AN AUDIT OF LIKELY LENS DOSES TO PATIENTS RECEIVING REPEAT EXPOSURES THROUGH THE ORBITS – INFORMING THE PRACTITIONER

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Background

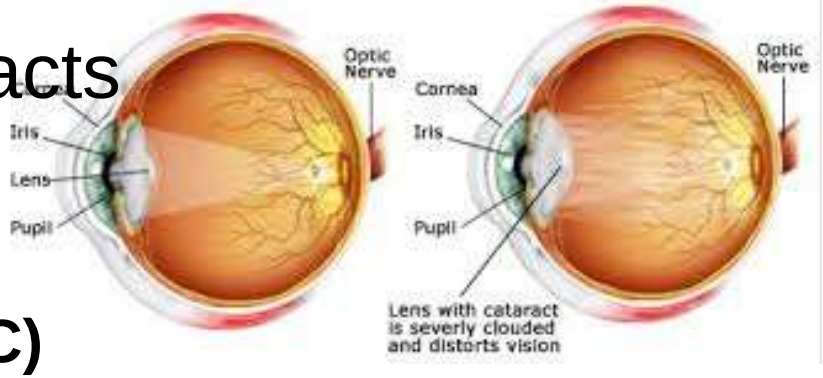
- ICRP Revision of Tissue Reaction Threshold
  - Report 118
  - Report 103

ICRP103	Lens Opacities	Visual Impairment
Acute	0.5-2 Gy	5 Gy
Chronic	2-10 Gy	8 Gy

- Neurosurgical Centre
- Reduced Occupational Eye Dose Limit
- COMARE16

Principal Pathology

- Len opacification i.e. cataracts
  - Cortical
  - Nuclear
  - **Posterior Subcapsular (PSC)**



- Societal burden of cataract surgery (300,000/y in the UK)

  (1 in 1000 loss of sight due to surgery – NHS Feb 2016)
- Considerable uncertainty between dose and radiation-induced cataracts

CT Head Scans

- Acute head trauma;
- Acute intracranial hemorrhage;
- Shunt malfunctions, or shunt revisions;
- Increased intracranial pressure;
- Headache;
- Acute neurologic deficits;
- Hydrocephalus;
- Brain herniation;
- Drug toxicity;
- Mass or tumor;
- Seizures;
- Syncope;
- Detection of calcification;
- When magnetic resonance imaging (MRI) imaging is unavailable or contraindicated

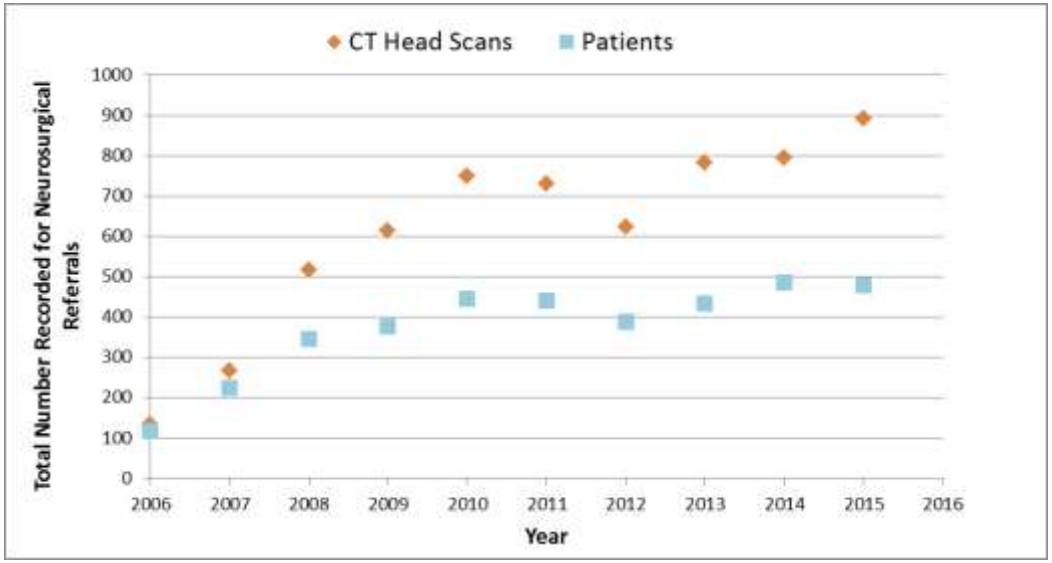
Our Study

- Identify cases requiring CT Head scan follow-up studies
- Assess Patient Eye Doses
- Compare practice to other centres
- Identify opportunities for optimisation

