The Secrets to Planning Previous Treatments

• Re-Treatments becoming the new normal

This looks “risky”

Lets do this!
Disappointment…

• Will not use deformable registrations
• Will not use dose deformation
• Will not tell you what you should or should not be doing
• Time constraints

WARNING:
Any numbers, constraints, or forms shown here only a snap shot in time! Subject to change!

Only use constraints, ideas and forms that your clinic is comfortable with and fully understand

Can I Redeem myself?

• Tips, tricks, and ideas!
  – Treatment planning agnostic.
    • Full disclosure: Our clinic uses Eclipse
• Hope to find concepts that we can MOSTLY agree on
• Things to consider while planning previous treatments
• Bonus! Two cases studies with prior treatments

Let’s officially begin!
Secrets to Planning Previous Treatments…

Not everyone is going to agree…

Example:
What is the typical dose tolerance of the spinal cord with a 2Gy/Fx treatment?

Answer: Usually 45-50Gy [Most Agree]

How do we get there [Everyone probably disagrees]?
-PRV 3mm on spinal canal? PRV 3mm on true cord?
-PRV 5 mm on spinal canal? PRV 5mm on true cord?
-True cord max? True cord 0.1cc?
-Spinal canal max? Spinal canal 0.1cc?
-Some combination of the above?

Previous Treatments Are Not Scary…

I Lied… Yes they are… BUT…

• Sometimes you just need to treat
• Not enough dose? The treatment may be worthless, if the treatment is worthless, why are we treating?
• So, at a certain point it becomes binary, you either treat or you don’t
Less Talking More Action! Thought Exercise...

Rx is 3000 cGy in 5 fractions. Cord previously got 4500 cGy. MD only request: Cord MUST BE below 500 cGy.

**Probably Easy**

[Image of CT scan]

Less Talking More Action! Thought Exercise...

Rx is 3000 cGy in 5 fractions. Cord previously got 4500 cGy. MD only request: Cord MUST BE below 500 cGy.

**Impossible**

[Image of CT scan]
Less Talking More Action! Thought Exercise…

Rx is 3000 cGy in 5 fractions. Cord previously got 4500 cGy. MD only request: Cord MUST BE below 500 cGy.

Yes with options

My Approach?

1.) If allowed move iso
2.) Do one run, see how far you can push it as a baseline number
3.) Can’t meet the goal? Talk/negotiate with MD...
   - How long ago was the treatment? 3 months, 2 years, 5 years, 10 years?
   - 4500 in how many fractionations? 25 fractions, 30 fractions, 35 fractions?
   - Alpha/Beta (ratio=2), standard Fx = 2Gy: 25fx = 4275, 30fx = 3938, 35fx = 3696
4.) Consider doing a simultaneous boost… 2000cGy expansion overlap area
Prior Treatment Categories

- The GAP
- The Partial overlap
- The Complete overlap

What is the Gap?

- Goal is to avoid prior treatment
- Leave a gap between current treatment and prior treatment
- Gap size can very
- Fusion accuracies and setup accuracies influence your gap
Tips for Gaps

- Half beam block

Tips for Gaps

- Cone down
**Tips for Gaps**

- Could consider matching at the OAR level

Be careful of anterior bowel

Be careful matching to multiple fields

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**Rigid Registration Warning!**

- Converting iso dose lines to contours for OAR doses? Be careful!
- OAR of interest must match identical from old scan and current scan
  - This is where deformable registration and dose deformation might be advantageous
Case Study of Partial Overlap: Patient A

- Current Treatment 500*5 = 2500 cGy to LT Flank (abdomen)
- Current and Prior treatments
  - Eliminate the Unimportant: Patient A
  - Current Treatment 500*5 = 2500 cGy to LT Flank (abdomen)
  - Prior treatments
    - R Skull
    - L Sphenoid
    - Whole Lung (Probably SOME Overlap)
    - Right Femur (Probably distant)
    - Sacrum (Probably distant)
    - LT Orbit
    - Pelvis (Probably distant)
    - C-Spine

  Find out, goes up to L2! Glad I checked, now may have marginal overlap

Problem greatly simplified!
Evaluate the Important: Patient A
• Whole Lung Treatment: (Prior Tx 1.5 years ago)
  – PTV: 150*10 = 1500 and SIB with PTVBoost: 350*10 = 3500
• I luck out, high dose away from current fields
• Only worrying about the prior PTV 1500 at this point

