Epworth HealthCare

Epworth Radiation Oncology

Intensity-Modulated Radiotherapy versus Three-Dimensional Conformal Radiotherapy; a retrospective study
Overview

• Literature search into Breast Intensity-Modulated Radiation Therapy (IMRT)
• Challenging Planning Target Volumes (PTV)
• Breast IMRT solution
• Critical review of technique
• Identify the clinical indicators
• Future direction of technique
• Radiation Therapy remains integral to the management of Breast Cancer (1-6)

• Dosimetric Improvements from Two-Dimensional to Three-Dimensional Conformal Radiation Therapy (3DCRT)

• Are further improvements possible?

• Does IMRT have a role to play?

• If so, what are the indicators?
Literature – Breast IMRT

- Retrospective studies question feasibility (1-3, 6, 8, 9, 10, 11)

<table>
<thead>
<tr>
<th>Positives</th>
<th>Negatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Homogeneity</td>
<td>↑ Integral Dose</td>
</tr>
<tr>
<td>Better PTV conformity index</td>
<td>↑ Heart Mean Dose</td>
</tr>
<tr>
<td>↓ Ipsilateral Lung V20 Gy</td>
<td>↑ Contralateral Breast Dose</td>
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</table>

- Increased trend to use IMRT for breast but no detailed specific clinical scenarios (Lisa, A 2011)

- IMRT is dependent upon technique (2, 6-7, 12)
Clinical Example

- Comparison of 2 different IMRT plans

6 FLDs Tan Approach  Vs  9 FLDs ~30° apart
Background

• Field-In-Field PTV based approach is standard

• Acknowledge IMRT is resource intensive

• Limited benefit to replace as standard \(^{(11)}\)

• However, real role to specific clinical scenarios \(^{(7, 9, 13, 10)}\)
  – Internal Mammary Chain (IMC)
  – Complex volumes close to Organs At Risk (OARs)
PTV & OAR
PTV & OAR
PTV & OAR

Right Coronary Artery (RCA)
Planning Risk Volume (PRV)
PTV & OAR

4.2cm
PTV & OAR

- Left Anterior Descending (LAD) Coronary Artery Delineation
The Clinical Decision

- Radiation Oncologist Driven
- Higher concern for IMC recurrence than Chronic toxicity
  - LAD dose <30 Gy \(^{(14)}\)
  - RCA dose <35 Gy
- Application of Evidence Based Dose Constraints \(^{(14, 16)}\)
- Extensive IMRT planning and treatment experience
- Collaboration with other sites
Method

- 9 field Beam Arrangement:
Method

- Supraclavicular Fossa (SCF) and Axilla Beam Arrangement:
Method

- SCF/Axilla Beam Arrangement:
Method

- Target Structures for IMRT Optimisation:
Method

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Method

- 3DCRT - Wide Field Tangents & SCF/Axilla:
Results

Isodose Range 47.5 Gy

IMRT Vs 3DCRT
Results

Isodose Range 47.5 Gy

IMRT Vs 3DCRT
Results

Isodose Range 25 Gy

IMRT Vs 3DCRT
Results

Isodose Range 5 Gy

IMRT Vs 3DCRT
### Results

#### Dose Volume Comparison – IMRT Vs 3DCRT

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<th>3DCRT (Gy)</th>
<th>Goal (Gy)</th>
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<td>PTV D 98%</td>
<td>47.0</td>
<td>47.8</td>
<td>47.5</td>
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<td>PTV D 2 %</td>
<td>52.8</td>
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<td>53.5</td>
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<td>Right Lung V20</td>
<td>30.0</td>
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<td>Heart Mean</td>
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<td>Heart Max</td>
<td>39.3</td>
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<td>&lt; 50</td>
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<td>PRV RCA Max</td>
<td>38.5</td>
<td>46.5</td>
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Discussion

• PTV depth to cover IMC is a challenge

• IMRT advantages over 3DCRT;
  – Improved Conformity of dose to PTV
  – Lower dose to most OARs.

• IMRT disadvantages over 3DCRT;
  – Increased mean dose to heart and contralateral lung
  – Higher integral dose

• Accurate delineation of OAR required
  – Pre & Post Contrast CT for LAD (RO)
Discussion

• Limitations of this study
  – Comparison of only one 3DCRT approach
  – Junctional electron technique

• Future Direction
  – 11 patients treated with IMRT for breast cancer to date
  – RapidArc and Respiratory Gating
  – IGRT match results trend review
  – Clinical use of breast drapes
Conclusion

• IMRT improves PTV coverage
• IMRT reduces OAR dose at expense of higher integral dose
• Wide field 3DCRT cannot achieve comparable results
• Careful selection of suitable cases is recommended
• IMRT has become the standard of care for complex breast cancer cases
Acknowledgements

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Thank you