Measurement of eye lens radiation doses to staff during percutaneous coronary interventional procedures

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Introduction

• In 2011 the International Commission on Radiological Protection (ICRP)
  - The dose limit for the eye reduced from 150mSv to 20mSv
  - Evidence of a lower dose threshold for radiation induced cataract

• Interventional clinicians a high risk group

• Eye lens dosimetry is challenging, measurement point at a remote position from the eye lens.
Objectives

• Improve the accuracy of eye lens dose measurements
  – Establishing optimal measurement position
  – Evaluate the effect of projection angles and patient sizes

• Evaluate dose reduction ability of protective eyewear and protective shields in use
Method

• Initial field studies, following clinical procedures
• Phantom measurements in the PCI room
  – Dose measurements at different positions on the forehead and in eye lens
  – Measurements on protective eyewear and shields
Measurement equipment

- Semiconductor-type dosimeters
- Calibrated Hp(0.07) in N80 field
- Suitable for energy range 14-120 keV
X-ray projections

Lateral projections

-90°: 0°
-60°: 0°
-30°: 0°
30°: 0°
60°: 0°
90°: 0°

Craniocaudal projections

0°: -30°
0°: 30°
Lens dose variation with projection angle

**lens dose variation relative to AP**

\( (0^\circ : 0^\circ ) \)
Deviation from lens dose

Projection LAT:CC

% deviation from lens dose

-40% -30% -20% -10% 0% 10% 20% 30% 40%

-90°: 0° -30°: 0° 0°: 0° 30°: 0° 90°: 0° 0°: -30° 0°: 30°

-15.3% -30.4% 2.7%

pos1 pos2 pos3 Average pos1 Average pos2 Average pos3
Dose reduction ability

- Model 1
- Model 2
- Model 3
Dose reduction ability over a range of projection angles
Protective shield

Ceiling suspended radiation shield, 0.5 mm lead equivalent
≈ 100% dose reduction
Conclusions

• **Optimal measurement point: left side of the face at eye level**
  – Mean deviation from dose in eye lens 3%
  – < 12% variation between different projection angles
  – Patient size did not affect the choice of position

• **Protective eyewear**
  – lower than expected dose reduction ability
  – size and curvature of frame of importance
  – dose reduction ability varied significantly with projection angle

• **Protective shields provide the best shielding ability**
Future work

- Establish routine for eye lens dose monitoring
- Test different models of protective eyewear
- How does eyewear affect our dose estimate and can we correct for it using a fixed dose reduction factor?
Thank you for listening!

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