Plymouth Hospital NHS Trust

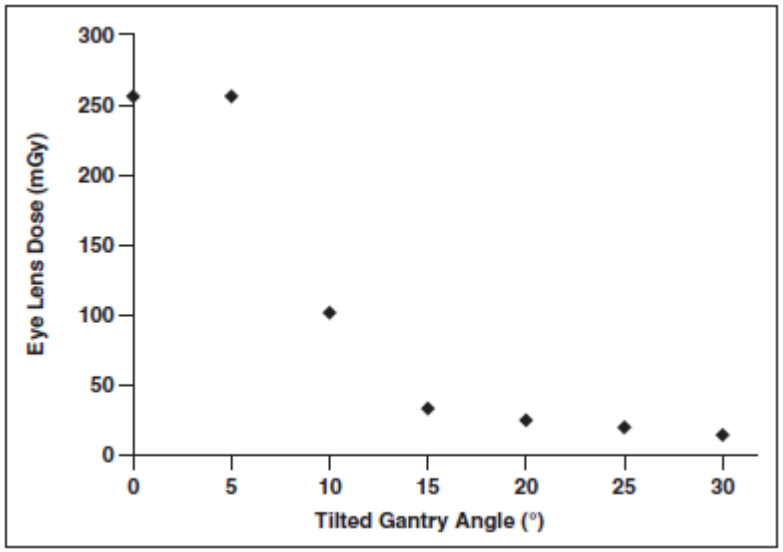
- CT Head LDRL 940 mGy.cm (NDRL 970 mGy.cm)
- >10 CT Head scans in a 6 month period (2006 -2016)
- Assuming eye lens dose as $^{2}/_{3}$ the $CTDI_{vol}$ [3]
- Highest fractionated delivery was1 Gy in 2 months

Patients/year	no. scans	Eye Dose/scan Gy	Total Fractionated Eye Dose Gy
2	20	0.05	1.0



Angle Modulation

- Typical Scan Planes
  - Orbito Meatal Baseline (OMBL)
  - Supra Orbital
- 50 – 80% dose reduction depending upon the angle [3] [6]



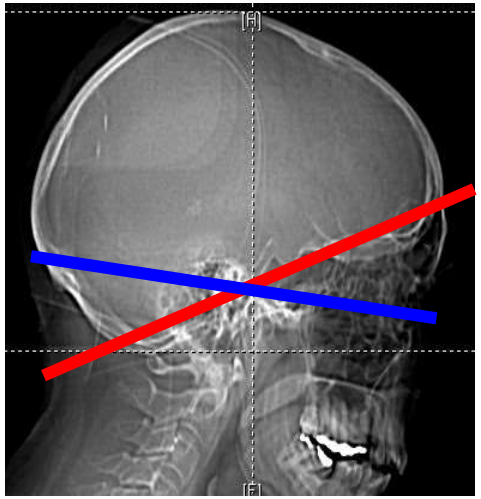
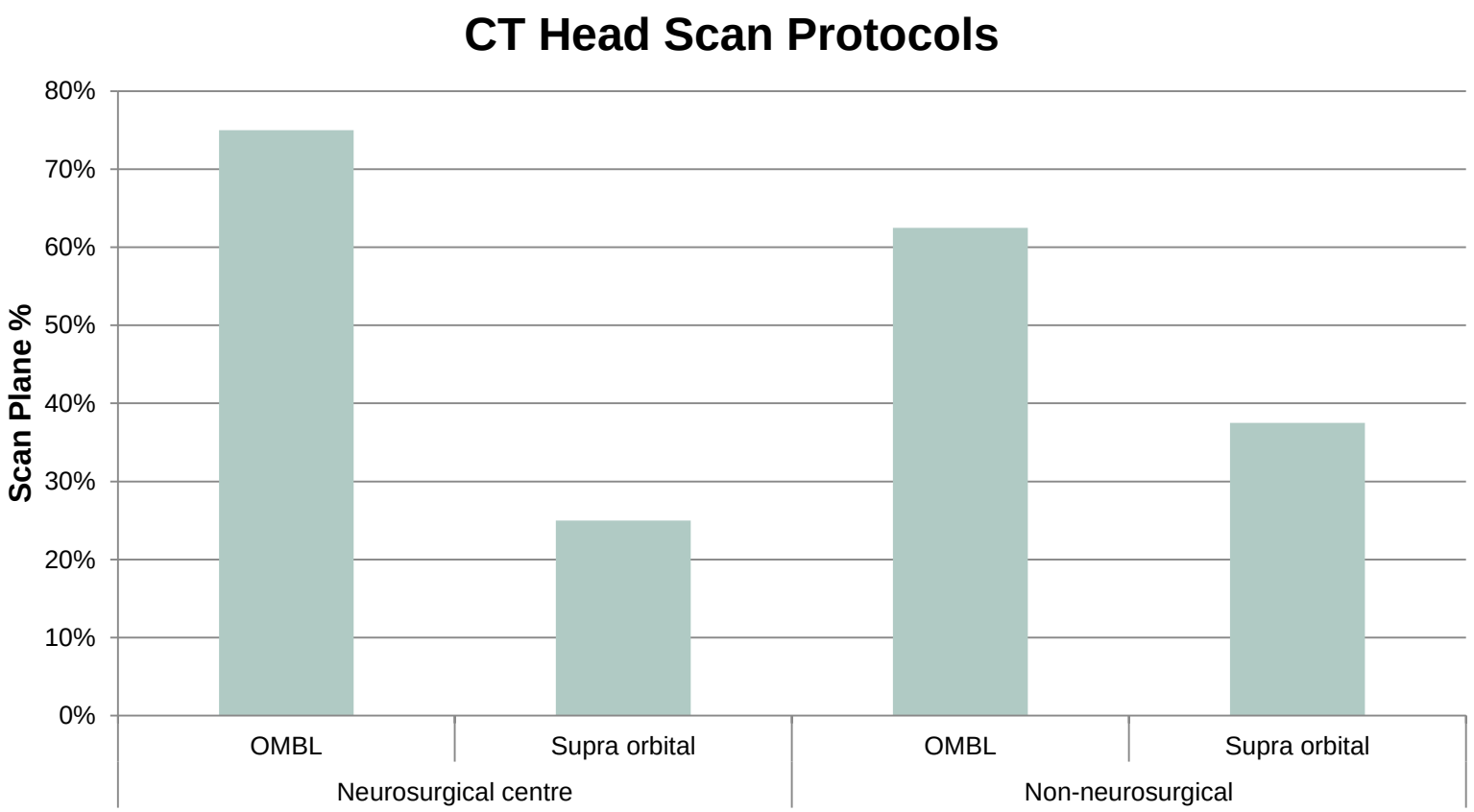


