2. When the suspended screen was correctly positioned (close to the patient & in front of the operator), the radiation reading fell to 46 μSv/h. 

Reduction factor of 26 (96% attenuation)!!!
Efficacy of protection tools: Protection screens

- Under some circumstances, other types of mobile screens might be used:

An anaesthesiologist stands close to the patient during a TAVI. Interventional cardiologists are at the patient’s right side and used a ceiling suspended screen, while the anaesthesiologist is at the opposite side and uses a mobile protection screen.

Image courtesy of R. Sánchez.
Efficacy of protection tools: Glasses

- Protection glasses are the second-best protection means for the lens of the eye, after ceiling suspended screens [3,4,5,6].
- They are usually manufactured with 0.5-0.75 mm lead equivalent with different designs.
- Dose reduction factor using 0.5 mm lead equivalent protective glasses is approximately 33 (i.e. 97% of the radiation is attenuated)
  - the radiation attenuation factor of the eyeglass lenses is not an adequate descriptor, by itself, of the effectiveness of the eyewear [4].

- Some authors have reported from their clinical practice a mean dose reduction factor of 2 (instead of 33) [6].
Efficacy of protection tools: Glasses

- The efficacy of radiation protection glasses depends on the orientation of the operator’s head relative to the irradiated volume [6].

![Image of head angles and dose reduction graphs]

**Phantom dose measurements at different angular positions of the head.** **A** - dose reduction of the protective eyewear (model 5) for both the left (tube side) and right (non-tube side) eye. The angle of 0 was defined as the head facing the table and a positive rotation as rotating the head away from the tube. A schematic top view of the phantom head rotation in the axial plane relative to the tube is shown on top. Image obtained from [6].
Efficacy of protection tools: Glasses

- Design of the glasses is very important.
- They should provide not only frontal protection but also lateral protection.
- Calculations showed that ‘wrap around’ glasses are the most efficient eyewear models reducing, on average, the dose by 74% and 21% for the left and right eyes respectively [7].

Image courtesy of R. Sánchez.
Summary

- Interventionalists have their eyes exposed to scatter radiation and need to protect their eyes.
- Suspended screens are the most effective protection means for the eyes.
- Effectiveness of protection screens depends on the proper positioning.
- Protection glasses also help to reduce eye lens doses.
- Wrap around glasses providing lateral protection are the most efficient.
REFERENCES


2. COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013 laying down basic safety standards for protection against the dangers arising from exposure to ionising radiation, and repealing Directives 89/618/Euratom, 90/641/Euratom, 96/29/Euratom, 97/43/Euratom and 2003/122/Euratom ICRP .