The Upper Fusion: Patient A
• Arms up for whole lung, current scan has arms down
  – What did I do?
    • Used for ball park only, I wanted it to help guide me
The Upper Fusion: Patient A

- Arms up for whole lung, current scan has arms down
  - What did I do?
    - Used for ball park only, I wanted it to help guide me
    - Converted prior 1500 cGy and 750 cGy iso lines
  - Using this info to get a rough sup/inf picture of the overlap
  - Left about a 1.5 cm margin called CordPrior-Sup
L2-Sacrum Prior Treatment: Patient A

• L2-Sacrum handcalc: (Prior 8 months ago)
  – AP/PA Fields 300*10 = 3000

The Lower Fusion: Patient A

• Came out much better, more confidence
The Lower Fusion: Patient A

- Came out much better, more confidence
- Converted prior 1500 cGy (50% iso line)
  - Basically abuts current treatment
- Left about a 1.0 cm margin called CordPrior-Inf
Goals: Patient A

- Entire cord below 1800 (if possible, don’t sacrifice coverage)
  - If not, MUST meet prior cords below 1800
  - New cord could get full dose if needed
- Bowel 5cc below 8500 cGy BED combined (Stomach same)
  - Should not be an issue
- L2-Sacrum: Kidneys blocked, kidneys not an issue
- Other OARs? No real re-treatment criteria…

Final Plan: Patient A
Final Plan With the Numbers: Patient A

Memorial Sloan Kettering Cancer Center
Final Plan With the Numbers: Patient A

Final Plan With the Numbers: Patient A
Final Plan With the Numbers: Patient A

<table>
<thead>
<tr>
<th>STRUCTURE</th>
<th>Current Plan (%)</th>
<th>L2-Sacrum (%)</th>
<th>Whole Lungs (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kidney, LT V18Gy</td>
<td>7.3%</td>
<td>Blocked</td>
<td>0%</td>
</tr>
<tr>
<td>Kidney, RT V18Gy</td>
<td>0%</td>
<td>Blocked</td>
<td>0%</td>
</tr>
<tr>
<td>Inferior Cord</td>
<td>1400</td>
<td>3000</td>
<td>NA</td>
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<tr>
<td>Superior Cord</td>
<td>1420</td>
<td>NA</td>
<td>1383</td>
</tr>
<tr>
<td>Stomach Max</td>
<td>2644</td>
<td>NA</td>
<td>1642</td>
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<tr>
<td>Stomach BED</td>
<td>4188</td>
<td>NA</td>
<td>1534</td>
</tr>
<tr>
<td>Bowel Max</td>
<td>1508</td>
<td>3000</td>
<td>NA</td>
</tr>
<tr>
<td>Bowel BED</td>
<td>1814</td>
<td>8600</td>
<td>NA</td>
</tr>
<tr>
<td>Liver V15Gy</td>
<td>0.1%</td>
<td>Blocked</td>
<td>5.8%</td>
</tr>
<tr>
<td>Heart V15Gy</td>
<td>1%</td>
<td>NA</td>
<td>9.1%</td>
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</tbody>
</table>

Case Study Complete Overlap: Patient B

- Left Temporal Pons 600*5 and big PTV 550*5 (SIB)
Case Study Complete Overlap: Patient B

- Left Temporal Pons 600*5 and big PTV 550*5 (SIB)
- 4 Months Later… Patient got emergency whole brain 200*1

Case Study Complete Overlap: Patient B

- Left Temporal Pons 600*5 and big PTV 550*5 (SIB)
- 4 Months Later… Patient got emergency whole brain 200*1
- Next phase, whole brain with a brainstem block 200*4
- Total so far, “whole brain” 1,000 cGy via handcalcs
MD Wanted a Plan: Patient B
• MD was afraid brainstem block was spring too much brain tissue
• Wanted to give another 2,000 cGy for a total of 3,000 cGy

- Composite would equal $200 \times 15 = 3,000$ cGy
  - $200 \times 1$ whole brain handcalc
  - $200 \times 4$ whole brain with brainstem block handcalc
  - $200 \times 10$ whole brain plan

• Goal: Spare ONLY the brainstem that was treated prior
The Fusion: Patient B
- Fused prior to current Tx scan