Figure Reference [3]

Clinical Concerns

- Radiographers raised concerns regarding angulation and image quality
- Surgeons utilising the images for procedure planning unable to apply angulated images

Angulation - Is there a consensus?



Justification

- Non-neuro centres adopting that of their neuro counterparts
- Organ Dose Modulation used though uncertain of the effects
- MRI use the same scan angle
- Use of OMBL due to surgery planning requirements

Literature Review

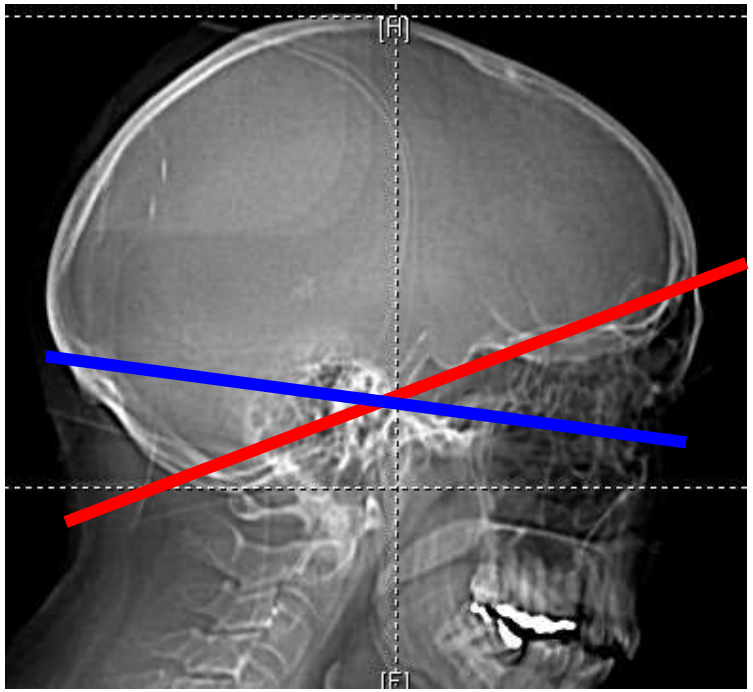
- Stochastic vs. Deterministic
- Method of cataract assessment
- Scan Plane Alteration
- Eye Shields
- Cataract Latency Period
- Data Availability

Latency Period

- Latency is inversely related to dose
- High level of Uncertainty
- Atomic bomb survivors: 1 Gy latency of 2-3 years [7]
- May reach 30-45 years for fractionated low doses [7]
- Age-modulation component
- 96% of >60 year olds have lens opacities in US [ICRP 103 – US 1992]
- Various environmental impacts
  - having a family history of cataracts
  - having diabetes
  - having other eye conditions
  - eye surgery or an eye injury
  - smoking
  - regularly drinking excessive amounts of alcohol
  - a poor diet lacking in vitamins
  - lifelong exposure to sunlight

Optimisation

- Angular modulation - ~80% reduction in eye dose using cadaveric heads [6]
- Z-axis modulation
- MDCT Variation
- Helical vs. Axial
- Tube current modulation
- Patient tilting
- Shielding
- Image Quality



Future Work

- Blind Study
- Scanner capability
- Patient positioning
- Patient follow-up studies
  - Visual acuity test
  - Slit-lamp examination

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Acknowledgements

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