



LUND
UNIVERSITY

Eye Lens Dosimetry for Interventional Procedures –Relation between Lens Dose and Dose at Measurement Sites

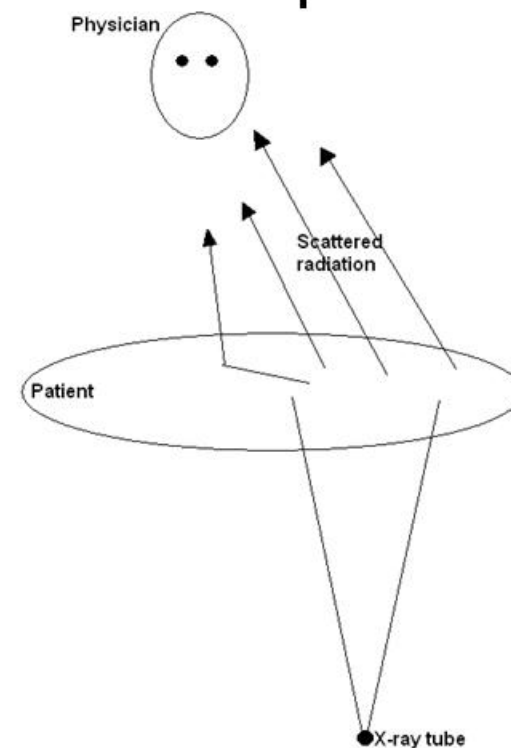
Therése GEBER, Mikael GUNNARSSON, Soren MATTSSON

Medical Radiation Physics

Department of Clinical Sciences Malmö, Lund University, Skåne University Hospital Malmö, Sweden

Aims

- Relation between the absorbed dose to the lens and the dose at a measurement site, using Monte Carlo simulations and phantom measurements
- Energy of the radiation striking the lens relative to the energy of the primary beam
- Relation between lens dose and dose to the patient
- Dose distribution inside the head
- Efficiency of eight models of protective eyewear



Methods, simulations

- PENELOPE
- Physicians head with brain, skeleton, soft tissue, sinuses, skin and eyes with lenses
- Ellipsoid of water representing a patient
- X-rays striking the patient from underneath
- “Dosemeter” of the same shape, size and material as the lens positioned at various positions