How to define “prior brainstem”?
The Fusion: Patient B

- Fused prior to current Tx scan
- How to define “prior brainstem”?
**The Fusion: Patient B**
- Fused prior to current Tx scan
- How to define “prior brainstem”?
  - We picked the 50% iso line, in this case 1375cGy
Prior Brainstem: Patient B

- Brainstem AND prior 50% iso line = Bstem Prior
- Now we have part of the brainstem that got 1375 cGy or MORE

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- Brainstem AND prior 50% iso line = Bstem Prior
- Now we have part of the brainstem that got 1375 cGy or MORE
- Brainstem NOT Bstem Prior = Bstem Less_1375
Prior Brainstem: Patient B

- Brainstem AND prior 50% iso line = Bstem Prior
- Now we have part of the brainstem that got 1375 cGy or MORE
- Brainstem NOT Bstem Prior = Bstem Less_1375

Goals: Patient B

- Spare Bstem Prior as much as possible
- Give dose to the whole brain as much as possible
- Looked like hippocampal sparing!
Goals: Patient B

• Spare Bstem Prior as much as possible
• Give dose to the whole brain as much as possible
• Looked like hippocampal sparing!
• Whole brain with VMAT while carving out Bstem Prior
• Was willing to accept a 120% hotspot…
• Push everything else as low as I can
• Main focus is prior brainstem!

Brainstem Prior Treatment Constraints…

• Spare Bstem Prior as much as possible
• D05% combined doses less then 70Gy in 2Gy/fx equivalent
• From prior treatment only: Brainstem D05% BED = 6690
• What can I give to avoid peer review?
• 7000 – 6690 = 310 cGy (on composite)
• Already gave 200 cGy from whole brain
• Left with: 110 cGy

Not going to happen!
Judgment Day (Final Plan): Patient B

![Image of a medical scan]

Memorial Sloan Kettering Cancer Center
Judgment Day (Final Plan): Patient B

Judgment Day (Final Plan): Patient B
Judgment Day (Final Plan): Patient B

[Image of a medical scan]

Judgment Day (Final Plan): Patient B

[Image of a medical scan]
Judgment Day (Final Plan): Patient B

- Bstem Prior max dose was 52.4% (1048 cGy)
- Bstem Prior D05% was 37.6% (~753 cGy)
- Max hotspot was 120.4% (2407 cGy)
- 95.8% of the PTV was getting Rx dose (2000 cGy)

The Numbers

<table>
<thead>
<tr>
<th>Site (Enter only RELEVANT treatments)</th>
<th>Composite of Whole Brain to C2, WBRT Prior RT Stacked, and WBRT Plan</th>
<th>Left Temporal, Left Parietal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date (MM/YY)</td>
<td>Current 9/17</td>
<td>Rx</td>
</tr>
<tr>
<td></td>
<td>200<em>4 + 200</em>4 + 200*5 = 3,000 cGy cumulative dose in 15 fractions</td>
<td>2750/5000 cGy (75%/80% in 15 fractions)</td>
</tr>
<tr>
<td>Overlap (Low, Normal, Marginal, High)</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Assessment (Fusion, Reproductive, Visual)</td>
<td>F, R</td>
<td>F, R</td>
</tr>
<tr>
<td>MSK or Outside (Specify)</td>
<td>MSK</td>
<td>MSK</td>
</tr>
<tr>
<td>STRUCTURE</td>
<td>DOSE(cGy)</td>
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<tr>
<td>Prior Brainstem (OSS)</td>
<td>1311</td>
<td>761</td>
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<tr>
<td>Prior Brainstem (D05) (cGy equiv)</td>
<td>6890</td>
<td>6890</td>
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<tr>
<td>Brainstem (D05) (cGy equiv)</td>
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<td>Less than 1833</td>
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<td>Eye L (max)</td>
<td>1563</td>
<td>295</td>
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<tr>
<td>Eye R (max)</td>
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<tr>
<td>Lens L (max)</td>
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<tr>
<td>Lens R (max)</td>
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<td>Cochlea L (max)</td>
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<tr>
<td>Cochlea R (max)</td>
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<tr>
<td>Chiasm (max)</td>
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<tr>
<td>Optic Nerve L (max)</td>
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<td>1187</td>
</tr>
<tr>
<td>Optic Nerve R (max)</td>
<td>3243</td>
<td>115</td>
</tr>
</tbody>
</table>

7,451 cGy

Peer review approved
Thanks!

- James Mechalakos, Ph.D, DABR
- MSKCC co-workers

Questions…