Testing the performance of a ScanNCut system for radiochromic film preparation

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Radiochromic film

- Radiochromic film is amazing! High spatial resolution, near energy independent, near water equivalent, environment insensitive, 2D measurements!

<table>
<thead>
<tr>
<th>Description</th>
<th>✓</th>
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</thead>
<tbody>
<tr>
<td>Patient specific QA</td>
<td>✓</td>
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<tr>
<td>Small field dosimetry</td>
<td>✓</td>
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<tr>
<td>MLC characterisation</td>
<td>✓</td>
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<tr>
<td>Superficial dose measurement</td>
<td>✓</td>
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<td>In-vivo dose verification</td>
<td>✓</td>
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<td>Postal dosimetry audits</td>
<td>✓</td>
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<tr>
<td>Personal dosimetry</td>
<td>✓</td>
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Film cutting

• Film can be cut into smaller pieces, allowing efficient use of large sheets, and use in small or irregularly shaped phantoms
• Cutting results in damage at field edges
  • AAPM no. 63 suggests avoiding analysis within 1.5 mm of cuts
  • Others have reported 1-8 mm (Yu et al.), 1-3 mm (Mayers et al.)
• For EBT3, Moylan et al. recommended scissors only (no guillotine)
• Scissors are require handling, are time-consuming, are cumbersome for intricate shapes
Brother ScanNCut CM550DX

- Blades cut shapes in material loaded on adhesive work mat
  - 2 blades: standard and deep
- Designed for arts and crafts
  - used for ART and SCIENCE!
- Work area of 29.8×29.8 cm²
- Optical scanner (300 DPI) digitizes drawn or printed cutting patterns; which can be edited on touch screen panel
Test patterns

swallow tail, C-shape, wavy line; to determine optimal system parameters (pressure, speed and extension)

CIRS 605 head phantom insert
Method

• Evaluated performance of:
  • Scissors
  • Single-cut (pattern run once)
  • Double-cut (pattern run twice)

• Measures of performance:
  • Reliability of cut
  • Extent of delamination from cut edge
  • Time required
  • Accuracy compared to pattern
Optimal parameters

- Optimal operating settings determined for the broad swallowtail, C-shape and curvy line

- Double cutting more reliably cut through film entirely

<table>
<thead>
<tr>
<th>Cut</th>
<th>Blade</th>
<th>Blade scale</th>
<th>Pressure</th>
<th>Speed</th>
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<tbody>
<tr>
<td>Circular</td>
<td>Deep cut</td>
<td>≥4</td>
<td>5–7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>≥9</td>
<td>7–9</td>
<td>1</td>
</tr>
<tr>
<td>Angular</td>
<td>Deep cut</td>
<td>≥3</td>
<td>4–7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>≥8</td>
<td>5–6</td>
<td>1</td>
</tr>
<tr>
<td>Curvy line</td>
<td>Deep cut</td>
<td>≥2</td>
<td>5–7</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Standard</td>
<td>≥9</td>
<td>7–9</td>
<td>1</td>
</tr>
<tr>
<td>Overall</td>
<td>Standard</td>
<td>9–12</td>
<td>6–8</td>
<td>1</td>
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</tbody>
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Delamination effect

- Cutting system resulted in delamination further from the film edge
  - 1.8 mm for cutting system
  - 1.0 mm for scissors, in agreement with literature
- Clinical impact is limited - literature recommends ignoring dose 1.5 to 2 mm from edge
Benefits of film cutting system

- No deviations greater than 0.5 mm observed between pattern and cut film
- Holes for alignment rods handled easily
- Times for phantom insert:
  - Single cut = 21 s
  - Double cut = 45 s
  - Scissors ≈ 5 min (with marking and handling)
Conclusion

• The system worked relatively well, but some features were less than ideal (adhesive work mat, for example)
• Some vendors and IROC use laser cutting - we are investigating cheap solutions
• You should hire Somayeh 😊
• And buy this text book!