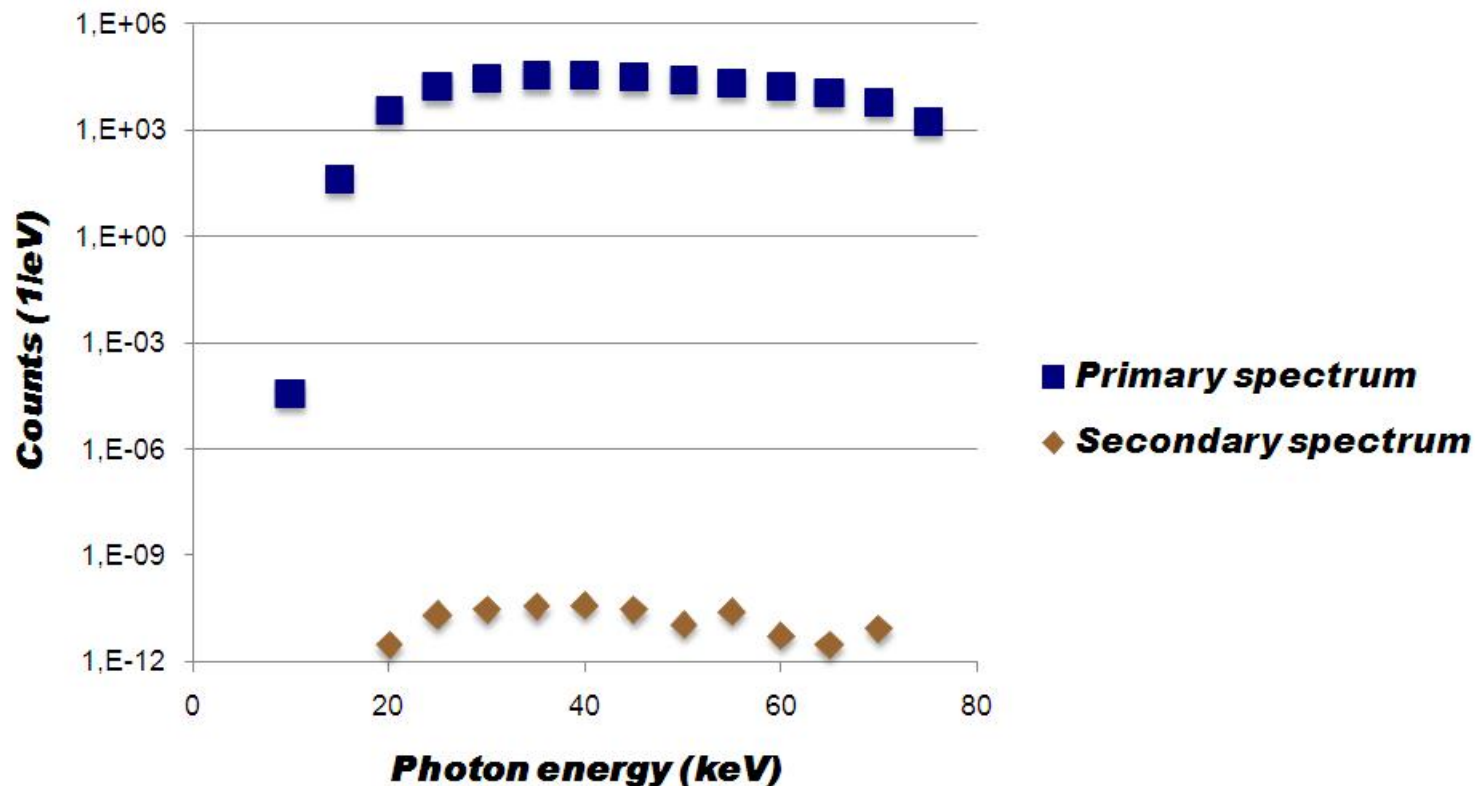


Methods, measurements

- Sliced anthropomorphic head phantom
- Thorax phantom for scatter
- TLDs in phantom at lens positions and in headband
- Solid state detector near left eye
- Radiochromic film between discs
- Two senior physicians working with heavy fluoroscopy
- TLDs in headband, same as in phantom measurements



Results –Energy of the Radiation Striking the Lens



Primary spectrum leaving the x-ray tube and secondary spectrum striking the left lens



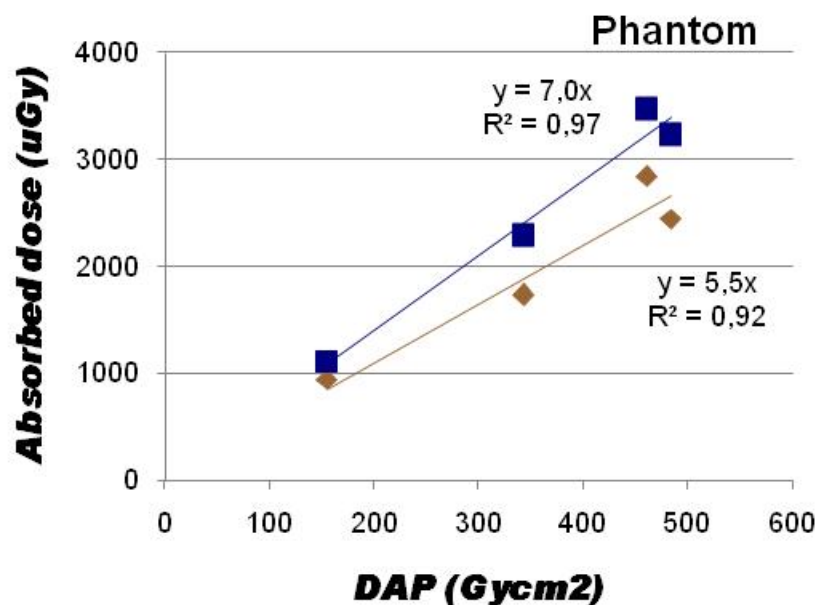
Results –Dose at Measurement Sites Relative to the Lens Dose

