Proton Therapy QA Around the Globe: IROC Houston’s Multi-Institutional Audit Program
IROC’s Mission

Provide integrated radiation oncology and diagnostic imaging quality control programs in support of the NCI’s NCTN Network thereby assuring high quality data for clinical trials designed to improve the clinical outcomes for cancer patients worldwide.
IROC’s Proton Program

We monitor 42 proton centers; 31 NCI members
NCI Proton Activity

- 22 protocols open that either allow protons or randomize proton vs. photon
  - Lung
  - H&N
  - Brain
  - Esophageal
  - Liver
Proton Activities Overview

Approval:
- Proton facility questionnaire
- Annual TLD output audit
- Baseline proton phantom audits w/ electronic data transfer
- On-site dosimetry audit

Credentialing:
- Additional phantom audits, per protocol
- Knowledge assessments
- IGRT evaluation

IRC QA Popular Links
- Credentialing Status Inquiry (CSI)
- TRIAD Tips & Tricks
- Phantom Request Form
- IROC QA Centers
- NCIN Structure Name Library
- Clinical Trial Reorganization

IRC Announcements
- Heterogeneities: Approved Algorithms
- ASTRO Safety Considerations for IMRT
- IMRT: ATC Guidelines for the Use ...

Protons in Clinical Trials
- NCI guidelines
- Proton Approval
42 proton centers have received IROC output checks

Mean: $0.997 \pm 0.20$
# Proton Phantoms

<table>
<thead>
<tr>
<th></th>
<th>Brain</th>
<th>H&amp;N</th>
<th>Liver</th>
<th>Lung</th>
<th>Prostate</th>
<th>Spine</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Analyzed</td>
<td>40</td>
<td>24</td>
<td>39</td>
<td>62</td>
<td>48</td>
<td>40</td>
<td>253</td>
</tr>
<tr>
<td># Passed</td>
<td>38</td>
<td>21</td>
<td>14</td>
<td>43</td>
<td>40</td>
<td>30</td>
<td>186</td>
</tr>
<tr>
<td>Pass Rate [%]</td>
<td>95%</td>
<td>88%</td>
<td>36%</td>
<td>69%</td>
<td>83%</td>
<td>75%</td>
<td>74%</td>
</tr>
</tbody>
</table>
Lung Phantom Concerns

• Overall lung phantom pass rate 63%
  – Disagreement between measurements and TPS
• Concerns about analytic (pencil beam) TPS algorithms
  – Subset of phantom plans recalculated using Monte Carlo algorithms
• BIG improvements seen with Monte Carlo
Lung Phantom Results

Right-Left Profile
Axial plane

Dose (Gy(RBE))

Distance (cm)

PTV

IROC Film
Institution values
Lung Phantom Results

Pencil Beam original calc

Monte Carlo recalc
NCI Proton Guidelines

- NCI Proton Guidelines being updated in 2019
  - Likely will require the use of Monte Carlo algorithm for proton trials in lung
Proton Site Visits

• Typically included in proton centers’ baseline approval for NCI trials

• Also available for fee

• Audit reviews clinical treatment planning practices, QA procedures, beam output, depth dose, patient fields, IGRT/proton coincidence, CT-RLSP conversion

• Institutions receive recommendations on how to improve their practice: average 2 recs
Most Common Site Visit Recommendation

- CT Number to Relative Linear Stopping power (RLSP) conversion
  - Predicts the range of the proton beam in tissue
  - Important for accuracy of dose delivery
  - Institutions often diverge from others at the extremes: very high or very low CT numbers

CTN-RLSP Conversion Curves

Scaled CTN

RLSP

0 0.5 1.0 1.5 2.0
0 500 1000 1500 2000
Our Program as a Whole

• Remote and on-site audit tools available
• IROC has identified areas for improvement in proton dose modeling and CT-RLSP conversion
• IROC helping to improve consistency and comparability of proton treatment around the globe
Questions?

Contact: PATaylor@mdanderson.org