Three methods for measuring irradiated slice width

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The issue...

- How should we be measuring irradiated slice thickness?
- What are our options?
- Which is best?
Our ideal...

- Something we have ownership of
- Instant result
- Simple and compact
Overview

- IPEM 2003 recommendation
- Czajka et al 1994
- Therapy film
- Fuji CR Plate
- Gafchromic film
Basic measurement method

- Detector placed at isocentre
- Expose to full and half dose
- Measure width of full dose exposure at points corresponding to half dose - FWHM

No one method or medium suggested

Tolerance is +/-1mm or 20% whichever is greater?
Czajka et al 1994

- Use of self-developing dental film or TLD
- Need special jig plus dental film
Therapy film

- Available from friendly radiotherapy colleagues
- Measurement by ruler and eye or use film digitiser and image processing software e.g. ImageJ
Therapy film
Fuji CR Plate

- Available where Fuji CR is used
- Need lowest possible scan parameters
- No instant “ruler” analysis possible
- Fuji reader allows image to be exported in DICOM format
- Expose – read – export – import - measure (5 steps)
Fuji CR Plate
Gafchromic film

- Owned by Med Phys
- Expose – digitise – measure (3 steps)
- Immediate response – can check with ruler then digitise for more accurate result
Gafchromic film
Scanning the Gafchromic film

- Normal desktop scanner HP Scanjet 4850
- Scanned as colour document - 600ppi
- Strips ~3cm wide scanned lengthways for <1% variation
Measurement comparison - Method

- Used a Siemens 64 slice scanner @ RHSC
- Exposed therapy film, Fuji CR plate and Gafchromic film on same day using 2mm and 10mm slice thicknesses
- Exposed full and half dose slices three times at each width
- Window image until half dose slice just vanishes
- Calculate average width for each method
## Measurement comparison - Results

<table>
<thead>
<tr>
<th>Method</th>
<th>Nominal 2mm collimation</th>
<th>Nominal 10mm collimation</th>
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<tbody>
<tr>
<td>Gafchromic film</td>
<td>2.46 ± 0.03</td>
<td>9.54 ± 0.06</td>
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<tr>
<td>Fuji CR</td>
<td>2.23 ± 0.04</td>
<td>9.75 ± 0.07</td>
</tr>
<tr>
<td>Therapy film</td>
<td>2.46 ± 0.12</td>
<td>9.73 ± 0.32</td>
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## Pros and cons

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<td>Exposure factors</td>
<td>120kV, 100mAs, 50mAs</td>
<td>80kV, 38mAs, 19mAs – not available everywhere</td>
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Fuji CR plate saturation

- Plate saturates above 25mAs
- Liu et al carried out similar investigations
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Response of Gafchromic film to changes in mAs

![Variation in slice width with mAs](image)

- Ratio of measured slice width to average
- mAs range from 0 to 700
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Conclusions

- Gafchromic film best method to use
  - Owned by Medical Physics
  - Highest resolution of all 3 methods
  - Usable on all CT scanners
  - Simple and portable
  - Instant result visible
References

- IPEM Report 91
- IPEM Report 32 “Part III Computed Tomography X-ray Scanners”
Thanks...

- Nick Weir – CT/MR physicist
- Radiography staff at Royal Hospital for Sick Children
- Physics staff in Oncology physics at the Western General Hospital