Position	Percentage of Left Lens		
	Measurements	Simulations	
Side	103%	95% (1.5cm)	99% (2.0cm)
Over	86% (55-108%)	93%	
Center	75%	90%	
Over, right eye	80%	-	
Solid state det.	112% (94-140%)	-	

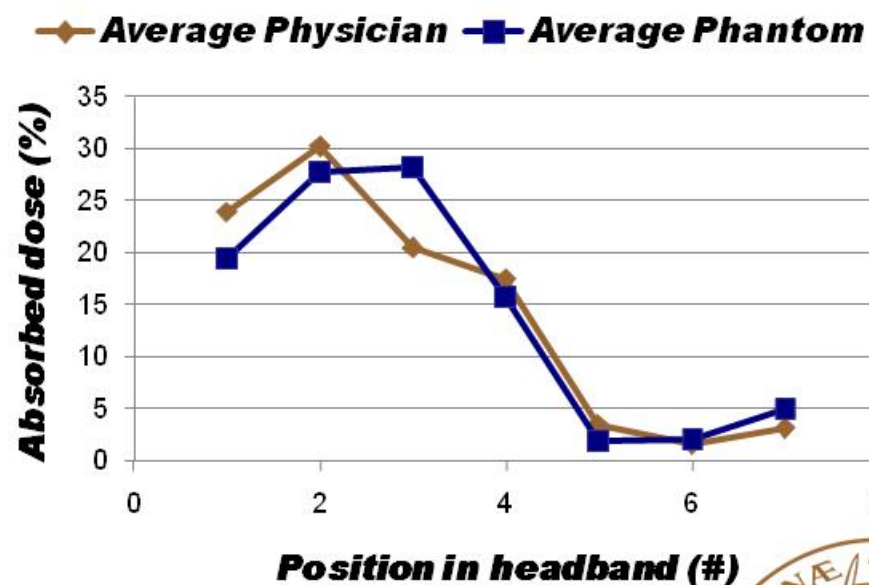
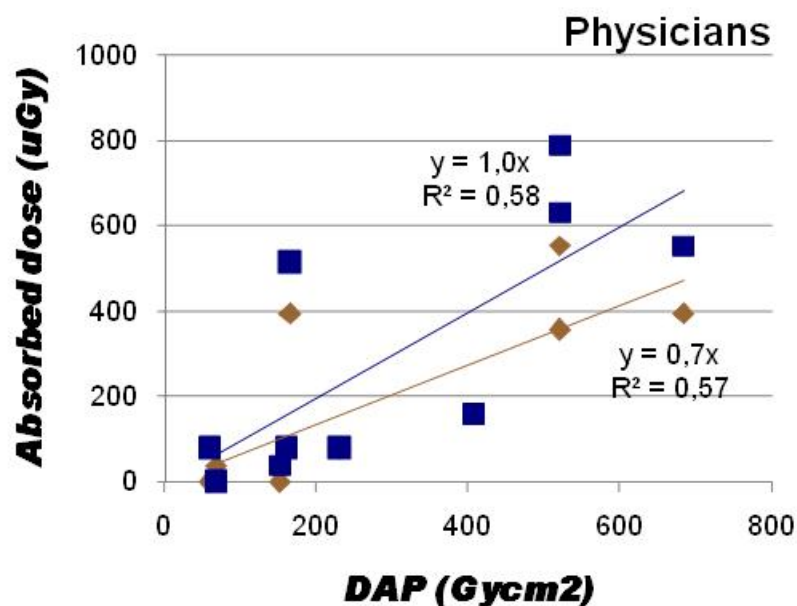
Absorbed dose at a measurement site relative to the absorbed dose in the left lens



Results –Patient Dose vs. Lens Dose

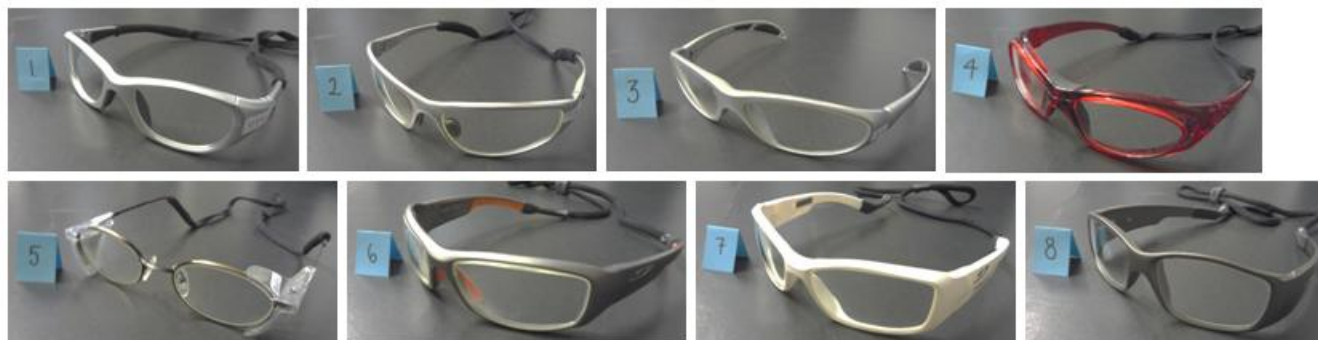


Headband with dosimeters



Results

–Effect of Protective Eyewear

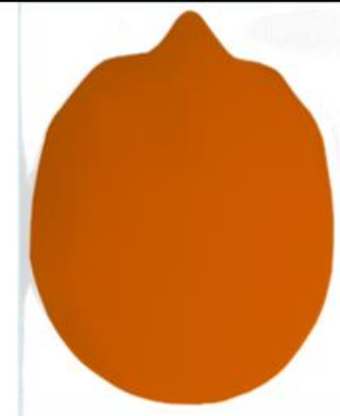
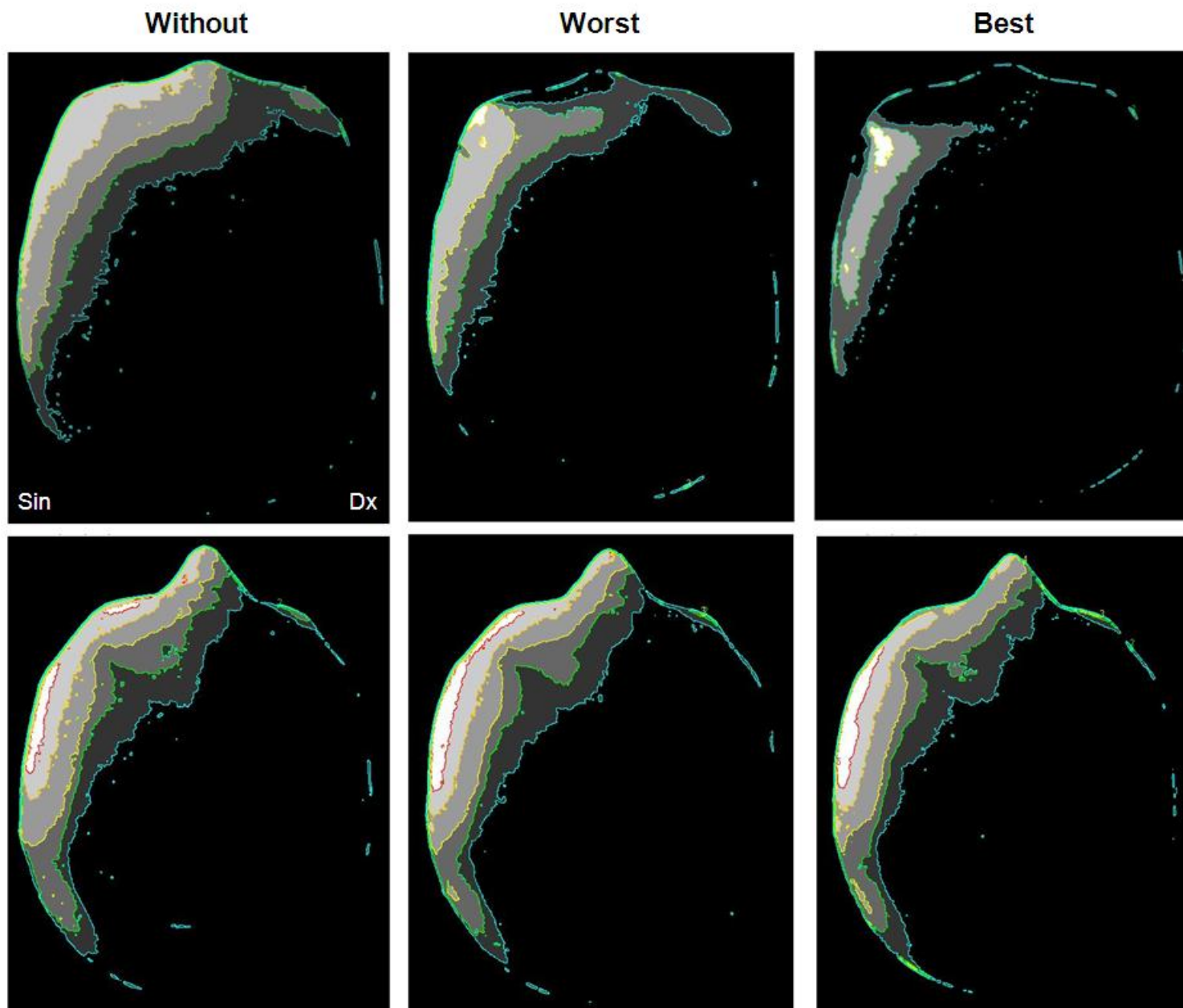


	Model of Eyewear (#)							
Radiation Direction	1	2	3	4	5	6	7	8
Average, Left lens, below (%)	72	43	78	85	86	22	35	70
Average, Right lens, below (%)	98	89	97	94	97	89	88	92
Average, Left lens, front (%)	18	14	27	26	23	14	16	20
Average, Right lens, front (%)	17	13	25	26	24	17	19	17

Remaining dose in the lens relative to the dose in the lens without protective eyewear



Results –Effect of Protective Eyewear



Conclusions 1

- According to phantom measurements a TLD at the forehead underestimates the dose to the lens within a range of 55-108 %, with an average of 86 %
- According to simulations a measurement point at the forehead underestimates the dose to the lens with 7 %
- A solid state detector near the left eye estimates the absorbed dose to the left lens within a range of 94-140 %, with an average of 112 %



Conclusions 2

- There is a relationship between absorbed dose to the lens and DAP-value for the patient
 - Perhaps a factor for estimating the lens dose without measurements could be found
- When radiation does not incident from the front there are deficiencies in the effect of protective eyewear
 - The design of the eyewear is decisive
 - Should minimize gaps and mould around the face



Take home message!

- There is a considerable risk that the absorbed dose to the lens is underestimated when dose measurements are performed using current methods
- The effect of protective eyewear varies between different models and the individual fit is decisive



Thank you for listening!

